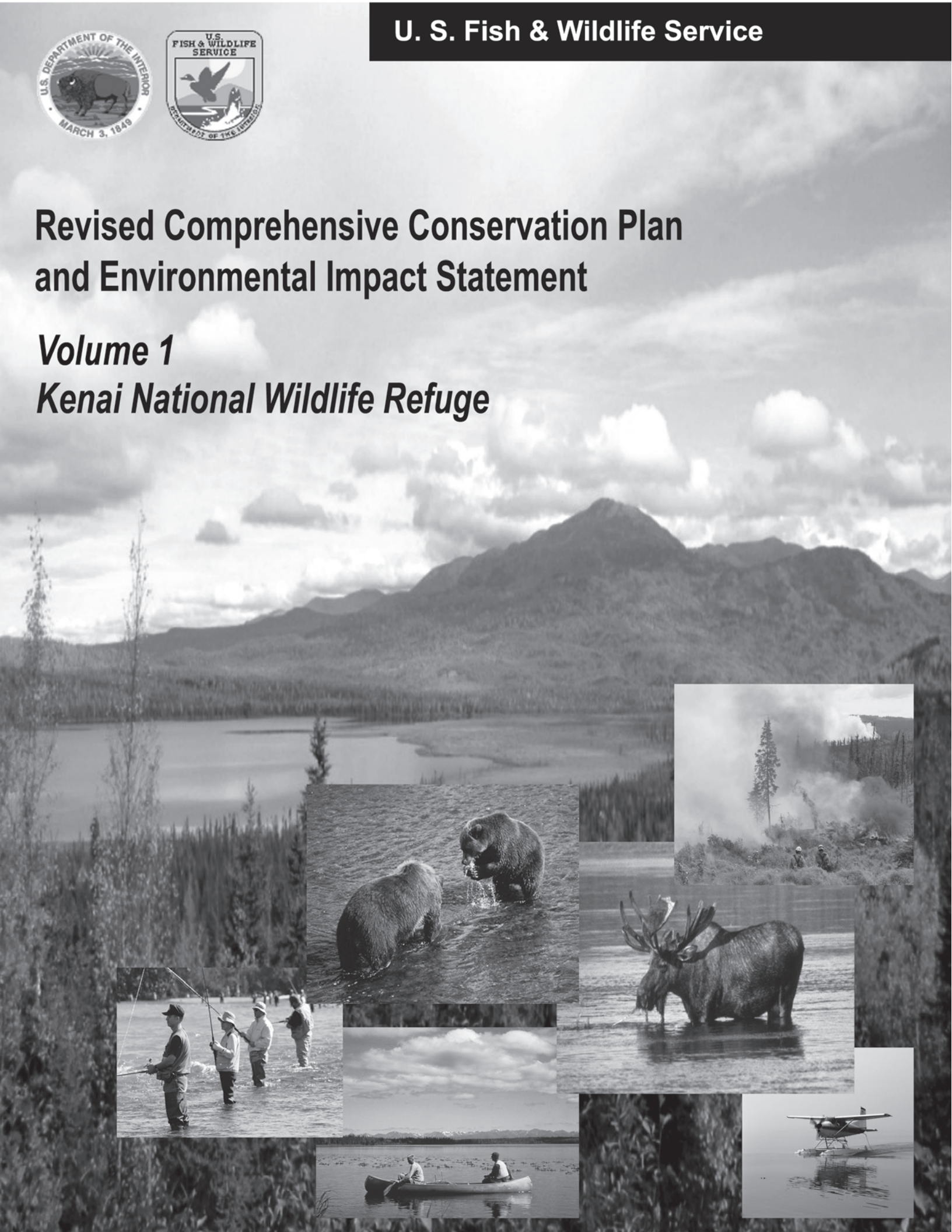
U. S. Fish & Wildlife Service

Revised Comprehensive Conservation Plan and Environmental Impact Statement

Volume 1
Kenai National Wildlife Refuge



U.S. Fish and Wildlife Service Mission Statement

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.

National Wildlife Refuge Mission Statement

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

—National Wildlife Refuge System Improvement Act of 1997

The comprehensive conservation plan details program planning levels that are substantially greater than current budget allocations and, as such, is for strategic planning and program prioritization purposes only. This plan does not constitute a commitment for staffing increases or funding for future refuge-specific land acquisitions, construction projects, or operational and maintenance increases.

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Revised
Comprehensive Conservation Plan
and
Environmental Impact Statement

Volume 1
Kenai National Wildlife Refuge

August 2009

Prepared by:

U.S. Fish and Wildlife Service

Region 7

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Dear Reader:

This Revised Comprehensive Conservation Plan (Plan) and Environmental Impact Statement (EIS) for the Kenai National Wildlife Refuge will guide management of the Refuge for the next 15 years. This Plan revises the Refuge's original comprehensive conservation plan completed in 1985. It outlines five management alternatives, including our preferred alternative, addresses management issues raised during public scoping, and presents our evaluation of the impacts associated with implementing each alternative.

This Plan has been published in two volumes. Volume 1 contains the background, issues, and analysis. Volume 2 contains the supporting appendices.

This Plan incorporates changes based on comments received on the Draft Plan. Those comments and our responses are presented in Volume 2, Appendix D. Most comments required only that we clarify or make minor corrections to the text. Others were more involved. For example, Objective 2.9 was re-written to remove the population objectives for Dall sheep and mountain goats in response to concerns expressed by the State of Alaska. Another change was to propose a change in regulations to allow the Refuge Manager to grant special use permits, for airplane access to normally closed lakes, to successful applicants in the State's limited drawing hunt program.

Most people will be unaffected by changes in Refuge management. For example, there will be no changes to how dog mushing activities can be performed on the Refuge.

Public involvement in the planning process is essential for development of an effective plan. While there will be no formal public review of this final Plan and EIS, comments on the plan will be considered until September 28, 2009. Comments should be specific, addressing merits of the alternatives and adequacy of the analysis. We will consider these comments as we prepare the Record of Decision. The Record of Decision will complete the comprehensive conservation planning process for Kenai National Wildlife Refuge.

You may view the Plan or a Summary of the Plan online at:
http://www.r7.fws.gov/nwr/planning/plans.htm or obtain a compact disk with both versions.

Comments and requests for copies of the Plan, the Summary, or a compact disk with both should be directed to:

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Thank you for participating in our planning process!
Your comments will help us prepare a better plan for the future of Kenai Refuge.

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Acronyms and Abbreviations

ADCED	Alaska Department of Community and Economic Development
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish & Game
ADGGS	Alaska Division of Geological and Geographical Surveys
ADNR	Alaska Department of Natural Resources
ADOT	Alaska Department of Transportation and Public Facilities
ADTPF	Alaska Department of Transportation and Public Facilities
AFS	Alaska Fire Service
ALCES	Alaska Landscape Cumulative Effects Simulator
ALMS	Alaska Landbird Monitoring Survey
ANCSA	Alaska Native Claims Settlement Act
ANHA	Alaska Natural History Association
ANILCA	Alaska National Interest Lands Conservation Act
AO	authorized officer
AOGCC	Alaska Oil and Gas Conservation Commission
AQRV	air quality-related values
ATV	all-terrain vehicle
AWFCG	Alaska Wildland Fire Coordinating Group
BAER	Burned Area Emergency Rehabilitation
BBS	Breeding Bird Survey
BLM	Bureau of Land Management
BLM/AFS	Bureau of Land Management Alaska Fire Service
Borough	Kenai Peninsula Borough
BSE	bovine spongiform encephalopathy (mad cow disease)
CAFF	Conservation of Arctic Flora and Fauna

CAP	Contaminants Assessment Process
CBC	Christmas Bird Count
CDC	Center for Disease Control
CDV	Canine Distemper Virus
CE	categorical exclusion
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIRI	Cook Inlet Region, Inc.
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CJD	Creutzfelt-Jacob disease
Conservation Fund	Land and Water Conservation Fund
CPV	*Canine Parvovirus*
CWD	chronic wasting disease
dB	decibels
DDT	dichlorodiphenyltrichloroethane
DEC	Alaska Department of Environmental Conservation
DEM	Digital Elevation Model
DLP	defense-of-life-or-property
DNR	Alaska Department of Natural Resources
DOI	Department of the Interior
E-SRS Project	East Swanson River Satellite Natural Gas Exploration and Development Project
e.g.	*exemplia gratia* – for example
EA	Environmental Assessment
EIN	easement identification number
EIA	environmental impact analysis
EIS	environmental impact statement
EO	executive order
EPA	Environmental Protection Agency

Et al.	*et alia* – and others
Etc.	*et cetera* – and others, especially of the same kind
et seq	*et sequens* – and the following one
F	Fahrenheit
FIA	Forest Inventory and Analysis
FIP	feline infectious peritonitis
FMH	Fire Monitoring Handbook
FMO	Fire Management Officer
FPA	Fire Program Analysis
FPV	feline panleukopenia virus
FRCC	Fire Regime/Condition Class
ft.	foot/feet (per context)
FY	fiscal year
GIS	Geographic Information Systems
GMU	game management unit
HCH	hexachlorocyclohexane
HPS	hantavirus pulmonary syndrome
I&M Plan	Inventorying and Monitoring Plan
IACUC	Institutional Animal Care and Use Committee
IBBST	Interagency Brown Bear Study Team
i.e.	*id est* – that is
IMPROVE	Interagency Monitoring of Protected Visual Environments
Improvement Act	National Wildlife Refuge System Improvement Act of 1997
Inc.	incorporated
IPM	integrated pest management
ISER	Institute for Social and Economic Research (University of Alaska)

IUP	Incidental Use Permits
Kenai Refuge	Kenai National Wildlife Refuge
KFWFO	Kenai Fish and Wildlife Field Office
KP-CWMA	Kenai Peninsula Cooperative Weed Management Area
KRSMA	Kenai River Special Management Area
LAC	Limits-of-Acceptable-Change
LMRD	Land Management Research Demonstration Site
LTEMP	Long-Term Ecological Monitoring Program
mcf	equals 1,000 cubic feet
MMPA	Marine Mammal Protection Act
MOU	Memorandum of Understanding
MRA	Minimum Requirements Analyses
MRC	Kenai Moose Research Center
NAAQS	National Atmospheric Air Quality Standards
NABCI	North American Bird Conservation Initiative
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
No.	number
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NWR	National Wildlife Refuge
ORV	off-road vehicle
Pad ES-A	East Swanson Pad A
Pad ES-B	East Swanson Pad B
PAH	polycyclic aromatic hydrocarbons

PCB	polychlorinated biphenyl
PDO	Pacific Decadal Oscillation
Peninsula	Kenai Peninsula
Plan	Kenai National Wildlife Refuge Revised Comprehensive Conservation Plan
PLO	public land order
PM 2.5	particulate matter up to 2.5 microns in diameter
PSD	prevention of significant deterioration
Range	Kenai National Moose Range
RARE II	Roadless Area Review and Evaluation
RAW	Remote Automated Weather Station
Refuge	Kenai National Wildlife Refuge
Refuge System	National Wildlife Refuge System
Refuge System Administration Act	National Wildlife Refuge System Administration Act (also as "Refuge Administration Act")
Refuge System Improvement Act	National Wildlife Refuge System Improvement Act (also as "Refuge Improvement Act")
RM	river mile
RNA	Research Natural Area
ROD	Record of Decision
RONS	Refuge Operational Needs System
RS-2477	Revised Statute 2477 (codified as U.S.C. 932); refers to potential established rights-of-way for construction of highways over public lands not reserved for public use
SAMMS	Service Asset Maintenance Management System
Service	U.S. Fish and Wildlife Service
SNAP	Scenarios Network for Alaska Planning
SOA DOTPF	State of Alaska Department of Transportation and Public Facilities
System	National Wildlife Refuge System
TFM	Technical Fire Management

TPH	total petroleum hydrocarbon
TSE	transmissible spongiform encephalopathies
TUS	Transportation and Utility Systems In and Across, and Access Into, Conservation System Units
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USGS-BRD	U.S. Geological Survey-Biological Resources Division
WNV	West Nile Virus
WRA	wildlife recreation area

1. Introduction

This document describes five alternatives for revising the Comprehensive Conservation Plan (Plan) for management of Kenai National Wildlife Refuge (Kenai Refuge, Refuge) and assesses the effects of implementing each of the options. When this revised Plan is finalized, it will replace the management direction for Kenai Refuge described in the existing Final Comprehensive Conservation Plan (USFWS 1985a) and associated Record of Decision (USFWS 1985b) adopted in 1985.

This chapter provides background information that establishes the framework used to develop this document. Section 1.1 describes why the U.S. Fish and Wildlife Service (Service) is revising the existing Plan. Section 1.2 provides information on the National Wildlife Refuge System and the laws, policies, and guidance that set the stage for management direction. Section 1.3 identifies the area covered by this planning effort, and section 1.4 identifies the purposes, vision, and goals specific to Kenai Refuge. A brief overview of the Refuge is provided in section 1.5, and its special values are identified in section 1.6. More detailed discussion of the Refuge is provided in Chapter 3. Section 1.7 provides information on the steps undertaken in this planning effort to date and about the steps that are to follow as public comments are used to develop a Final Comprehensive Conservation Plan and Environmental Impact Statement (EIS). Section 1.8 describes how the Service determined which issues would be addressed in this plan and section 1.9 identifies the five significant planning issues that are addressed in the alternatives.

1.1 Purpose and Need for Action

The purpose of this proposed planning action is to develop a Revised Comprehensive Conservation Plan (Revised Plan) for Kenai National Wildlife Refuge located in southcentral Alaska. The Refuge's original plan, developed in 1985, provided broad policy guidance and established long-term goals for U.S. Fish and Wildlife Service management of the Refuge. As directed by Section 304(g) of the Alaska National Interest Lands Conservation Act of 1980 (ANILCA), the Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997, and the National Environmental Policy Act of 1969 (NEPA) as amended, Kenai Refuge's Plan is being revised to guide the management direction of the Refuge for the next 15 years. Revising the plan allows us to incorporate changing public interests, new scientific information, and revised management direction.

In general, a comprehensive conservation plan serves to do the following:

- Ensure that the purposes for which the refuge was established and the mission of the Refuge System are being fulfilled

- Ensure that national policy is incorporated into the management of the Refuge
- Provide continuity in refuge management
- Ensure that opportunities are available for interested parties to participate in the development of management direction
- Provide a systematic process for making and documenting refuge decisions
- Establish a long-term vision for the refuge
- Establish management goals and objectives
- Define compatible uses
- Provide a basis for evaluating accomplishments
- Provide a basis for budget requests

This document includes a draft Environmental Impact Statement (EIS) for the Revised Plan. It describes current management (Alternative A) plus four action alternatives for managing the Refuge (including the Service's Preferred Alternative—Alternative E). The Plan includes a description of the Refuge's existing environment (chapter 3) and an assessment of the effects of implementing each of the alternatives (chapter 4). Each alternative provides choices for addressing management concerns and for resolving public issues. After public review, the Service will evaluate comments on this draft, will make necessary revisions (which could include making changes to the alternatives), will select one of the alternatives, and will publish a Final Comprehensive Conservation Plan and EIS.

1.2 Planning Context

The Kenai National Wildlife Refuge is part of a national system of more than 545 refuges. The U.S. Fish and Wildlife Service places an emphasis on managing individual refuges in a manner that reflects the National Wildlife Refuge System (System, Refuge System) mission. As a result, the Revised Plan must also contribute to meeting the overall System mission and goals.

1.2.1 The U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (Service) is the principal Federal agency responsible for conserving, protecting, and enhancing fish, wildlife, plants, and their habitats for the continuing benefits of the American people. In addition to the National Wildlife Refuge System the Service also operates national fish hatcheries, fishery resource offices, and Ecological Services field stations. The Service enforces Federal wildlife laws, administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, and helps foreign governments with their conservation efforts. It also oversees the Federal Aid in Wildlife Restoration program, which

distributes to State fish and wildlife agencies hundreds of millions of dollars derived from excise taxes on fishing and hunting equipment.

The mission of the U.S. Fish and Wildlife Service is:

Working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.

1.2.2 The National Wildlife Refuge System

The National Wildlife Refuge System comprises more than 96 million acres of Federal lands, which encompass more than 545 national wildlife refuges, thousands of small wetlands, and other special management areas. The areas within the System are located in all 50 states and the territories of the United States. The System was created to conserve fish, wildlife, plants, and their habitats. This conservation mission includes providing Americans with opportunities to participate in compatible wildlife-dependent recreation on System lands and to better appreciate the value of and need for fish and wildlife conservation.

Alaska contains 16 national wildlife refuges (Figure 1-1). These refuge lands contain a wide range of habitats with varied terrain that includes mountains, glaciers, tundra, grasslands, wetlands, lakes, woodlands, and rivers. Together, the 16 refuges comprise 76.8 million acres and constitute about 80 percent of the National Wildlife Refuge System.

The mission of the National Wildlife Refuge System is:

To administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Administration Act, as amended).

Figure 1-1. National Wildlife Refuges in Alaska

1.2.3 Principles of Refuge Management

The National Wildlife Refuge System Administration Act, as amended, states that each refuge shall be managed to fulfill both the mission of the Refuge System and the purposes for which the individual refuge was established. It also requires that any use of a refuge be a compatible use—a use that will not materially interfere with nor detract from, in the sound professional judgment of the refuge manager, fulfillment of the mission of the System or the purposes of the refuge.

The 1997 amendments to the National Wildlife Refuge System Administration Act of 1966 identified a number of principles to guide management of the Refuge System. They include the following:

- Conserve fish, wildlife, and plants, and their habitats within the System
- Maintain the biological integrity, diversity, and environmental health of the System
- Coordinate, interact, and cooperate with adjacent landowners and State fish and wildlife agencies
- Maintain adequate water quantity and water quality to meet refuge and System purposes and acquire necessary water rights
- Maintain hunting, fishing, wildlife observation, wildlife photography, interpretation, and environmental education as the priority general public uses of the System
- Provide opportunities for compatible priority wildlife-dependent public uses within the System
- Provide enhanced consideration for priority wildlife-dependent public uses over other general public uses in planning and management
- Provide increased opportunities for families to experience priority general public uses, especially traditional outdoor activities such as fishing and hunting
- Monitor the status and trends of fish, wildlife, and plants in each refuge

This Act provided that compatible wildlife-dependent recreational uses are the priority general public uses of the System and shall receive priority consideration in refuge planning and management. These uses include hunting, fishing, wildlife observation, wildlife photography, interpretation, and environmental education,

To maintain the health of individual refuges, and the National Wildlife Refuge System as a whole, managers must anticipate future conditions. Managers must endeavor to avoid adverse impacts and take positive actions to conserve and protect refuge resources. Effective management also depends on acknowledging resource relationships and acknowledging that refuges are parts of larger ecosystems. Refuge managers work together with partners—including other refuges,

Federal and State agencies, tribal and other governments, Native organizations and entities, and nongovernmental organizations and groups—to protect, conserve, enhance, or restore all native fish, wildlife (including invertebrates), plants, and their habitats.

1.2.4 Legal and Policy Guidance and State Coordination

Refuge management is dictated, in large part, by the legislation that created the unit and its purposes and goals. However, other laws, regulations, policies and, in the case of Alaska refuges, agreements with the State, also guide management. This section identifies the acts and the policy guidance that are integral in the development of this Plan.

1.2.4.1 Legal Guidance

Operation and management of refuges throughout the System are influenced by a wide array of laws, treaties, and executive orders. Among the most important are the National Wildlife Refuge System Administration Act, as amended by the National Wildlife Refuge System Improvement Act; the Refuge Recreation Act; the Endangered Species Act; and the Wilderness Act. Acts and treaties specific to Kenai Refuge are described briefly in Volume 2, Appendix A.

For national wildlife refuges in Alaska, the Alaska National Interest Lands Conservation Act (ANILCA), as amended, provides key management direction. ANILCA sets forth the purposes of the refuge, defines provisions for planning and management, and authorizes studies and programs related to wildlife and wildland resources, subsistence opportunities, and recreation and economic uses. ANILCA also provides specific direction for the management of designated Wilderness areas and Wilderness Study Areas in the State of Alaska. How ANILCA influences management of the refuge is described throughout this document.

1.2.4.2 Policy Guidance

Programmatic guidance and policy documents provide additional direction for the management of national wildlife refuges. These documents include the following:

- U.S. Fish and Wildlife Service Manual chapters
- Director's orders
- National policy issuances
- Handbooks
- Director's memoranda
- Regional directives

Although it is not practical to provide information about all these documents in this Plan, they are important to management of the Refuge. Much of the management direction described throughout this

plan is influenced by guidance from these programmatic and policy documents.

Several of these documents direct that an ecosystem approach be used in Refuge management. In other words, we must consider the health of both living and nonliving components when managing the Refuge. This concept requires close coordination with others. In Volume 2, Appendix A provides a brief description of this concept and of several national and regional management plans and programs that were considered during the development of this Plan. Other key policies, such as the Compatibility Policy, are described in later chapters, as they provide guidance in the Plan.

1.2.4.3 Coordination with the State of Alaska

In 1982, the Service and the Alaska Department of Fish and Game (ADF&G) signed a Master Memorandum of Understanding that defines the cooperative management roles of each agency and sets the framework for cooperation between the two agencies (Volume 2, Appendix B). From that agreement, the following policy statements were developed:

1. ADF&G has the primary responsibility for managing fish and resident wildlife populations in the State.
2. On refuge lands, ADF&G is to manage fish and resident wildlife populations in their natural species diversity.
3. On refuge lands, the Service and ADF&G share a concern for all fish and wildlife resources and their habitats, and both agencies are engaged in extensive fish and wildlife conservation, management, and protection programs.
4. The refuge is to conserve fish and wildlife, and their habitats, and to regulate human use on refuge lands.

Additional management responsibilities are also identified in the memorandum. The State of Alaska establishes fishing, hunting, and trapping regulations throughout the State at the direction of the Alaska Boards of Fisheries and Game. These regulations apply to Federal public lands unless superseded by Federal regulations. The State is divided into 26 game management units (GMUs); most of these are further divided into game management subunits (GMSs). Management objectives are developed for populations within the GMUs. All of Kenai Refuge's lands lie within GMU 7, 15A, 15B, or 15C (Figure 1-2).

The Alaska Department of Natural Resources (DNR) and its divisions are also key management partners with all refuges in Alaska. DNR manages all State-owned land, water, and surface and subsurface resources except for fish and game.

Additional information about key State programs is provided in Volume 2, Appendix B.

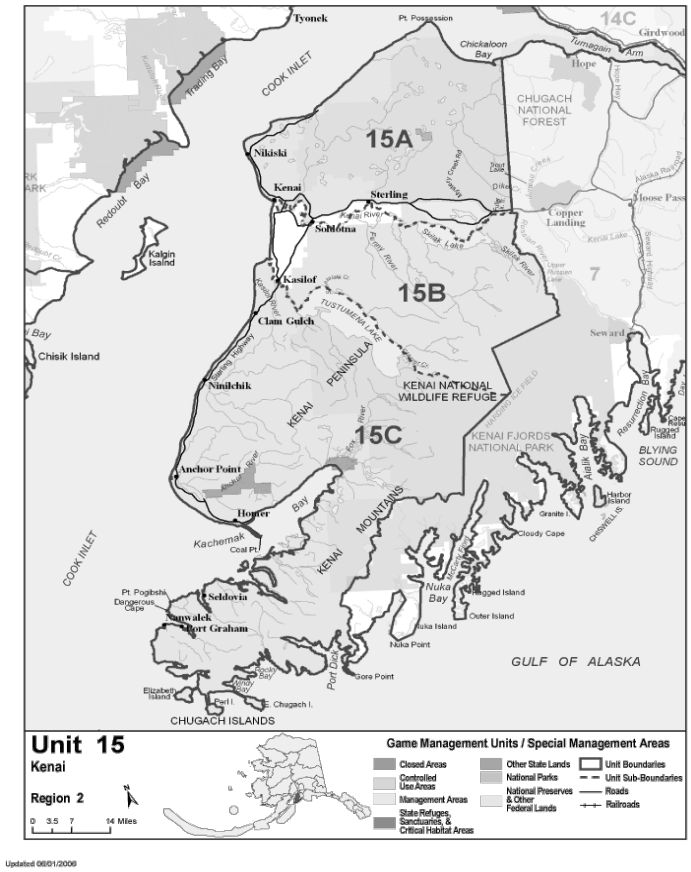

Figure 1-2. State of Alaska Game Management Unit 15

1.3 Planning Area

The planning area for the development of the Revised Plan encompasses the entire 1.98-million acre Kenai National Wildlife Refuge located in southcentral Alaska (Figure 1-3). The Refuge is located on the 5-million acre Kenai Peninsula (Peninsula) and is bordered on the north by Chickaloon Bay; on the east by the Chugach National Forest and Kenai Fjords National Park; on the south by Kachemak Bay; and on the west by Cook Inlet. The Refuge is bordered by a number of communities, including Hope to the northeast; Cooper Landing to the east; Seward to the southeast, Homer to the southwest; Ninilchik, Soldotna, and Kenai to the east; and Sterling in the center.

1.3.1 Establishment of Kenai National Wildlife Refuge

Franklin D. Roosevelt established the Kenai National Moose Range (Moose Range) on December 16, 1941, for the purpose of "*. . . protecting the natural breeding and feeding range of the giant Kenai moose on the Kenai Peninsula, Alaska, which in this area presents a unique wildlife feature and an unusual opportunity for the study, in its natural environment, of the practical management of a big-game species that has considerable local economic value…"* (Executive Order 8979).

ANILCA substantially affected the Moose Range by modifying its boundaries and broadening its purposes from moose conservation to protection and conservation of a broad array of fish, wildlife, habitats, other resources, and educational and recreational opportunities. ANILCA also redesignated the Moose Range as the Kenai National Wildlife Refuge, added nearly a quarter of a million acres of land, and established the 1.32-million acre (534,349 hectare) Kenai Wilderness.

The Refuge is considered by many to be "Alaska in Miniature." It consists of the western slopes of the Kenai Mountains and forested lowlands bordering Cook Inlet. Treeless alpine and subalpine habitats are home to mountain goats, Dall sheep, caribou, wolverine, marmots, and ptarmigan. Most of the lower elevations on the Refuge are covered by boreal forests composed of spruce and birch forests intermingled with hundreds of lakes. Boreal forests are home to moose, wolves, black and brown bears, lynx, snowshoe hares, and numerous species of neotropical birds such as olive-sided flycatchers, myrtle warblers, and ruby-crowned kinglets. At sea level, the Refuge encompasses the largest estuary on the Peninsula—the Chickaloon River Flats. The Flats provide a major migratory staging area for thousands of shorebirds and waterfowl and provide a haul-out area for harbor seals and feeding areas for beluga whales.

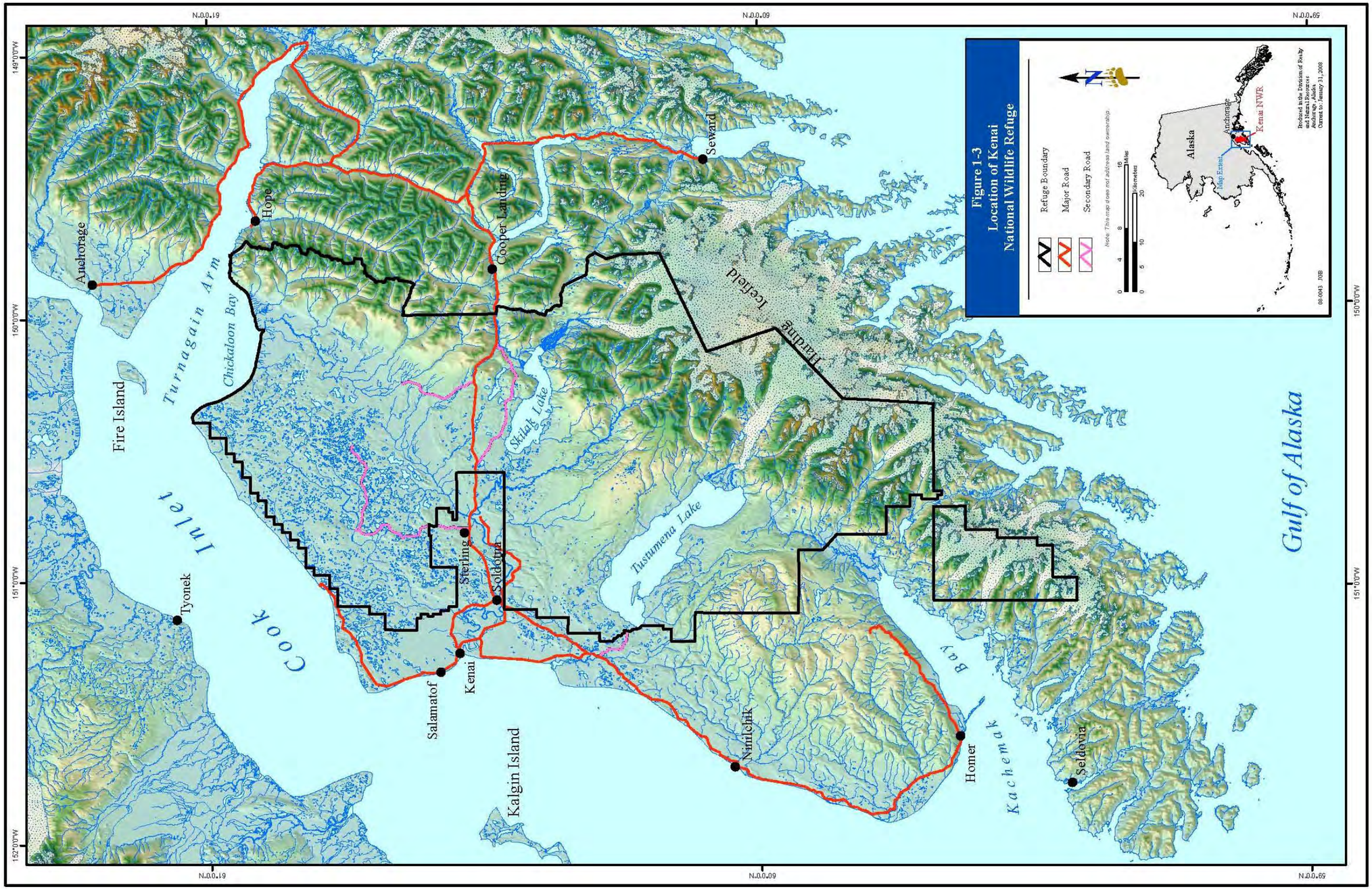

Figure 1-3. Location of Kenai National Wildlife Refuge

1.4 Refuge Purposes, Vision, and Goals

1.4.1 Refuge Purposes

ANILCA sets out the purposes for each refuge in Alaska. The purposes of Kenai Refuge are described in Section 303(4)(B) of the act. The purposes identify the reasons why Congress established the Refuge and sets the management priorities for it.

ANILCA purposes for Kenai Refuge are as follows (unless otherwise noted):

(i) to conserve fish and wildlife populations and habitats in their natural diversity, including but not limited to moose, bears, mountain goats, Dall sheep, wolves and other furbearers, salmonoids and other fish, waterfowl and other migratory and nonmigratory birds;

(ii) to fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats;

(iii) to ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (i), water quality and necessary water quantity within the Refuge;

(iv) to provide in a manner consistent with subparagraphs (i) and (ii), opportunities for scientific research, interpretation, environmental education, and land management training; and

(v) to provide, in a manner compatible with these purposes, opportunities for fish and wildlife-oriented recreation.

The Wilderness Act of 1964 (Pub. L. 88-577) provides the following purposes for the Kenai Wilderness Area:

(i) to secure an enduring resource of wilderness;

(ii) to protect and preserve the wilderness character of areas within the National Wilderness Preservation System; and

(iii) and to administer [the areas] for the use and enjoyment of the American people in a way that will leave them unimpaired for future use and enjoyment as wilderness.

1.4.2 Our Vision for Kenai National Wildlife Refuge

Kenai Refuge staff developed the following statement about what they believe the Refuge will be in the future, considering the mission of the Refuge System, the specific purposes of the Refuge and Wilderness Act, and other relevant Service mandates:

The Kenai National Wildlife Refuge will serve as an anchor for biodiversity on the Kenai Peninsula despite global climate change, increasing development, and competing demands for Refuge resources. Native wildlife and their habitats will find a secure place here, where

Refuge staff and partners work together using the best science and technology available to ensure that biological health is maximized and human impacts are minimized.

Visitors will feel welcomed and safe by means of a wide variety of wildlife-dependent recreation opportunities, facilities, and interpretive and educational programs that encourage informed and ethical use of the Refuge's natural resources. The Refuge will achieve excellence in land, water, and Wilderness stewardship; and—with careful planning, forethought, and human determination—an enduring legacy of abundant plant, fish, and wildlife populations will be ensured for people to enjoy today and into the future for this phenomenal land we call "The Kenai."

1.4.3 Refuge Goals

Goals are descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose but do not define measurable units. Goals for Kenai Refuge will direct work at carrying out the Refuge's mandates and achieving the purposes defined in ANILCA.

The following goals are derived from the vision statement and Refuge purposes to reflect the Refuge's contribution to the National Wildlife Refuge System and other key management responsibilities that stem from law and policy. The Revised Plan adopted as a result of this planning effort must work toward meeting all these goals.

Goal 1: ***Research—***Increase our knowledge of fish, wildlife, and plant populations, ecosystems, and dynamic processes on refuge lands and waters.

Goal 2: ***Conservation and Management—***Ensure natural diversity and viability of refuge species, habitats, and ecosystems.

Goal 3: ***Resource Assessment—***Ensure that the integrity of ecological systems is protected and unimpaired for future generations.

Goal 4: ***International Treaties—***Ensure that refuge management practices affecting avian species contribute to the successful implementation of the Migratory Bird Treaty Act.

Goal 5: ***Water Resources—***Ensure natural function and condition of water resources necessary to conserve fish and wildlife populations and habitats in their natural diversity.

Goal 6: ***Environmental Education and Training—***Natural resource professionals, students, and the visiting public will value opportunities to increase their knowledge of ecosystems and refuge management practices.

Subgoal 6.1: Environmental Education and Interpretation— Diverse audiences will have equal opportunity to understand and appreciate all management programs and will support the refuge's efforts to maintain and enhance wildlife populations and habitats.

Subgoal 6.2: Land Management Training—Land managers, scientists, and other partners will learn practices and techniques to study, manage, and monitor refuge ecosystems.

Goal 7: ***Wildlife-Oriented Recreation—***Visitors of all skills and abilities will enjoy wildlife-oriented recreation opportunities in safe and secure settings.

Goal 8: ***Facilities—***Visitors and refuge personnel will value and enjoy safe, well-maintained facilities and quality programs.

Goal 9: ***Wilderness Stewardship—***Preserve, and where necessary, restore the character and integrity of Wilderness for present and future generations.

Objectives are more concise statements of what the Service wants to achieve during this planning cycle, how much to achieve, when and where to achieve it, and who is responsible for conducting the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. A complete list of objectives can be found in chapter 2.

1.5 Refuge Overview

1.5.1 Historical Perspective

The human history of Alaska's Kenai Peninsula is believed to date back to approximately 10,000 years ago, when glacial ice began to recede from the area. Five distinct cultural traditions have been documented, including both Eskimo and Indian occupations. Early inhabitants hunted a variety of animals from Kenai forests and mountains and caught salmon and other fish from the area's many lakes and streams. Today, the remains of barabaras (shelters dug into the ground) and other cultural artifacts are common in many areas of the Refuge.

On July 24, 1741, Captain Vitus Bering, a Dane in Russian Service, first sighted the Kenai Peninsula aboard the *St. Peter*. In May 1778, a British sea explorer, Captain James Cook, landed at Point Possession on the northern boundary of the Refuge and claimed the land for England. Russian fur trappers arrived later and established settlements on the Kenai Peninsula in 1786.

By the mid-1800s, demands for furs from sea otters and other animals had seriously depleted their populations. American fishermen and canneries largely replaced the fur trapper, but Russian traditions and culture remained evident in some place names and in the lives of some local residents. Alaska was purchased by the United States from Russia in 1867, and the salmon fishing industry grew rapidly. Gold mining also brought many prospectors and speculators to the Kenai Peninsula in the late 1800s and early 1900s. Small communities sprang up, and the face of the Kenai was forever changed.

By the late 1890s, the Kenai became know as a destination for sportsmen from all over the world, most seeking moose, Dall sheep, and other game. Returning hunters noticed the decline in game populations due to increased human use and commercial hunting of animals and began lobbying the Federal government to establish the area as a special area to conserve wildlife, specifically moose. On December 16, 1941, only six days after the bombing of Pearl Harbor, President Franklin D. Roosevelt signed Executive Order 8979 creating the 1,730,000-acre Kenai National Moose Range (Range).

Human use of the Kenai Peninsula continued to change after the establishment of the Range with the discontinuance of homesteading, construction of the Sterling Highway to the Kenai Peninsula in 1950, discovery of oil in the Swanson River area of the Range in 1957, and the nearly exponential growth in population during each new 10-year census period. The area increasingly became used for recreation; and trails, campgrounds, and canoe systems were established on the Range.

The Kenai Moose Range was subject to several executive orders and land withdrawals after its initial establishment. A significant boundary adjustment to the Range occurred on May 22, 1964. The purpose of the adjustment was to realign the boundaries of the Range to facilitate administration and as a basis for survey of adjoining selections by the State of Alaska. The effect of the adjustment was to add 40,115 acres in the Caribou Hills, important for moose feeding, from formerly undesignated Federal lands. It removed from the Range a six-mile-wide strip of land along the shores of Cook Inlet and an additional strip of land from Bishop Creek to Point Possession. The remaining Moose Range lands (1,730,000 acres) were subject to all laws and regulations applicable to the original Kenai Moose Range and were withdrawn from all forms of appropriation under the public land law (including mining), except the mineral leasing laws.

In 1980, ANILCA changed the name of the Range to the Kenai National Wildlife Refuge, increased the size of the Refuge to 1.92 million acres, designated approximately two-thirds of the Refuge as Wilderness, and changed the purposes to include the conservation of all fish and wildlife species. No longer was the Refuge to be managed just for moose, but for all wildlife.

1.5.2 Refuge Environment

1.5.2.1 Physical Environment

The Refuge has a subarctic climate characterized by long, cool winters and short growing seasons in the summer. Temperatures occasionally exceed 80 degrees Fahrenheit (27 degrees Celsius) in summer, and rarely drop below minus 30 degrees Fahrenheit (-34 degrees Celsius) in winter.

The Kenai Mountains within the eastern third of the Refuge vary in elevation from 3,000 to 6,600 feet (914–2,012 meters) and are heavily glaciated in many of the higher elevation areas. The largest glaciated area, the Harding Ice Field, covers more than 1,100 square miles (2,849 square kilometers) and lies within the boundaries of both the Refuge and adjoining Kenai Fjords National Park. Located within the icefield, and on the Refuge, is Truuli Peak, the highest peak on the Kenai Peninsula at 6,600 feet (2,012 meters).

The Kenai Lowlands make up approximately two-thirds of the Refuge and contain thousands of lakes and boreal forest covering low hills, ridges, and muskeg. The largest two lakes on the Kenai Peninsula are Tustumena (73,000 acres [29,542 hectares]) and Skilak (25,000 acres [10,117 hectares]).

The Kenai River is the dominant river system on the Refuge and drains about 2,148 square miles (5,563 square kilometers). Approximately 54 percent of the watershed is on the Refuge, with 37 percent on the Chugach National Forest and the remainder on State of Alaska or private land. The four major tributaries providing the most water volume and fish habitat to the Kenai River system are the Funny, Moose, Killey, and Russian rivers. The Chickaloon, Swanson, and Kasilof rivers are three other significant systems contained wholly or mostly within the Refuge.

1.5.2.2 Biological Environment

More than 175 species of mammals and birds occur on the Refuge during at least part of the year. ANILCA mandated the conservation of all fish and wildlife populations and habitats in their natural diversity but made specific mention of moose, bear (brown, grizzly, and black bear), mountain goats, Dall sheep, wolves, and other furbearers, salmonids and other fish, and waterfowl and other migratory and nonmigratory birds. Bald eagles, trumpeter swans, and common loons are frequently observed bird species on lakes and rivers of the Refuge. Slate-colored junco, myrtle warbler, orange-crowned warbler, Swainson's thrush, boreal chickadee, ruby-crowned kinglet, gray jay, alder flycatcher, and American robin are common breeding landbirds in Refuge forests. Twenty species of fish are documented on the Refuge with salmon (Chinook, coho, sockeye, and pink) being most important from ecological, recreation, and off-Refuge commercial viewpoints.

Anglers travel from all around the world to the Kenai area each year to fish for salmon, trout, and Dolly Varden. No reptiles and only one species of amphibian is found on the Kenai: the hardy wood frog, which survives long winters by burrowing into mud that will ultimately freeze for many months before spring thaw.

Vegetation on the Refuge is diverse and rich, with 484 vascular plants, 97 fungal, 35 lichen, and 90 moss species catalogued to date. Most of the vegetation falls into a few land cover types, including alpine tundra, estuarine or riparian areas, black spruce forest and peat bog, hardwood and mixed spruce–hardwood forests, black spruce forest, and white spruce forests. Wildfire is an important natural landscape process in forests dominated by black spruce. Spruce bark beetle and, to a lesser extent, wildfire, are important natural processes in forests dominated by white spruce. Avalanches on steep slopes of the Kenai Mountains, receding glaciers, and drying wetlands in the Kenai Lowlands also continue to influence the Refuge's natural landscape.

1.5.2.3 Human Uses

Approximately 1.2 million people travel through the Kenai National Wildlife Refuge each year on the Sterling Highway, and an estimated 300,000 visitors spend extended periods of time on the Refuge enjoying a variety of outdoor activities, including fishing, camping, hunting, hiking, wildlife viewing and photography, and canoeing. There are now also more than 50,000 year-round residents on the Kenai Peninsula.

As the seasons change, so do the dominant human uses of the Refuge. Intense visitation from visitors enjoying fishing, hiking, sightseeing, and camping is most obvious in spring, summer, and fall. Hunting occurs throughout the year but is predominantly a fall activity. When winter snows come, Refuge users turn to crosscountry skiing, snowshoeing, trapping, ice fishing, and snowmachine travel once portions of the Refuge have been opened to such use. Regulations allow for more than half of the Refuge to be opened to snowmachine use from December 1 through April 30 each winter, once the Refuge manager has determined adequate snowfall exists to protect underlying vegetation and soils.

Hundreds of individuals make a portion of their livelihood directly off the Refuge, predominantly by being permitted guides or outfitters. Thousands of other Alaskans benefit indirectly as they take advantage of the economic input of the Refuge's many visitors. Still others, such as those in the commercial fishing industry, benefit from the Refuge providing the majority of the critical salmon spawning and rearing habitat for Upper Cook Inlet salmon. Finally, oil and gas development within the Refuge has provided a significant number of jobs and economic stability to the Region for nearly five decades.

1.6 Special Values

Section 304(g) of ANILCA states that before developing or revising a comprehensive conservation plan, "the special values of the Refuge, as well as any other archaeological, cultural, ecological, geological, historical, paleontological, scenic, or wilderness values of the Refuge" should be identified. The following discussion describes the special values that have been identified for Kenai Refuge (Figure 1-4).

1.6.1 Refuge Characteristics Valued by the Public

Public comments received during scoping (Table 1-7) indicated that people value the Refuge's wilderness character, its accessibility, and the role it plays in conserving fish, wildlife, and their habitats.

Some people also mentioned specific places on the Refuge that they valued. Some of these places have also been documented by Refuge staff and other knowledgeable people. Special ecosystems and places identified as having special values are listed in the following subsection.

1.6.2 Valued Ecosystems and Places

1.6.2.1 Chickaloon Watershed and Estuary

The Chickaloon watershed and associated estuary, located on the Turnagain Arm of upper Cook Inlet, is the major waterfowl and shorebird migratory staging area on the Kenai Peninsula and the only estuary on the Refuge. Protection of the Chickaloon Flats was the major reason the Refuge's northeastern boundary was extended to include most of the Chickaloon and Indian Creek watersheds.

1.6.2.2 Harding Icefield

The Harding Icefield is one of four major ice fields in the United States. Its glaciers continue to carve valleys through the Kenai Mountains and feed rivers throughout the Peninsula; as a result of global climate change; however, the icefield is receding.

1.6.2.3 Kenai River and its Tributaries

The Kenai River, together with its tributaries—the Moose, Funny, Killey, and Russian rivers—is the largest drainage system on the Kenai Peninsula. The Kenai River is important to the entire Refuge ecosystem, including the Cook Inlet salmon fishery. The Kenai River provides priceless spawning and rearing habitat for millions of salmon.

1.6.2.4 Lowland Lakes System

The numerous lakes located throughout the northern lowlands are a unique geologic feature that provides a variety of aquatic habitats for Refuge wildlife. The Swanson River and Swan Lake canoe routes are the only nationally designated trails in the Alaska refuge system and

annually provide thousands of refuge visitors the opportunity to enjoy this mix of forest and wetland habitats and their associated wildlife.

1.6.2.5 Skilak Wildlife Recreation Area

The Skilak Loop area was first recognized as a unique recreation destination in 1958 when it, along with the Chickaloon Flats and Skilak-Tustumena Benchland, was removed from potential oil and gas leasing. Today, the Skilak Wildlife Recreation Area—which contains a variety of habitats, wildlife species and scenic vistas that are road accessible to Refuge visitors—is recognized as a special area that provides opportunities for wildlife viewing, environmental education, interpretation, photography, and other non-conflicting wildlife-dependent recreation activities.

1.6.2.6 Tustumena Lake and its Watershed

Tustumena Lake is the largest lake on the Kenai Peninsula and the fifth largest lake in Alaska. This immense glacial lake encompasses approximately 73,000 acres (29,542 hectares), and its Kasilof River drainage is second only to the Kenai River drainage in size. Rich in fisheries, wildlife, wilderness, and historical values, Tustumena Lake is popular with boaters and campers and provides a gateway, via several Refuge trails, for wilderness hikers and hunters to the scenic glacier flats and tundra benchlands located nearby. Historic cabins remain along the lakeshore as a reminder to earlier years of gold mining and trapping in the area. Tustumena Lake and its tributaries are significant contributors to Cook Inlet area commercial, recreation, and personal use sockeye salmon fisheries. Whether visited via boat, horse, airplane, or snowmachine in winter, the Tustumena Lake area provides scenic outdoor wilderness experiences to thousands of Refuge visitors each year.

1.6.2.7 Tustumena-Skilak Benchlands

This unique ecological area lies between Tustumena and Skilak lakes. It consists of alpine plateaus on the west side of the Kenai Mountains and is home to Dall sheep, caribou, mountain goat, brown and black bear, and moose. It is encompassed by the Andrew Simons Research Natural Area and lies within the Kenai Wilderness established by ANILCA in 1980.

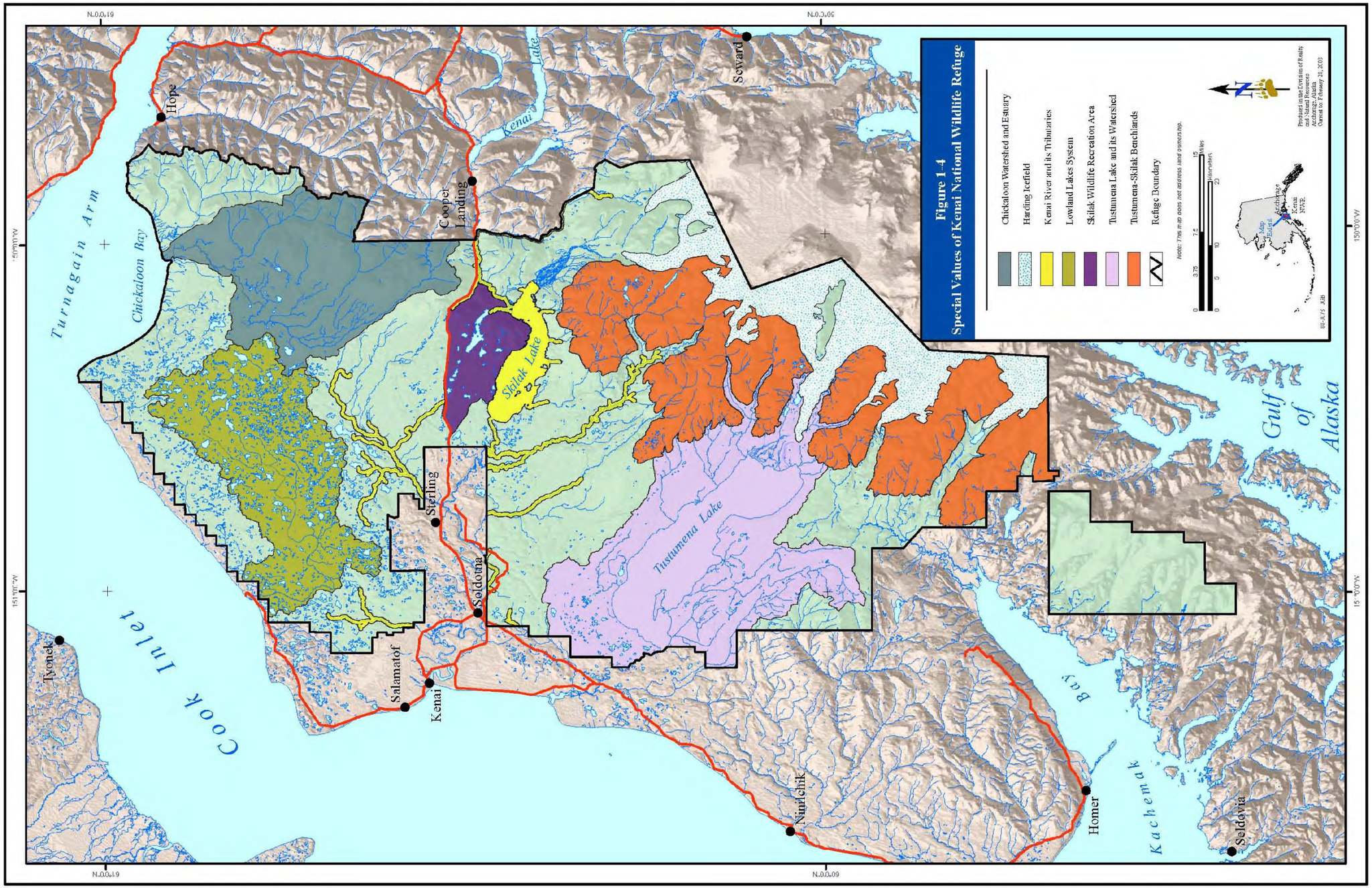

Figure 1-4. Special Values of Kenai National Wildlife Refuge

1.7 The Planning Process

This section describes the process used to develop this draft Plan and Environmental Impact Statement (EIS). The process is consistent with the planning requirements specified in Section 304(g) of ANILCA; the National Wildlife Refuge System Administration Act, as amended; the Service's planning policy (602 FWS); National Environmental Policy Act (NEPA) direction (42 U.S.C. 4321-4347); and the Council on Environmental Quality's Regulations for Implementing the Procedural Provisions of NEPA (Figure 1-5).

The process being used to revise the Plan contains eight steps. With publication of this Plan and EIS, the planning process is currently partway through step 6. The rest of this section describes what we have done at each step and what we anticipate doing to finish the plan. Table 1-7 describes the issues that were identified by the public and what aspects of management the Plan and the alternatives will emphasize.

Figure 1-5. The Planning Process

1.7.1 Preplanning

The first step in the planning process helps the planning team decide whether the original Plan should be revised or a new Plan developed. For the Kenai Refuge planning effort, a number of preplanning meetings were held throughout 2004, and the following tasks were completed:

- Established an interdisciplinary interagency planning team
- Developed a workplan and an associated task schedule
- Identified all relevant laws, regulations, and policies that would have to be considered during the development of the Plan

- Reviewed the original plan to determine if its issues had been adequately addressed
- Developed a list of potential issues to address in the draft Plan
- Identified resource data needs

Based on the assessment conducted during preplanning, the team determined that a revision was necessary and that the Revised Plan would focus on specific issues that need to be addressed rather than on developing a new Plan. It was also concluded that new and amended laws (e.g., Refuge System Improvement Act) and new or revised regulations and policies needed to be included in the Refuge's management policies and guidelines.

1.7.2 Initiate Public Involvement and Scoping

The purpose of this step was to let people know that the planning process was beginning and to solicit ideas on what issues should be addressed in the Revised Plan. Formal scoping began with publication of a notice of intent to prepare an EIS, which was published in the *Federal Register* on November 26, 2003 (Volume 68, Number 228, pp. 66476-66478).

In December 2003, a planning update, which announced the planning effort and solicited comments from the public, was mailed to more than 3,100 individuals; local businesses; local, State, and Federal agencies; and organizations nationwide. This mailing contained information about the Refuge, the planning process, and some preliminary issues identified by Refuge staff. The mailing included an optional issues workbook to make it easier for people to identify their issues and concerns.

Five public open house meetings were held, four in communities on the Kenai Peninsula and one in the city of Anchorage (Table 1-1). One hundred people attended the meetings. A total of 313 written or telephone responses were received during the scoping period (December 2003–May 2004). The responses were reviewed, coded, and analyzed over a three-month period in spring 2004. More than 50 separate concerns were identified, grouped, and categorized into six topic areas.

Table 1-1. Location, Attendance, and Dates of Public Meetings

Community	Attendance	Meeting Date
Cooper Landing	10	2/10/04
Homer	21	2/11/04
Soldotna	34	2/12/04
Seward	6	2/17/04
Anchorage	29	2/18/04

Three radio interviews were conducted by the Refuge manager during January and February 2004 to promote the dates, locations, and times of public scoping meetings. Two additional radio interviews were conducted in August and September 2004 to provide updates on the status of the planning effort.

Tables 1-2 through 1-6 list concerns by topic area.

Table 1-2. Wildlife and Habitat-Related Concerns Identified During Scoping

Concern	General Public	State of Alaska	Federal Agencies	USFWS
Aging Forest	x			x
Beetle Kill	x	x		x
Birch Hill Oil and Gas Unit				x
Commercial Fishing	x			
Consumptive Uses	x			
Fire (Prescribed and Wildland)	x	x		x
Fish Populations	x			x
Global Climate Change				x
Habitat Fragmentation				x
Habitat Management				x
Interagency Coordination and Cooperation	x	x	x	x
Kenai River Watershed	x	x	x	x
Law Enforcement				x
Mechanical Treatment	x		x	
Moose Range Meadows: Non-Development Easement	x	x		
Non-native Species	x			x
Research	x			x
Riparian Habitats	x	x	x	
Subsistence	x			x
Wilderness Quality and Character	x			x
Wildlife	x			x
Wildlife Restoration	x			x

Table 1-3. Recreation-Related Concerns Identified During Scoping

Concern	General Public	State of Alaska	Federal Agencies	USFWS
Bear Baiting		x		
Christmas Tree Harvesting				x
Collection of Natural Resources	x	x		x
Education and Interpretation	x		x	x
Fishing	x	x		x
Hunting	x	x		x
Increasing Use	x			x
Public Use Encroachment				×
Trapping	x	x		
Visitor Experiences	x	x	x	x
Wildlife Viewing	x	x		x

Table 1-4. Crowding-Related Concerns Identified During Scoping

Concern	General Public	State of Alaska	Federal Agencies	USFWS
Canoe Trail Systems	x			
Kenai River	x	x		x

Table 1-5. Facilities-Related Concerns Identified During Scoping

Concern	General Public	State of Alaska	Federal Agencies	USFWS
Administrative			x	x
Cabins	x	x	x	
Campgrounds	x	x		
Campsites	x			
Cultural Resources				x
Contaminated Sites				x
Fire (Protection of Human Health, Safety, and Property)	x			
Land Management Training				x
Oil and Gas Infrastructure	x			x
Oil and Gas Development and Production	x	x		x
Oil and Gas Remediation and Restoration	x			x
Parking and Pullouts	x	x		x
Restrooms	x			
Roads	x	x		x
Signs	x			
Trails	x	x	x	x
Training Facilities				x
Visitor Center and Facilities		x		x

Table 1-6. Access-Related Concerns Identified During Scoping

Concern	General Public	State of Alaska	Federal Agencies	USFWS
Airplanes	x	x		x
Canoe Carriers	x	x		
Game Carts	x	x		x
Snowmachines	x	x		x
Private Inholdings	x	x		
Wheelchairs/Baby Strollers	x	x		x

1.7.3 Determine Significant Issues

To determine the significant planning issues being addressed in the draft Plan, the planning team reviewed the concerns identified by the public along with management concerns identified by Refuge staff and those submitted by the State of Alaska and Federal agencies. Significant planning issues are those issues for which multiple approaches to resolving the issue will be evaluated as part of the planning process. Sections 1.8 and 1.9 of this chapter provide more detail on the process used to identify the significant issues and what those issues are.

1.7.4 Develop and Analyze Alternatives

The fourth step is to develop alternative approaches to the issues. These alternatives meet the Refuge's purposes and goals and comply with the Service and Refuge System mission. The planning team developed a range of alternatives that respond to the significant planning issues and eliminated alternatives that did not meet Refuge purposes or that were outside of the Service's ability to implement.

In March 2005, approximately 2,700 postcards were mailed to individuals, organizations, businesses, and local, State, and Federal government agencies on the Kenai mailing list to notify them that draft alternatives were available for public review and comment via the Internet.

The draft alternatives were refined based on comments received from the planning update. The environmental effects of the alternatives were analyzed, and the results were presented in chapter 4 of the draft. We evaluated the alternatives against a set of criteria and presented that discussion in chapter 5 of the draft.

1.7.5 Prepare Draft Plan and Environmental Impact Statement

The purpose of the fifth step was to produce the draft document. The draft Plan and EIS contained five management alternatives, including one that described the continuation of current management (No-Action Alternative) and one that is currently the Service's Preferred Alternative (Alternative E). This step included an analysis of the potential impacts of implementing each alternative and described how the Service decided upon its preferred alternative. Also included was a description of management actions that would be the same for all of the action alternatives (Alternatives B–E). During the public review and comment period, the Service held public meetings in the city of Anchorage and in various communities on the Kenai Peninsula to obtain public comments on the draft Plan and EIS. Comments were also accepted by mail.

1.7.6 Prepare and Adopt a Final Plan and Environmental Impact Statement

In the sixth step, comments received on the draft Plan and EIS were reviewed and analyzed. (These comments and our responses to them are presented in Volume 2, Appendix D of this Plan.) The draft Plan and EIS was modified as needed, including refining the Preferred Alternative, after which this Final Revised Comprehensive Conservation Plan (Final Revised Plan) and EIS was published. A 30-day comment period follows publication, then the Service's regional director will issue a Record of Decision (ROD) that describes the alternative that will be implemented. The ROD identifies the rationale the regional director used to decide how the Refuge will be managed for the next 15 years. The Service will publish the Refuge's Revised Plan after that decision is made. The Revised Plan will be used for day-to-day management, and will include management direction but not NEPA required items.

1.7.7 Implement Plan, Monitor, and Evaluate

After the ROD and Revised Plan are distributed, Refuge staff will begin to initiate any changes called for in the Plan. A critical component of management is monitoring and measuring resources and social conditions to make sure that progress is being made toward meeting goals. Monitoring also detects new problems, issues, or opportunities that should be addressed. The Refuge is using an adaptive management approach, which means that information gained from monitoring is used to evaluate and, as needed, to modify Refuge objectives.

1.7.8 Review and Revise Plan

Agency policy directs that the Plan be reviewed annually to assess the need for changes. The Plan will be revised when significant new information becomes available, ecological conditions change, or the need to do so is identified during the annual review. If major changes are proposed, public meetings may be held, or new environmental assessments and environmental impact statements may be necessary. Consultation with appropriate State agencies and Native corporations would occur during any future revision. Full review and revision of the plan will occur at least every 15 years. The public will continue to be informed and involved throughout the Plan's implementation meetings held in local communities at least annually and through published Refuge updates.

1.8 Issues

Refuge planning policy defines an issue as any unsettled matter that requires a management decision: an initiative, opportunity, resource management problem, threat to Refuge resources, conflict in uses, public concern, or presence of an undesirable resource condition (602

FW 1.6I.). Public responses obtained through two newsletters and five public open house meetings—in addition to management concerns identified by Refuge staff and State and Federal natural resource agencies—were used to identify issues addressed in this draft Plan and EIS.

Public responses identified a broad range of concerns, which were grouped and categorized by how they would be addressed (and, in some cases, not addressed) in the Plan. This process helped the planning team identify significant issues (Table 1-7).

Table 1-7. Addressing Issues Raised During Scoping

Category	Concern	Examples of How Some Issues are Addressed in the Plan
The concern is addressed by existing laws, regulations, or policies.	Fishing Hunting (including bear baiting) Trapping	Hunting: ANILCA guarantees that opportunities for both subsistence and recreational hunting continue to be provided on national wildlife refuges in Alaska (Section 101 [b] and [c]). In addition, the National Wildlife Refuge System Administration Act, as amended, lists recreational hunting as one of the six public uses that are allowed and facilitated on national wildlife refuges when compatible with the purposes of the Refuge.
The concern is outside scope of this Revised Plan.	Global Climate Change Wild and Scenic River Designations Wilderness Designations	Recommendations for Wilderness Designations: Section 1317 of ANILCA required a review of Wilderness suitability of all lands in Alaska refuges not designated as Wilderness. This review was completed in accordance with the Wilderness Act as part of the 1985 Plan. The Record of Decision for the Supplemental Environmental Impact Statement for the Wilderness Proposal of the Final Kenai Comprehensive Conservation Plan/Environmental Impact Statement/Wilderness Review (USFWS 1985b) recommended 195,000 acres for designation as Wilderness. This recommendation will remain in effect until Congressional action is taken or the Plan is amended to modify or remove it. After reviewing the requirements for conducting Wilderness reviews, the Service determined that the comprehensive planning requirements of Section 304(g) of ANILCA were best satisfied by honoring the Wilderness recommendations identified in the 1985 Plan. Recommendations for Wild and Scenic River Designations: Because of concerns expressed by the State of Alaska and subsequent analysis of those concerns by the Service, alternatives that would have recommended Congress consider rivers for inclusion in the National Wild and Scenic Rivers System were considered but eliminated from detailed consideration. In compliance with Section 304(g) of ANILCA, river-related special values of the refuge are discussed in this plan (section 3.6); however, recommendations for designations are not included in the alternatives. Current and proposed management direction may provide adequate protection for all river-related values.
The concern is addressed in the same manner regardless of the alternative selected.	Wildlife and Habitats: Commercial Fishing Consumptive Uses Fish Populations Habitat Fragmentation	Beetle Kill, Fire Safety, Habitat Management: Spruce bark beetle outbreaks will not be managed. The Refuge will continue to manage hazardous forest fuels, especially in the wildland–urban interface where beetle kill trees and other fuel hazards increase the threat of wildfire to communities or private lands. Adjacent private lands, inholdings, and Refuge structures will continue to receive the

Category	Concern	Examples of How Some Issues are Addressed in the Plan
	Habitat Management Interagency Coordination and Cooperation Kenai River Watershed Mechanical Treatment Non-native Species Oil and Gas Remediation and Restoration Research Riparian Habitats Subsistence Wilderness Quality and Character Wildlife and Restoration <u>Recreation:</u> Canoe Carriers Education and Interpretation Game Carts Law Enforcement Public Use Encroachment Trash Visitor Experiences Wheelchairs and baby strollers <u>Facilities:</u> Administrative Beetle Kill Birch Hill Oil and Gas Unit Cabins Campgrounds Campsites Cultural Resources Fire (Protection of Human Health, Safety, and Property) Land Management Training Moose Range Meadows: Non-Development Easement Oil and Gas Production and Development	maximum possible fire protection through interagency agreements. Law Enforcement: Law enforcement will continue to conduct activities in accordance with public law and agency policy to ensure natural and cultural resources protection and visitor safety. Law enforcement presence will be increased Refuge-wide by implementing the Service's deployment model. Oil and Gas Field Developments and Production: Numerous comments expressed concern about existing oil and gas field developments, recognizing that developments have grown to include numerous gravel roads, well pads, buildings, bridges, pipelines, utility lines, and other structures. Little restoration activity has occurred on sites that are no longer in production; therefore, the field's footprint on the landscape remains the same or continues to increase. It is the Refuge's desire that facilities no longer needed for production be removed, cleaned up, and restored so the footprint of the field is reduced. The Refuge will continue to request that field operators identify facilities that are no longer needed and have these sites cleaned up and restored to predevelopment conditions or that the sites be altered/cleaned up so as to be utilized for some other use. Research: To better conserve natural diversity, the Refuge will continue to develop and implement its comprehensive and integrated research and monitoring program, which includes state-of-the-art geographic information system and relational database management; enhanced water quality, air quality, and meteorological monitoring station network; permanent study sites; and a multi-species landscape-level inventorying and monitoring program. Wildlife Restoration: The Refuge will continue to implement restoration projects focused on caribou, trumpeter swan, marten, and red fox populations. Exotic species management and enhanced monitoring and modeling for early detection of species at risk will be included in such efforts. Assessing the distribution and status of multiple species at the landscape level to ensure against local extirpation of wildlife is currently being evaluated. Such projects will continue to be developed and implemented regardless of the Preferred Alternative selected in this Revised Plan.

Category	Concern	Examples of How Some Issues are Addressed in the Plan
	Restrooms Signs Visitor Center and Facilities <u>Access:</u> Private Inholdings	
The concern is addressed in the same manner regardless of the action alternative selected (Alternative B through Alternative E).	<u>Recreation:</u> Christmas Tree Harvesting Personal Collection of Natural Resources <u>Facilities:</u> Contaminated Sites Sterling Highway Pullout Trail Maintenance and Planning	Trails: Kenai Refuge has more than 200 miles of land and water (canoe) trails. These trails exist at a lesser standard than often expected by the public. They are generally narrow, are poorly drained, have minimal signing, and include frequent obstructions. The Service proposes to develop a trail needs assessment for a variety of trails located in non-Wilderness areas. The assessment will identify a set of construction standards and will prioritize construction and maintenance needs. This management action is proposed in Alternatives B through E.
The concern is significant. The Revised Plan proposes a variety of ways to address it.	<u>Wildlife and Habitat Management:</u> Aging Forests Prescribed Fire Use Uses of Wildland Fire <u>Facilities:</u> Beaver Creek Oil and Gas Unit Mystery Creek Access Road and Alaska Pipeline Corridor Ski Hill Road Swanson River Oil and Gas Unit <u>Crowding:</u> Swanson River/Swan Lake Canoe Systems Upper and Middle Kenai River <u>Access:</u> Aircraft Access to Lakes in Designated Wilderness Aircraft Access to Chickaloon Flats Snowmachine Access	Kenai River Crowding: Use of the areas within Kenai Refuge along the Kenai River has increased greatly in recent years, with it being one of the most popular fishing areas in the State of Alaska. The area currently has a number of use restrictions, including a highly regulated recreational fishery, prohibition on the use of outboard motors in spring to reduce impacts to trumpeter swans, and Wilderness restrictions on the east side of the river. Concerns over archaeological resource damage or theft, riverbank erosion, human waste and sanitation, public safety, and brown bear protection have been raised by Refuge staff, other agencies, and members of the public. Additional concerns associated with this area include the regulation of commercial recreational fishing guides. Currently, Refuge permits are required for all guides launching from a Kenai Refuge facility and/or for those who use the uplands for part of their operation. These permits have been issued without limit. A variety of action alternatives have been developed and are presented in the Revised Plan.

Reference: (USFWS 1985b)

1.9 Significant Planning Issues

Five significant planning issues were identified for consideration during revision of this draft Plan. These issues reflect problems, opportunities, or points of discussion that the draft Plan addresses in a variety of ways. Chapter 4 displays the potential consequences of implementing the alternatives on Refuge resources.

In addition to describing the identified significant planning issues, this section includes a brief summary of comments received during scoping, including examples of individuals' comments about the issue using their own words. This provides readers with a greater understanding of how people who care about the Refuge view each issue. The comments were selected to demonstrate the broad range of approaches and opinions people bring to the issues, not to represent the proportion of each type of comment received. The complete set of written and verbal responses received is available from the U.S. Fish and Wildlife Service regional office in Anchorage.

Public comments are not considered votes. Sometimes important topics are identified only by a few people familiar with a specific area or problem. Other issues are of national interest and generate a large number of comments from across the country. Strong public support or opposition is an important consideration, but the decision must also consider how to best meet the Refuge's purposes and the mission of the Refuge System.

Issue 1: How will the Refuge address large-scale habitat changes and the use of fire?

Summary of Comments

Members of the general public and the planning team expressed concerns about the state of the Refuge's ageing forests and the impacts associated with beetle kill. Numerous people noted that wildfire was being suppressed on the landscape and that prescribed fire was being inadequately used as a management tool to enhance wildlife habitat. In some cases, prescribed fire was advocated as a tool to protect life and property by reducing hazardous fuels.

Representative Comments

"The lack of letting the forest burn naturally, the habitat for many Refuge species is deteriorating quickly. [Need to] burn or log—clear."

"I understand and accept the value of Wilderness fires and the desire to provide healthy regrowth and habitat for wildlife. I oppose road-building for this purpose. Aerial management [is] ok if feasible and enough equipment and management available to protect nearby communities."

"[Need a] buffer zone between cities and the Refuge that will stop fires (either natural or prescribed) that place people in danger."

Issue 2: How will the Refuge manage existing facilities for public use while ensuring natural resource protection?

Summary of Comments

Members of the general public, the State of Alaska, and the planning team raised concerns about trails, highway pullouts and rest stops, and oil and gas field infrastructure. Trail-related comments focused on the need for additional planning, design, and maintenance. The State of Alaska is specifically interested in developing trails to lakes that support sportfish. Comments related to highway pullouts and rest stops focused on the need for additional parking and related rest stop facilities along the Sterling Highway. Comments related to oil and gas field infrastructure focused on future public use and restoration of associated roads, bridges, buildings, and pads after operations close.

Representative Comments

"[I'm concerned about . . .] maintaining the quality of the visitor experience, maintaining facilities (trails, campgrounds, roads, etc.) and wildlife habitat in an era of increased visitor use and shrinking budgets."

"If you are going to have trails then you need to maintain them to proper standards."

"Skilak Loop Road is usually a mess! Paving it would be an excellent option."

"I don't like to see pristine areas become developed on the Refuge. Every year more and more man-made infrastructure (roads, oil pads, pipelines, campgrounds, highways, utility ROW) impacts pristine natural areas."

"I don't like continued and expanded oil/gas development in the Refuge."

"The oil fields should be returned to wildlife habitat. The main road in the Swanson River area should be left for nonmotorized access for public recreation (including the use of mountain bikes for wildlife related recreation). Otherwise, rehabilitate all roads, bridges, pads."

Issue 3: How will the Refuge enhance wildlife-dependent recreation opportunities?

Summary of Comments

Members of the general public, the State of Alaska, and the planning team identified opportunities to improve wildlife-dependent recreation activities.

Representative Comments

"Non-commercial, personal use collecting should be permitted as an encouragement of enjoying nature's bounty and healthy wildlands. Commercial quantity and collecting for resale should continue to be prohibited."

Issue 4: How will the Refuge manage increasing public use to ensure protection of resources and visitor experience?

Summary of Comments

Members of the general public and the planning team raised concerns about increasing public use of Refuge resources. There is a sense that Refuge use has grown substantially since the development of the 1985 Plan and that such use has affected Refuge resources and visitor experiences. The Kenai River corridor and the Swanson River and Swan Lake Canoe System were specifically identified by the public as areas in need of additional management. The State of Alaska supports the need for additional development of public use facilities along the Kenai River to address resource impacts and to minimize public conflicts associated with crowding.

Representative Comments

"The proliferation of guides has put so many boats on the river that it's hard for me and my family to find a place to fish. They bring so many people and drop-offs just line the banks. It's just terrible. For peace and serenity fishing before 6:00 a.m. and after 9:00 p.m. is necessary. I'm ready to sell my boat! I'm disgusted!"

"People [are] loving it to death. The canoe trails are seeing a lot more traffic than in the past. Not everyone is good about cleaning up after themselves or as courteous as in the past."

"The burgeoning growth and development of tourism [is a problem]. Backcountry habitat degradation/fragmentation and displacement of wildlife are brought about by overuse from recreationists and an expanding human population in-state."

"Because of increasing population and a consequent rise in Refuge visitation you are going to see more habitat destruction and more frequent user conflicts in all areas."

Issue 5: How will the Refuge balance motorized access with protection of resources and visitor experiences?

Summary of Comments

Members of the general public, the State of Alaska, and the planning team raised concerns about various motorized access issues on the Refuge. Comments focused on snowmachines and aircraft. Snowmachine-related concerns focused on impacts on Refuge resources and visitor experiences, although a number of stakeholders stated their interest in maintaining access without additional restriction. Aircraft-related concerns focused on visitor experience impacts, although some stakeholders and the State of Alaska stated their interest in modifying the availability of landing sites in the Chickaloon Flats and Kenai Wilderness of the Refuge.

Representative Comments

"Too much area in the Refuge is closed to motorized access."

"There is increasing mechanized recreation and an inadequate effort to protect opportunities for 'quiet' users."

"Most of the Kenai Wilderness is closed to aircraft. This needs to change."

"Willow, Camp Fire, Duckling, Nest, Kayak, Yugok, and Arrow lakes should be included in the no-airplane motorized canoe system. So should the East Fork of the Moose and its string of lakes. These areas are easily accessed from the road system."

"Maintain existing snowmachine access. Access is allowed in high country of Caribou Hills, no access about timber on the Tustumena Bench."

"The cumulative recreational use of Caribou Hills snowmobile use is damaging and not traditional."

1.10 References

Executive Order 8979. 1941. 6 Federal Register 6471. Enacted Alaska (Kenai National Moose Range)

USFWS. 1985a. Kenai National Wildlife Refuge Final Comprehensive Conservation Plan, Environmental Impact Statement, and Wilderness Review. Anchorage, Alaska: U.S. Fish and Wildlife Service. 193 pp.

USFWS. 1985b. "Record of Decision: Kenai National Wildlife Refuge Comprehensive Conservation Plan, Environmental Impact Statement, and Wilderness Review." June 27, 1985. Anchorage, Alaska: U.S. Fish and Wildlife Service.

USFWS. "Service Manual." Accessed October 24, 2007. At http://fws.gov/policy/manuals.html on the World Wide Web, produced by U.S. Fish and Wildlife Service.

2. Alternatives, Goals, and Objectives

This chapter includes three major sections: 1) Alternatives; 2) Refuge Purposes; Goals, and Objectives; and 3) Management Policies and Guidelines. Section 2.1 presents five alternatives for managing Kenai Refuge, including continuation of current management (Alternative A) and the U.S. Fish and Wildlife Service's (Service) preferred alternative (Alternative E). Refuge purposes, goals and objectives, which provide focus for the management direction, are presented in section 2.2. They are followed by management policies and guidelines identified in section 2.3 and explained in further detail in Volume 2, Appendix C. This management direction incorporates both nation and Alaska specific direction and applies to refuges within the Alaska region specifically. It applies to all Alaska refuges unless modified to meet specific management needs for a particular refuge. The primary sources of this management direction are the laws governing the National Wildlife Refuge System (System) and the regulations, policies, and other national and regional guidance developed to implement the laws. If specific regulations or other guidance change while this plan is in effect, management direction for the Refuge would be modified as necessary to comply with the changes.

2.1 Alternatives

2.1.1 Process Used to Develop Alternatives

The alternatives described in this chapter were developed to comply with NEPA, ANILCA, and other pertinent laws. They provide different ways to address and respond to major issues, management concerns, and opportunities identified during the planning process. Alternatives take an interdisciplinary approach to problem solving by considering the physical, biological, economic, and social effects of the proposed actions on the environment.

Under regulations implementing NEPA, a plan must "rigorously explore and objectively evaluate all reasonable alternatives, and, for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated" (40 CFR 1502.14[a]). A reasonable alternative achieves, in large part, the agency's defined purpose and need and addresses significant issues.

As discussed in chapter 1, issues of concern to the public were identified from responses to planning updates and five public meetings. Five management alternatives were developed by the planning team with input received from the public. The alternatives were designed to meet Refuge goals, respond to identified issues, and encompass a range of options for addressing each issue. Each alternative had to be responsive to numerous laws and regulations governing management of the National Wildlife Refuge System, the mission and goals of the Service and the Refuge System, and the purpose for which Kenai Refuge was established.

Each alternative also had to embrace regional management direction. Although these considerations limited the range of potential alternatives, all input into the planning process was considered to achieve a reasonable range of alternatives incorporating differing approaches to resolving issues and accomplishing Refuge goals.

Four preliminary management alternatives were presented to the public for review in a planning update published on the Internet in March 2005. A number of public comments were received. Each major issue, activity, and management concern was discussed and evaluated by the planning team, but ultimately, only one significant change was made to the alternatives: a registration requirement for general public use in the Mystery Creek area would be implemented under Alternatives C and D. The planning team then began to analyze the alternatives to determine the potential environmental impacts associated with implementing them. In 2007, following the review of the impact analyses, the planning team developed a fifth alternative—the Service's preferred alternative—which included elements from each of the four preliminary alternatives.

2.1.2 Alternatives Considered But Eliminated from Detailed Study

Many potential actions were eliminated from further consideration because they were impractical, unfeasible, or too expensive to implement. Other actions were considered viable and were included in the development of preliminary management alternatives formulated by the planning team for early input from the public. Actions considered in preliminary alternatives but subsequently eliminated from detailed consideration include the following:

Issue: *Crowding on the Upper Kenai River*
Action Considered: Reducing the Number of Float Starts by Commercial Guides

Public use studies conducted by the Refuge and the Kenai Fish and Wildlife Field Office were conducted on the Upper Kenai River in 1994, 1999, and 2004 to determine the types and levels of use on the river. The results of these studies indicate that the principal and increasing use is by private, non-commercial watercraft consisting of either inflatable rafts or drift boats (chapter 3, section 3.4.6). As such, limiting commercial use alone would not address the crowding issue. Although reducing the number of commercial starts would reduce the number of guided boats on the river at any given time, this alternative was eliminated from further consideration because it wasn't the most effective management action the Refuge could take to address crowding.

Issue: Airplane Access to Lakes in Designated Wilderness
Action Considered: Developing Management Objectives for Trumpeter Swans

An alternative to identify specific management objectives for trumpeter swan populations was eliminated from further consideration because the

primary purpose of the Refuge is to conserve fish and wildlife populations and their habitats in their natural diversity. Natural diversity implies allowing wildlife populations to vary naturally over time (i.e., not sustaining them at artificially high levels through management activities or allowing population declines due to management activities). Consequently, development of specific population objectives for trumpeter swans would be inconsistent with Refuge mandates.

Issue: Airplane Access to Lakes in Designated Wilderness
Action Considered: Providing Airplane Access Later in the Season

An alternative to allow airplane access to lakes after mid-September was eliminated from further consideration because trumpeter swan broods are still flightless 13–15 weeks after hatching, resulting in many broods not fledging until well into September. Allowing airplane access during the suggested time period would lead to premature brood breakup and poor survivorship because brood success is poor prior to fledging.

Issue: Airplane Access to Lakes in Designated Wilderness
Action Considered: Phasing the Opening of Lakes and Studying the Impacts to Trumpeter Swan Broods

An alternative to allow a phased opening of lakes to airplane access in conjunction with research studies designed to assess the impacts of such access on trumpeter swan brood success was eliminated from further consideration because additional research was not deemed justifiable. A preponderance of studies already exists which identify the negative impacts of airplane disturbance on broods. Furthermore, current management strategies demonstrate the positive effects on swan populations (i.e., the number of breeding swan pairs has increased from less than 40 pairs to more than 60 pairs since 1985) (see section 3.3.8.3).

Issue: Airplane Access to Uplands
Action Considered: Providing Access to the Funny River Airstrip, and North and South Alaska Pipeline airstrips

An alternative to consider opening the Funny River Airstrip, and North and South Alaska Pipeline airstrips to facilitate airplane access to upland areas was eliminated from further consideration because the Funny River airstrip was not a constructed strip, but rather an upland landing area that was closed to use over 40 years ago due to resource concerns. The area has naturally revegetated and is largely not discernable to the casual observer as an airstrip. The North and South Alaska Pipeline airstrips were constructed airstrips along the Mystery Creek pipeline corridor to help facilitate pipeline construction. They have become part of the largely unmaintained route with highway vehicles driving on them in summer and fall and snowmachines and dog teams using them in winter. These old airstrips were designed for industrial purpose access and not with public use in mind. They would have inherent safety concerns associated with airplane use and do not provide critical access to

inaccessible areas. Additionally, the pipeline operator has expressed concerns about vandalism to their industrial infrastructure and has requested restricted access on their right-of-way.

Issue: Snowmachine Access
Action Considered: Providing Snowmachine Access to Canoe Systems

An alternative to consider opening the Swanson River and Swan Lake canoe systems to snowmachine access was eliminated from further consideration because snowmachine use has been and is currently permitted on 1.25 million acres (64 percent) of the Refuge. Such use has been managed for decades to balance visitor interests and resource protection needs. The canoe systems have been closed to snowmachine use since the 1970s, pre-dating ANILCA and Wilderness designation. Public sentiments range from providing more liberal snowmachine use to reducing it, largely dependent upon individual personal values. No information currently available suggests the Refuge should look at opening or closing specific additional areas to snowmachine use beyond what has been historically allowed. The range of alternatives accepted for this planning process, however, do include an alternative that would examine this issue—evaluate use patterns, intensity, and impacts of snowmachine use—the results of which could conceivably propose additional open areas, such as part or all of the canoe systems, or perhaps additional closures, such as restrictions in the Caribou Hills.

Issue: Use of Canoe Carriers
Action Considered: Allowing Canoe Carriers in the Canoe Systems

An alternative to consider allowing wheeled canoe carriers throughout the canoe systems was eliminated because wheeled carts are currently prohibited on the Refuge except on roads designated and open for public vehicular access (50 CFR 36.39 [i] [7] [v]). While wheeled carts might be useful on some trails, variable trail standards, soil types, and other factors likely make them inappropriate or impractical in many areas. Any consideration of wheeled carts would require a detailed inventory and analysis of current trail conditions and uses to ensure the continued protection of resources and visitor experiences. That level of detail is best provided in a specific, step-down management plan rather than this Revised Comprehensive Conservation Plan. For these reasons, this alternative was eliminated from further consideration. However, the Refuge-wide trails assessment proposed as part of this plan will provide the needed foundation for making informed decisions about if and where to allow wheeled carts in the future.

Issue: Wild and Scenic River Recommendations

As a result of concerns expressed by the State of Alaska and subsequent analysis of those concerns by the Service, alternatives that would have recommended that Congress consider rivers for inclusion in the National Wild and Scenic Rivers System were considered but eliminated from

detailed study. In compliance with section 304 (g) of ANILCA, special values of the Refuge, including river-related values, are discussed in chapter 3; however, recommendations for designations are not included in the range of alternatives. Current and proposed management direction provides adequate protection for all river-related values.

Issue: Wilderness Recommendations

As a result of concerns expressed by the State of Alaska and subsequent analysis of those concerns by the Service, alternatives that would have recommended that Congress consider lands for inclusion in the National Wilderness Preservation System were considered but eliminated from detailed study. The Service has a recommendation for Wilderness designation (approximately 195,500 acres) from the Supplemental Environmental Impact Statement for the Wilderness Proposal of the Final Kenai Comprehensive Conservation Plan/Environmental Impact Statement/Wilderness Review (USFWS 1988). This recommendation will remain in effect unless withdrawn or until submitted to Congress. Wilderness values are discussed in chapter 3, but recommendations for additional designations are not included in the range of alternatives. Current and proposed management direction provides adequate protection for all wilderness values.

2.1.3 Elements Common to All Alternatives

This section identifies some of the key elements that will be included in the Comprehensive Conservation Plan regardless of the alternative selected. Each of the alternatives would do the following:

- Contribute to achieving the purposes for which the Refuge was established, as set forth in Executive Order 8979 (December 16, 1941), and section 303(4)(B) of ANILCA
- Ensure that rural residents have access to and priority use of Refuge resources for the purposes of subsistence, as determined by law
- Ensure that Refuge management complies with all other Federal laws and regulations that provide direction for managing units of the National Wildlife Refuge System
- Protect and maintain fish and wildlife in their natural diversity
- Maintain opportunities to pursue traditional subsistence activities; scientific research; and hunting, fishing, and other wildlife-dependent recreation activities
- Maintain most of the Refuge in a relatively undeveloped state
- Minimize disturbances to fish and wildlife habitats and populations
- Allow public use of the Refuge using traditional access methods, provided use remains compatible with the purposes of the Refuge

2.1.4 Management Direction Common To All Alternatives

This section identifies management direction that has not been identified in either the management direction table (Volume 2, Appendix C, table C-1) or in the range of proposed management alternatives (Table 2-12). This management direction will be implemented regardless of which alternative is ultimately selected.

2.1.4.1 Beetle Kill Trees/Fire Safety

Spruce bark beetle outbreaks will not be managed. However, the Refuge will continue its collaborative interagency efforts to promote wildfire safety and implement wildfire mitigation principles on Refuge lands, especially in wildland urban interface areas.

Beetle killed trees constitute a large fuel base that can contribute to large wildfires. Other fuels such as mature black spruce can also drive large fire events. Although the Kenai area has a long history of natural fires, with increases in human population and the growing urban interface, large uncontrolled wildfires constitute a risk to the public. Managing these fuels through prescribed fire, mechanical treatments, and appropriate management responses to naturally ignited fires is necessary to mitigating threats to communities. There are risks, such as smoke or escaped fires, involved with many of these management tools.

2.1.4.2 Cultural Resources Management

Cultural resources management will be enhanced through cooperative research, planning and education efforts, and increased law enforcement presence.

2.1.4.3 Existing Oil and Gas Units

Industrial facilities will operate under current State and Federal regulations. Facility operators will prevent, to the maximum extent possible, releases of hazardous materials and substances, crude oil, and produced water. Each facility will have a current oil discharge prevention and contingency plan outlining procedures for accidental releases. Sampling, remediation, and restoration of contaminated sites will be the responsibility of the company operating the facility and will occur in consultation with the Service and the Alaska Department of Environmental Conservation (ADEC). All sites no longer being used by industry will be sampled for contaminants to ensure proper disposal of material and to ensure that Refuge staff or visiting public are not exposed to contaminants if re-use is planned.

2.1.4.4 Integrated Research and Monitoring

An integrated research and monitoring program will provide opportunities for scientific research. An enhanced informational infrastructure will be developed, including a state-of-the-art Geographic Information System, an enhanced air and water quality and meteorological monitoring network, permanent research study sites, and a multi-species landscape-level

inventorying and monitoring program. Collaborative research and monitoring opportunities will be pursued through the development of a Boreal Forest Research, Monitoring, and Management Training Program (see Land Management Training Facility).

2.1.4.5 Kenai River Scenic Float Trip Guides

Kenai River scenic float trip guides will continue to be limited to no more than nine permits issued through a competitive bid process, and of which no more than four would be high volume businesses as described in the prospectus. Numbers of permits and conditions to reduce crowding would be reviewed and revised annually before each open bid process. Incidental use permits for scenic float trips, similar to sportfishing incidental use permits, would continue to be issued (to include blackout dates and quotas to avoid crowding during high use periods).

2.1.4.6 Land Management Training Facility

A Boreal Forest Research, Monitoring, and Management Training Facility will be developed that provides classroom and field opportunities to learn state-of-the art monitoring and management methodologies. The facility will be available for use by Service personnel and other Federal and State agencies, organizations, and academic institutions. A nonprofit research institute will be created to promote and coordinate research efforts.

2.1.4.7 Law Enforcement

Law enforcement presence will be increased Refuge-wide by implementing the Service's deployment model.

2.1.4.8 Moose Range Meadows Non-Development Easement

Regulations will be developed to provide landowners with a clear description of the affected lands, concise definitions of the easement and its conditions, and unambiguous language relating to non-development restrictions.

2.1.4.9 Skilak Wildlife Recreation Area

The 44,000-acre Skilak Wildlife Recreation Area, where special restrictions on hunting and trapping apply, will be managed to provide enhanced opportunities for wildlife viewing, environmental education, interpretation, and photography.

2.1.4.10 Subsurface Entitlements to Minerals

Any new development where subsurface entitlements exist or in the Birch Hill Oil and Gas Unit would be designed and constructed to have the least negative environmental impact possible. Once exploration and/or production ceases, all industrial roads, pipelines, and other related facilities will be completely removed and the area restored.

Industry would be required to investigate, and if necessary, test suspected contaminated sites to confirm the existence and identity of contaminates

and to remediate and restore the sites as necessary. Remediation and/or restoration would be to standards agreed upon by the Alaska Department of Environmental Conservation (ADEC), Bureau of Land Management (BLM), Fish and Wildlife Service (FWS), and the site owner or operator.

2.1.4.11 Visitor Center

A visitor center with the capacity to serve 150 visitors will be constructed in the headquarters area.

2.1.4.12 Wildlife/Habitat Restoration

Ongoing methods for assessing the distribution and status of multiple species at the landscape level to ensure against local extirpation of wildlife will continue. New trajectories for species distributions and abundance due to global climate change and changes in natural processes (wildfire and spruce bark beetle rates) will continue to be modeled. Exotic, injurious, and invasive species will be eliminated, controlled, or minimized through development of a comprehensive step-down management plan. Research will be promoted that evaluates possible endemism in flora and fauna, particularly brown bear and wolverine. Marten and red fox populations will continue to be evaluated in the absence of active management, and restoration opportunities will be identified and implemented as appropriate.

2.1.5 Alternative A—Current Management

This alternative, the "no-action alternative," describes current and future management of the Refuge assuming present actions and initiatives are carried forward. It provides the baseline against which to compare the action alternatives (Alternatives B–E).

2.1.5.1 General Management Direction

Management of the Refuge would continue to follow the 1985 Kenai National Wildlife Refuge Comprehensive Conservation Plan (USFWS 1985a) and Record of Decision (USFWS 1985b) as amended by subsequent step-down management plans. The majority of the Refuge (76%) would continue to be managed to protect wilderness values. This includes the 66.4% of the Refuge which is designated Wilderness and the 9.7% of the Refuge which is classified Minimal management. The lands in Minimal management have been recommended for Wilderness designation. Fish and wildlife management outside Wilderness would continue to focus on species of special interest such as moose, wolves, trumpeter swans, and salmon. Populations of predators would be maintained at relatively natural levels in relation to prey. Hunting, fishing, and trapping would continue to be allowed consistent with State and Federal regulations.

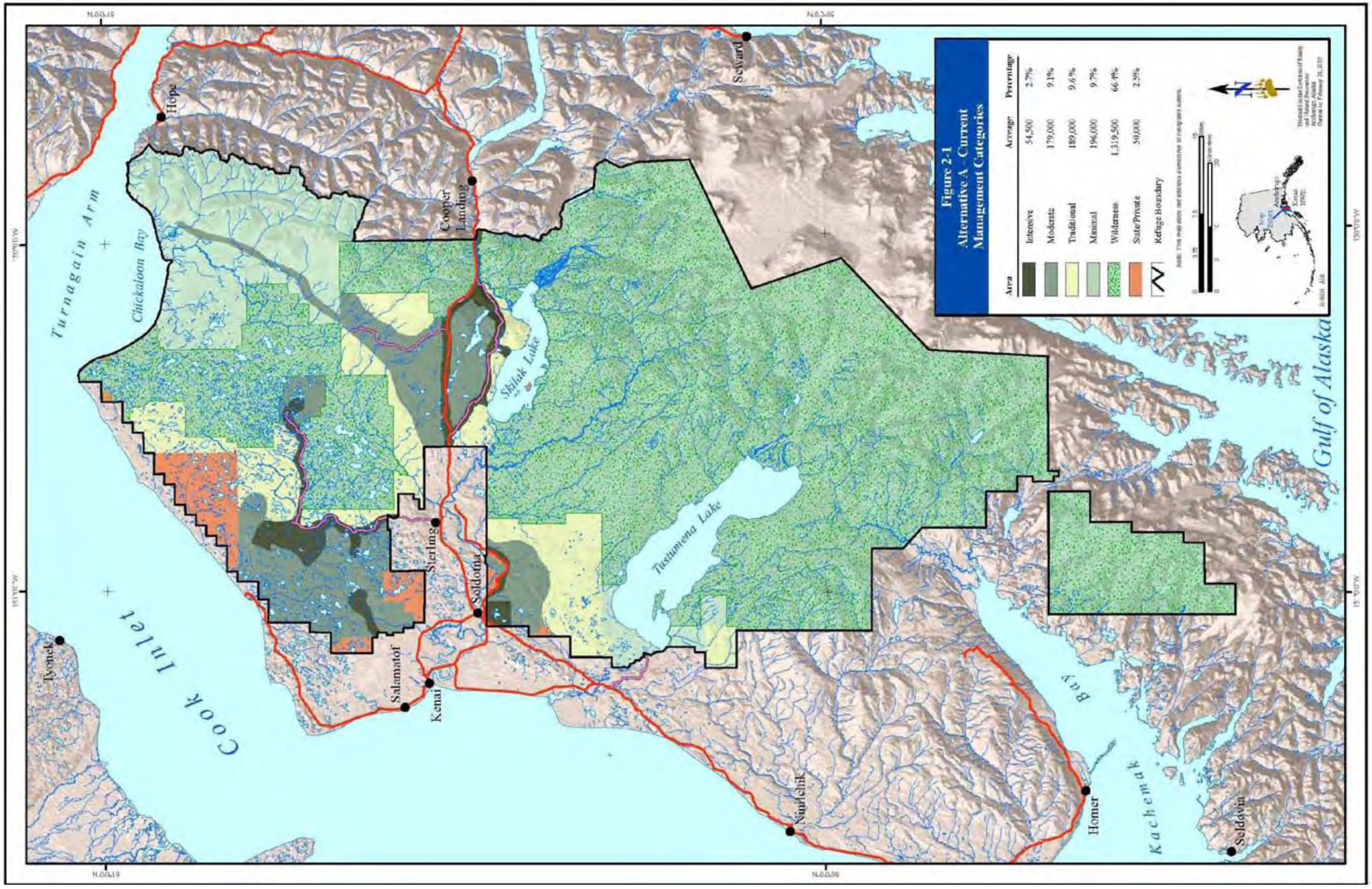

Figure 2-1. Alternative A - Current Management Categories

2.1.5.2 Management Categories

Kenai Refuge would continue to be managed under five management categories (Figure 2-1). For information about management of these lands see Volume 2, Appendix C, section 1.2.

Intensive Management – This least protective category encompasses areas of high public use and development. Natural processes are modified, and the influence of human activities is evident. Public facilities, administrative sites, industrial development, and transportation systems are allowed in this category. Approximately 54,500 acres (2.7 percent) of land will be managed under the Intensive management category.

Moderate Management – This category manages areas easily accessible to the public and manipulates a significant amount of habitat to benefit populations of selected species (principally moose). Although some natural processes are altered, habitat management is designed to maintain natural andscapes. Permanent facilities may be provided for public recreation or public safety. Approximately 179,000 acres (9.1 percent) of land will be managed under the Moderate management category.

Traditional Management – This category encompasses undeveloped areas where habitat and public use are managed to provide a mixture of benefits in a natural setting. No roads occur within this category. Management of forest habitats relies on natural tools such as prescribed burning with no mechanical manipulation of commercial timber harvest. Approximately 189,000 acres (9.6 percent) of land will be managed under the Traditional management category. Table 2-1 depicts the differences between the Traditional and Minimal management categories.

Minimal Management – Management under this category would be directed at maintaining the pristine conditions of areas that have important fish and wildlife and wilderness values. These areas generally would not be subject to planned habitat manipulation. Restrictions are placed on motorized access, recreation, and economic uses. Lands in this category represent the Service's recommendations for future Wilderness designation. Approximately 196,000 acres (9.7 percent) of land will be managed under the Minimal management category.

Table 2-1. Differences Between Traditional and Minimal Management Under Alternative A

Land Management Activity	Traditional Management Category	Minimal Management Category
Prescribed Fire	Permitted	Restricted to the protection of life or property or significant resource value
Sand and Gravel Removal	Permitted on a site-specific basis for use on Refuge subject to reasonable regulation	Not Permitted
Oil and Gas Exploration	Permitted on a site-specific basis subject to reasonable regulation	Not Permitted
Oil and Gas Leasing	Permitted on a site-specific basis subject to reasonable regulation	Not Permitted

Wilderness Management – This category includes those areas of the Refuge currently designated as Wilderness. It preserves the pristine and unmodified character of these areas. Natural fish and wildlife population dynamics and habitats are emphasized, although regulated hunting, fishing, and trapping is allowed. Motorized access is permitted for traditional activities subject to reasonable regulations to protect natural resources, including wilderness values. Regulations limiting motorized access on Kenai Refuge, including Congressionally-designated Wilderness, can be found at 50 CFR 36.39(i). This management category is the most protective. Approximately 1,320,500 acres (66.4 percent) of land will be managed under the Wilderness management category.

2.1.5.3 Management Direction Identified By Issue

The following discussion describes how Alternative A would address the issues identified during the scoping process. It provides management direction for major Refuge programs as they would be implemented under the alternative.

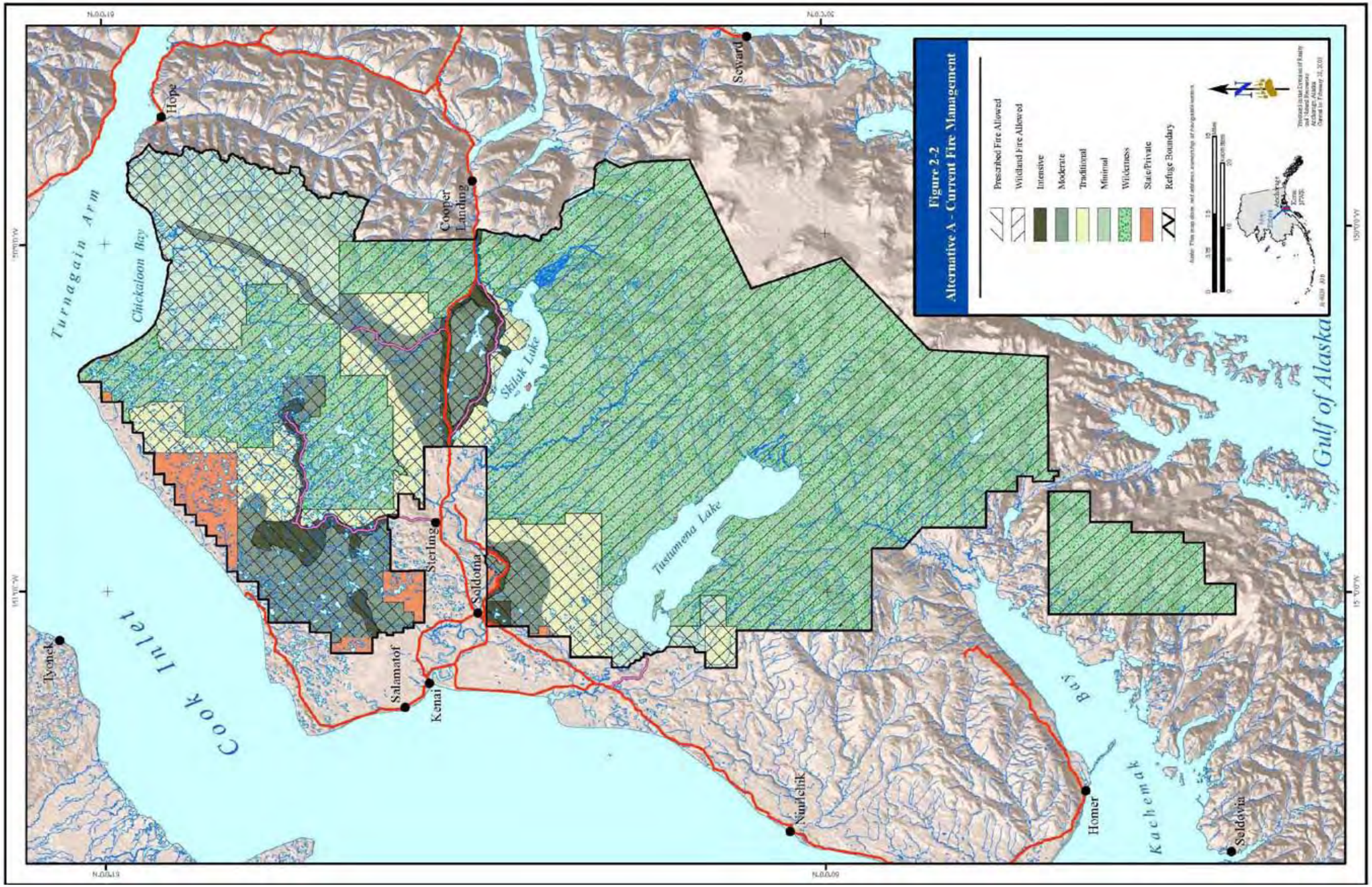

Figure 2-2. Alternative A - Current Fire Management

Issue 1: How will the Refuge address large-scale habitat changes and the use of fire?

Fire Management Program

Use of Fire as a Management Tool

Management direction would allow prescribed fire, use of wildland fire, and mechanical treatments to improve habitats for select wildlife species (Figure 2-2).

Prescribed fire would be allowed in the Intensive, Moderate, Traditional, and Minimal management categories (approximately 618,500 acres or 31percent of the Refuge), though its use would be limited in the Minimal management category (approximately 196,000 acres or 9.7 percent of the Refuge).

Use of wildland fire would be allowed in the Moderate, Traditional, Minimal, and Wilderness management categories (approximately 1,883,500 acres or 95 percent of the Refuge). Undesirable wildfires (i.e., those not contributing to Refuge management goals) would be suppressed through the use of an "appropriate management response."

Issue 2: How will the Refuge manage facilities for public use while ensuring natural resources protection?

Facilities Program

Swanson River Oil and Gas Unit

Industrial roads, pipelines, and facilities may be authorized in support of exploration, discovery, development, and production of oil and gas found within the unit by the current unit operator. Such operations would be subject to prior approval of the Fish and Wildlife Service (FWS). An annual Plan of Development and Operations would be required from each unit operator. The Plan would be reviewed by the FWS for comment, and approved by the BLM authorized officer (AO). The AO's approval, with the FWS's concurrence, of specific operations must be obtained prior to commencement of such operations. During the life of the project, the Refuge would request, on a case-by-case basis, that industrial roads, pipelines and associated fixtures, and facilities not needed to support ongoing operations be removed and the sites restored.

After the life of the project, most industrial roads and facilities may be removed and the sites restored, though some industrial roads and facilities may be retained for possible public and administrative uses at the Refuge manager's discretion. If roads are retained and vehicles are allowed on those roads, bicycles would be allowed. Bicycles would not be allowed otherwise, and camping facilities would not be provided.

Beaver Creek Oil and Gas Unit

Same as *Swanson River Oil and Gas Unit* (see previous text).

Contaminated Sites

Industrial facilities would be required to operate in compliance with applicable Federal and State environmental statues and regulations, known contaminant releases will be cleaned up in a timely manner, and areas no longer in use will be restored to predevelopment conditions.

Mystery Creek Road and Pipeline Corridor

Maintenance of the unimproved access road from the Sterling Highway to the Alaska Pipeline corridor would be conducted by ENSTAR during the life of the project. Public use of the area would not require registration, and vehicle use of the unimproved access road and Alaska Pipeline corridor north to Chickaloon Bay would be allowed from the start of moose hunting season (approximately August 9) until snow cover. Pedestrian and horse use would be allowed year-round with no seasonal restrictions. Snowmachine use would be allowed when the Refuge manager determines there is adequate snow cover and when adjacent areas are open. Bicycle use would be allowed when the access road and Alaska Pipeline corridor are open to public vehicle use (approximately August 9 until snow cover). After the life of the pipeline project, the unimproved access road and Alaska Pipeline corridor would be restored at the discretion of the Refuge manager.

Ski Hill Road

If the State of Alaska Department of Transportation and Public Facilities continues to maintain the graveled road on an irregular basis, the Refuge would continue to conduct grading and plowing on an "as needed" basis. The northern and southern routes would remain open to pedestrian, bicycle, and public vehicle use.

Sterling Highway Pullout

Maintenance of the undeveloped pullout at milepost 62 would not be conducted, and public use facilities would not be provided.

Trail Maintenance and Planning

The development of new trails would be allowed in all management categories except Wilderness. New trails would be only developed in response to a documented need and when compatible with Refuge purposes. Maintenance decisions would be driven by availability of funding.

Issue 3: How will the Refuge enhance wildlife-oriented recreation opportunities?

Visitor Services Program

Personal Collection of Natural Resources

Personal collection of berries, mushrooms, other edible plants, and/or shed antlers would not be allowed by regulation 50 CFR 27.51 and 27.61, which generally prohibits such activities.

Christmas Tree Harvesting

Harvesting one black or white spruce tree no larger than 20 feet in height at least 150 feet from roads, trailheads, campgrounds, picnic areas, and waterways per family per year between Thanksgiving and Christmas Day for personal use would be allowed upon general announcement.

Issue 4: How will the Refuge manage increasing public use to ensure resource and visitor experience protection?

Visitor Services Program

Swanson River/Swan Lake Canoe Systems

All canoeists would be required to register at entrance points. Maximum group size would be limited to 15 individuals without a special use permit. Dispersed camping would be allowed but may not exceed 14 days in any 30-day period.

Upper Kenai River (Russian River to Skilak Lake)

Non-Guided Public Use — Non-guided public use would be allowed without restriction.

Guided Use: Sportfishing — Special use permits would be required for sportfishing guides. Permits issued would be limited to 20. Each permit would allow 10 starts per week with no more than 4 starts per day. Additional restrictions may be imposed if demand for commercial recreational services increases.

Guided Use: Sportfishing Incidental Use Program — State-licensed sportfishing guides not having Refuge special use permits may be issued incidental use permits for as many as three trips per year, subject to quotas and blackout dates.

Camping — Dispersed camping would be allowed but may not exceed 14 days in any 30-day period. Camping would not be allowed within one-quarter mile of the Sterling Highway.

Middle Kenai River (Skilak Lake Downstream to Refuge Boundary)

Non-Guided Public Use — Non-guided public use would be allowed without restriction on the number of users.

Guided Public Use: Sportfishing — Special use permits would be required for sportfishing guides. Permits would be issued without limit.

Issue 5: How will the Refuge balance motorized access with protection of resources and visitor experiences?

Airplane Access to Lakes in Designated Wilderness

Airplane access would be allowed on 46 lakes in designated Wilderness (Figure 2-3and Figure 2-4).

- Dave Spencer Unit: Scenic, Nekutak, Shoepac, Norak, Grouse, King, Bedlam, Taiga, Snowshoe, Wilderness, Mull, Tangerra, Bird, Cook, Sandpiper, and Vogel lakes, plus Pepper, Gene, and Swanson lakes would be open for ice fishing only.
- Andy Simons Unit: Upper Russian, East Twin, West Twin, Emerald, High, Dinglestadt Glacier terminus, Lower Russian, Iceberg, Green, North Kolomin, South Kolomin, Wosnesenski Glacier terminus, Pothole, Harvey, Martin, Windy, Tustumena and all wilderness lakes within one mile of the shoreline of Tustumena Lake (Fox, Nikolai, and Point lakes), and all unnamed lakes in sections 1 and 2, T. 1 S., R. 10 W, and sections 4, 5, 8, and 9, T. 1 S., R 9 W., Seward Meridian, AK (six lakes).
- Mystery Creek Unit: An unnamed lake in section 11, T. 6 N., R. 5 W., Seward Meridian, AK.

Airplane access would not be allowed from May 1 through September 30 on any lake where nesting trumpeter swans and/or their broods are present except on two lakes in designated Wilderness—Scenic Lake, located within the Dave Spencer unit of the Kenai Wilderness, and Windy Lake, located within the Andy Simons unit of the Kenai Wilderness, where the closure would be May 1 through September 10.

Airplane Access to the Chickaloon Flats Area

Wheeled airplane access would be allowed year-round within designated areas including three upland landing zones, a designated beach landing zone, and the unmaintained Big Indian Creek airstrip; and floatplane access would be allowed on 6.5 miles of the Chickaloon River (Figure 2-5).

Snowmachine Access

Snowmachines less then 46 inches in width and less than 1,000 pounds in weight would be allowed in designated areas from December 1 through April 30 if the Refuge manager determines that there is adequate snowcover to protect underlying vegetation and soils.

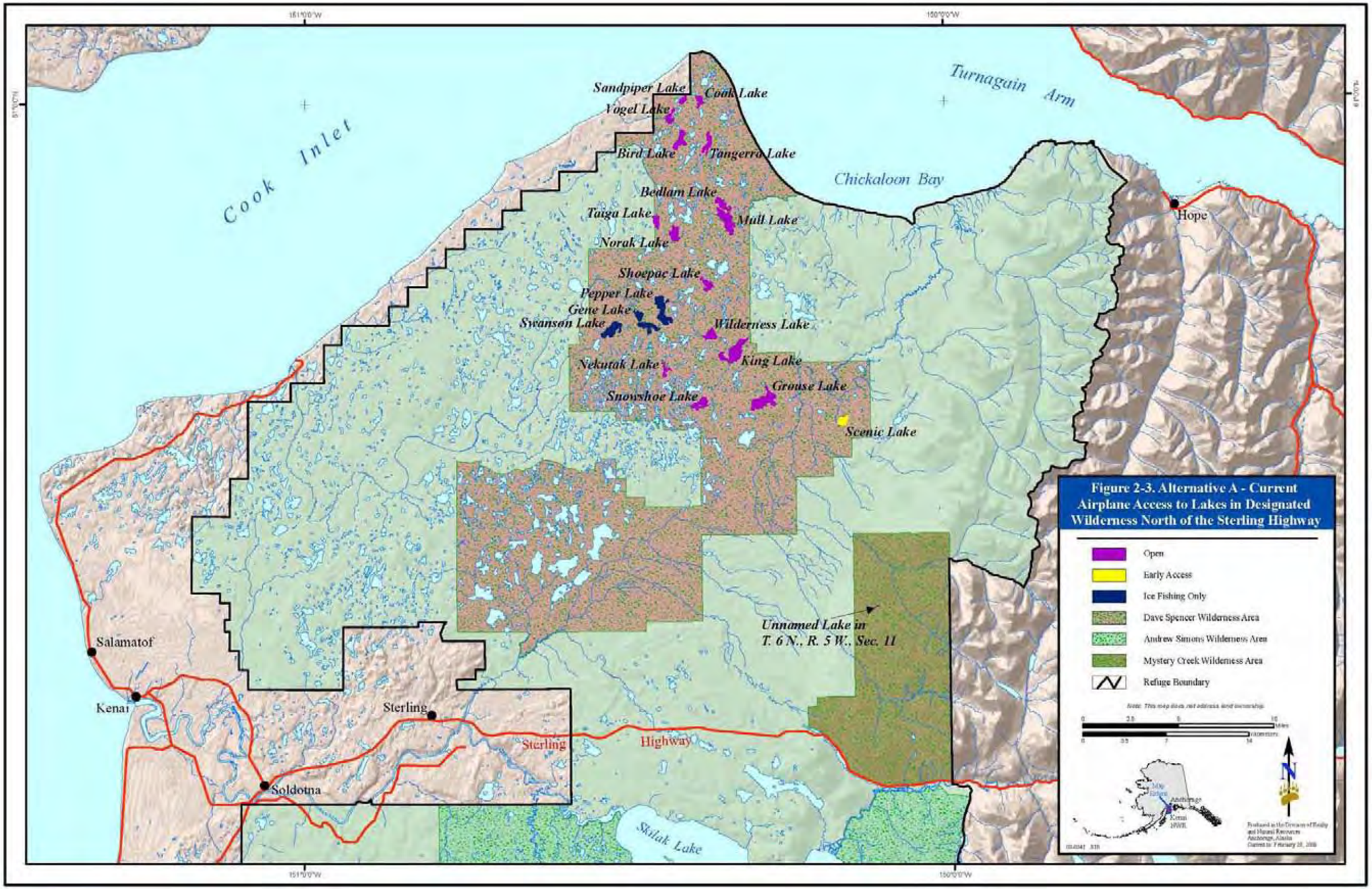

Figure 2-3. Alternative A - Current Airplane Access to Lakes in Designated Wilderness North of the Sterling Highway

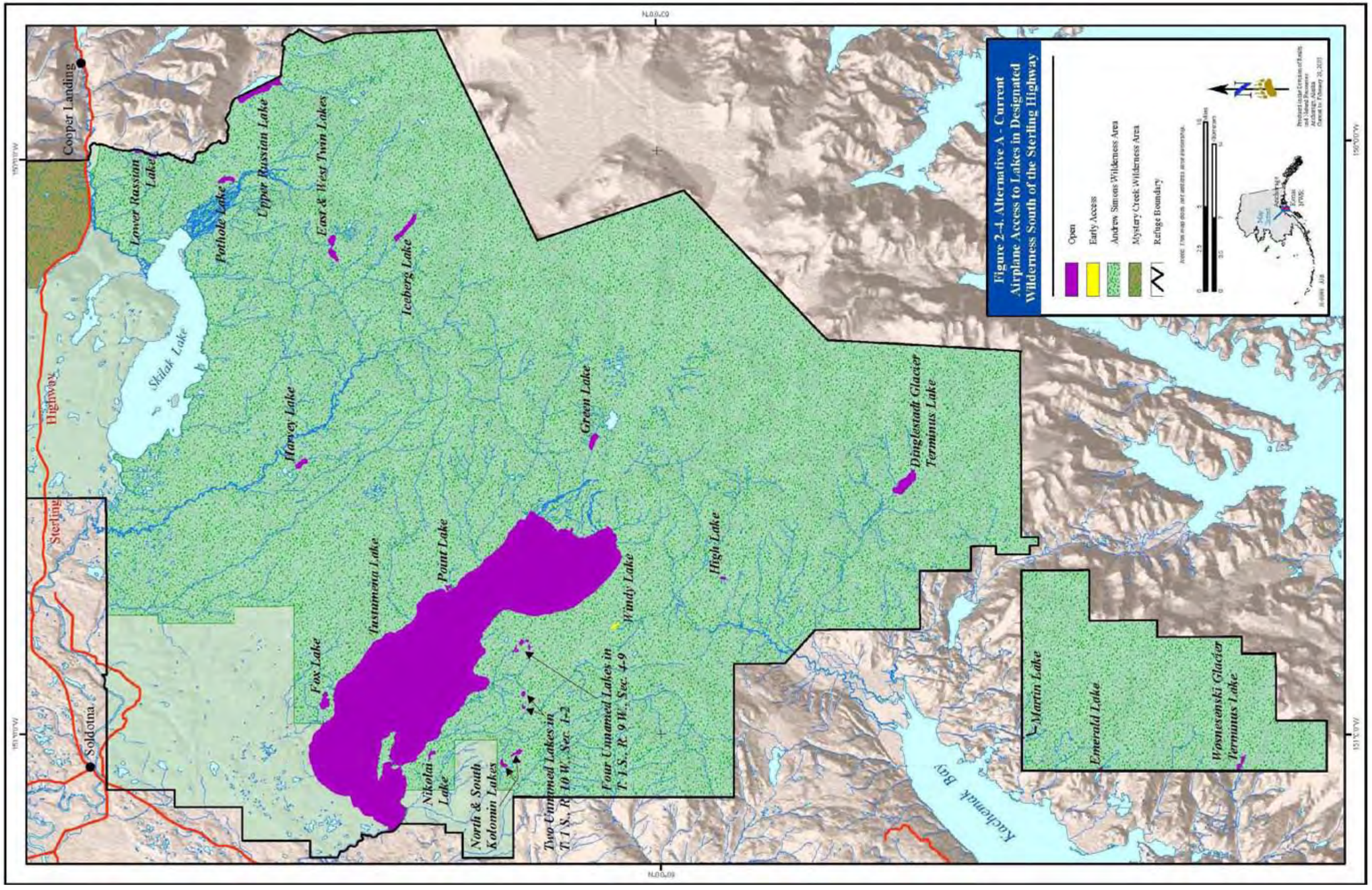

Figure 2-4. Alternative A - Airplane Access to Lakes in Designated Wilderness South of the Sterling Highway

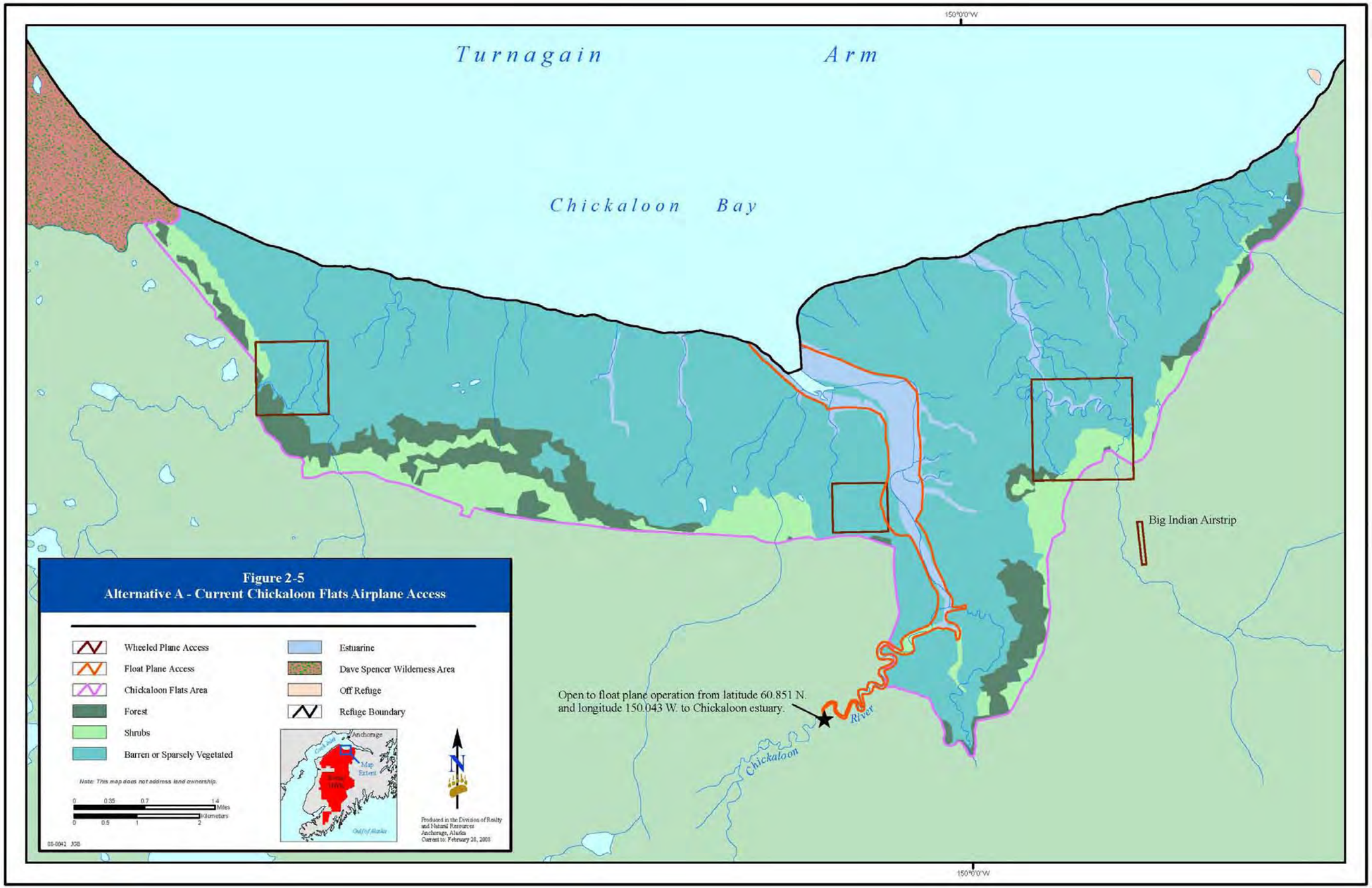

Figure 2-5. Alternative A - Current Chickaloon Flats Airplane Access

2.1.5.4 Funding and Personnel Requirements

Base Funding

The base Refuge operational budget in fiscal year (FY) 2007 was $3,245,000. Additional funds necessary to operate Refuge programs were received for annual maintenance ($312,000), one-time operations ($390,000), and fire operations ($528,000). To maintain the current level of services, adjustments will be necessary to balance the offsets of fixed costs and inflation. Current funding levels are inadequate to fully implement existing biological and visitor services programs, and the one-time operations addition was necessary to operate at FY 2005 levels.

Table 2-2reflects the funds necessary to implement Alternative A. The figures demonstrate the level of funding needed to maintain programs plus inflation adjustments for the short term. Long-term adjustments to the base budget reflect not only short-term adjustments, but also implementation of projects currently identified in the Refuge Operations Needs System (RONS) database. These figures represent the funding and accomplishment of established goals and objectives previously identified.

Table 2-2. Alternative A Budget Needs

Item	Short-Term Needs (1 – 3 Years)	Long-Term Needs (3 – 15 Years)
Refuge Operations	$3,635,000	$14,216,410
Annual Maintenance	$360,000	$1,620,000
Fire Funding	$1,120,000	$5,653,000
Total Annual Budget Needs	**$5,115,000**	**$21,489,410**

RONS/SAMMS Projects

RONS is the mechanism that the Refuge uses to justify needed funds and personnel for new programs and for projects necessary to meet legal mandates, Refuge plans, and U.S. Department of the Interior and Service directives. This Internet accessible database is used by all refuges to compete for dollars to adequately fund programs. The identified projects are needed to:

1. Continue implementation of projects initially identified in the Refuge's 1985 Comprehensive Conservation Plan,
2. Continue implementation of projects identified in approved Refuge step-down management plans,
3. Meet approved Refuge goals and objectives necessary for the Refuge to achieve establishment purposes,
4. Meet legal mandates,

5. Implement approved ecosystem goals,
6. Implement approved partnership programs necessary to benefit Refuge resources.

The needs currently listed in Kenai's RONS database date back to 1985; there are 50 projects totaling $10,747,000 and 25 new staff positions.

The Service Asset Maintenance Management System (SAMMS) is a database the Refuge uses to document and justify significant maintenance projects and equipment replacement. Kenai's SAMMS project list currently has 253 projects identified for a total of $50,142,000.

Other

Management of oil and gas related activities on the Refuge is a time consuming and difficult process necessary to meet the Service's legal obligations for Federal leases. In FY 2007, it is estimated that oil and gas management costs amounted to approximately $300,000. This includes costs associated with aircraft and vehicle utilization, personnel, and travel for meetings and site inspections. This program has never been fully funded at the current level of management.

Current and Additional Staffing Needs

In FY 2007, Kenai Refuge had a staff size of 118 employees and volunteers: 35 permanent full-time employees, 8 permanent seasonal employees, 12 temporary seasonal employees, and 63 volunteers. Table 2-3 identifies the number of staff needed beyond current levels to fully implement Alternative A.

Table 2-3. Alternative A Staffing Needs Beyond Current Levels

Action Type	Short-Term Needs (1 – 3 Years)	Long-Term Needs (3 – 15 Years)
Permanent Full-Time Employees	5	20
Permanent Seasonal Employees	4	14
Temporary Seasonal Employees	25	45
Volunteers	20	60

2.1.6 Alternative B

2.1.6.1 General Management Direction

Although most of the general management direction described in Alternative A would continue, some specific direction and actions occurring under current management would be altered under Alternative B. The following discussion identifies management direction proposed under Alternative B. Additionally, the Refuge Goals and Objectives presented in section 2.2 and the Management Direction, Policies, and Guidelines presented in Volume 2, Appendix C apply to this alternative.

2.1.6.2 Management Categories

Four management categories would be applied to Kenai Refuge under Alternative B (Figure 2-6).

Intensive Management – Approximately 54,500 acres (2.7 percent) of land would be managed under the Intensive management category.

Moderate Management – Approximately 204,000 acres (10.3 percent) of land would be managed under the Moderate management category.

Traditional Management – This category would be eliminated. Of the 189,000 acres of land currently identified as Traditional management, approximately 25,000 acres would convert to the Moderate management category, and 164,000 acres would convert to the Minimal management category.

Minimal Management – Approximately 360,000 acres (18.1 percent) of land would be managed under the Minimal management category.

Wilderness Management – Approximately 1,320,500 acres (66.4 percent) of land would be managed under the Wilderness management category.

2.1.6.3 Management Direction Identified By Issue

The following discussion describes how Alternative B would address the issues identified during the scoping process. It provides management direction for major Refuge programs as they would be implemented under the alternative.

Issue 1: How will the Refuge address large-scale habitat changes and the use of fire?

Fire Management Program

Use of Fire as a Management Tool

Management direction would allow prescribed fire, use of wildland fire, and mechanical treatments as the principle management tools to improve wildlife habitats, reduce hazardous accumulations of wildland fuels, and maintain or restore natural fire regimes (Figure 2-7).

Prescribed fire would be allowed in the Intensive and Moderate management categories (approximately 258,500 acres or 13 percent of the Refuge), and in the Minimal management category (approximately 360,000 acres or 18 percent of the Refuge) but only on lands not adjoining designated Wilderness.

Use of wildland fire would be allowed in the Minimal and Wilderness management categories (approximately 1,679,500 acres or 84.5 percent of the Refuge). Undesirable wildfires (i.e., those not contributing to Refuge management goals) would be suppressed through the use of an "appropriate management response."

Issue 2: How will the Refuge manage facilities for public use while ensuring natural resources protection?

Facilities Program

Swanson River Oil and Gas Unit

Industrial roads, pipelines, and facilities may be authorized in support of exploration, discovery, development, and production of oil and gas found within the unit by the current unit operator. Such operations would be subject to prior approval of the U.S. Fish and Wildlife Service. An annual Plan of Development and Operations would be required from each unit operator. The Plan would be reviewed by the Service for comment and approved by the BLM authorized officer (AO). The AO's approval, with the Service's concurrence, of specific operations must be obtained prior to commencement of such operations. During the life of the project, the Refuge would request, on a case-by-case basis, that industrial roads, pipelines and associated fixtures, and facilities not needed to support ongoing operations be removed and the sites restored.

After the life of the project, all industrial roads (except the Swanson River Road); pipelines and associated fixtures, regardless of whether they are located along industrial roads, on gravel well pads, or traverse the landscape; and all facilities built to support oil and gas operations would be removed and the sites restored to match the surrounding landscape. No industrial roads or facilities built to support oil and gas operations would be retained for public and/or administrative uses. Camping facilities would not be provided, and bicycles would not be allowed.

Beaver Creek Oil and Gas Unit

Same as *Swanson River Oil and Gas Unit.*

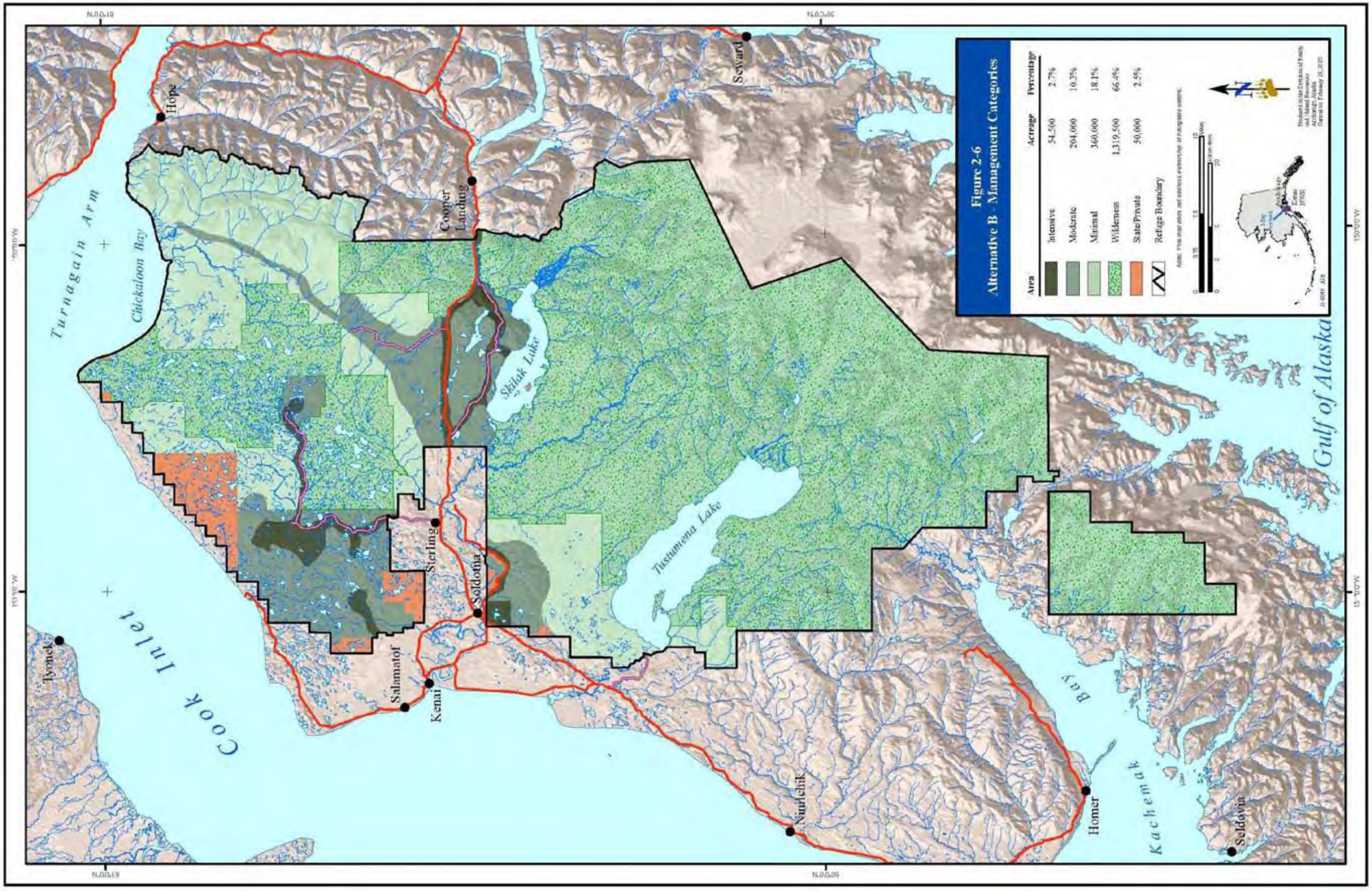

Figure 2-6. Alternative B - Management Categories

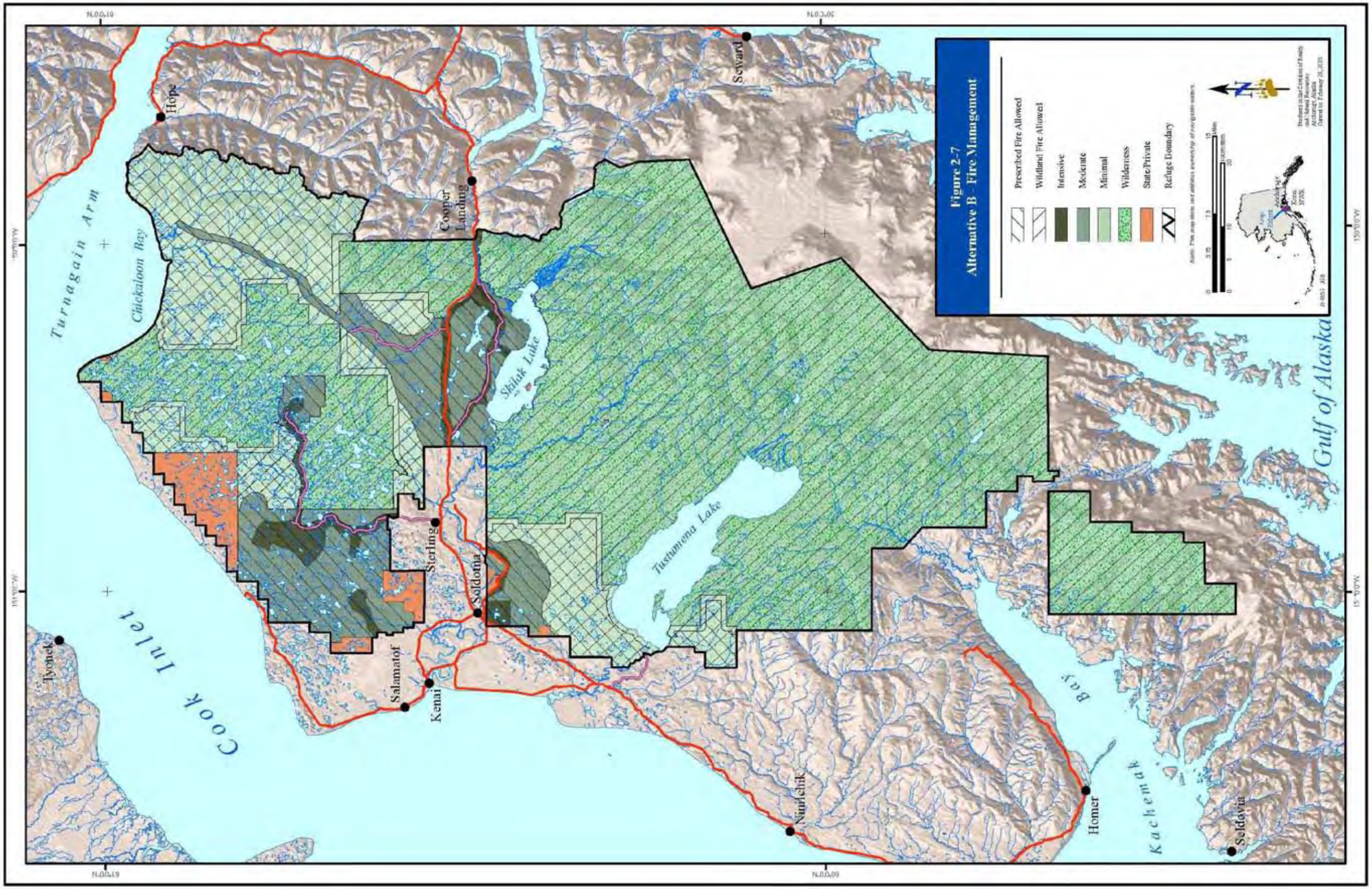

Figure 2-7. Alternative B - Fire Management

Contaminated Sites

Industrial facilities would be required to operate in compliance with all applicable Federal and State environmental statues and regulations, known contaminant releases are to be cleaned up in a timely manner, and areas no longer in use are to be restored to predevelopment conditions. Industry would be required to investigate, and if necessary, test suspected contaminated sites to confirm the existence and identity of contaminates and to remediate and restore the sites as necessary to acceptable standards agreed upon by Alaska Department of Environmental Conservation (ADEC), Bureau of Land Management (BLM), the Service, and the site owner or operator.

Mystery Creek Road and Pipeline Corridor

Maintenance of the improved access road from the Sterling Highway to the Alaska Pipeline corridor would be increased and conducted by ENSTAR during the life of the project. Road improvements would facilitate public access, enhance public safety, and ensure environmental protection. Public use of the area would require registration at points of entry. Public vehicle use of the improved access road and Alaska Pipeline corridor north to Chickaloon Bay and southwest to the East Fork of the Moose River would be allowed from July 1 through November 30. Pedestrian and horse use would be allowed year-round with no seasonal restrictions. Snowmachine use would be allowed when the Refuge manager determines there is adequate snow cover and when adjacent areas are open. Bicycle use would be allowed generally from May 1 through November 30. After the life of the pipeline project, public use and/or restoration opportunities would be re-evaluated. If the improved access road is retained, maintenance would revert to the Refuge.

Ski Hill Road

The Refuge will assume management and maintenance responsibilities for the Ski Hill Road upon its transfer from the State to the Service. Maintenance of the graveled road would be conducted on a regular basis by the Refuge; and the northern and southern routes would remain open to pedestrian, bicycle, and public vehicle use.

Sterling Highway Pullout

Develop a formal rest stop at milepost 62 through a cooperative effort with the State of Alaska Department of Transportation and Public Facilities.

Trail Maintenance and Planning

Develop a trail needs assessment that identifies and prioritizes construction and/or maintenance needs and construction standards for a variety of trails.

Issue 3: How will the Refuge enhance wildlife-oriented recreation opportunities?

Visitor Services Program

Personal Collection of Natural Resources

Refuge-specific regulations would be amended to allow the personal collection and use of unlimited quantities of berries, mushrooms, and other edible plants. Such collection would be for non-commercial use only and could only be undertaken in a manner that does not unduly damage other resources (e.g., an individual could not cut down live trees to harvest the seeds and/or cones). Additionally, the collection of up to eight naturally shed moose or caribou antlers per person per year for non-commercial purposes would be allowed.

Christmas Tree Harvesting

Refuge-specific regulations would be amended to allow for harvesting one black or white spruce tree no larger than 20 feet in height per family per year between Thanksgiving and Christmas Day. Trees could not be taken within the two-square-mile Refuge Visitor Center area on Ski Hill Road or closer than 150 feet from roads, trails, campgrounds, picnic areas, and waterways (lakes, rivers, streams, or ponds). Additionally, for safety reasons, stumps from harvested trees must be trimmed less than six inches from the ground.

Issue 4: How will the Refuge manage increasing public use to ensure resource and visitor experience protection?

Visitor Services Program

Swanson River/Swan Lake Canoe Systems

All canoeists would be required to register at entrance points, and Refuge officers would spot-check and enforce the registration requirement. Maximum group size would be limited to 15 individuals without a special use permit. Dispersed camping would be allowed but may not exceed 14 days in any 30-day period. A Limits-of-Acceptable-Change framework would be implemented to guide future management of the canoe systems.

Upper Kenai River (Russian River to Skilak Lake)

Non-Guided Public Use — Work cooperatively with stakeholders to modify, as needed, existing management agreements or plans (or develop new ones) to address Upper Kenai River crowding issues for non-guided public use.

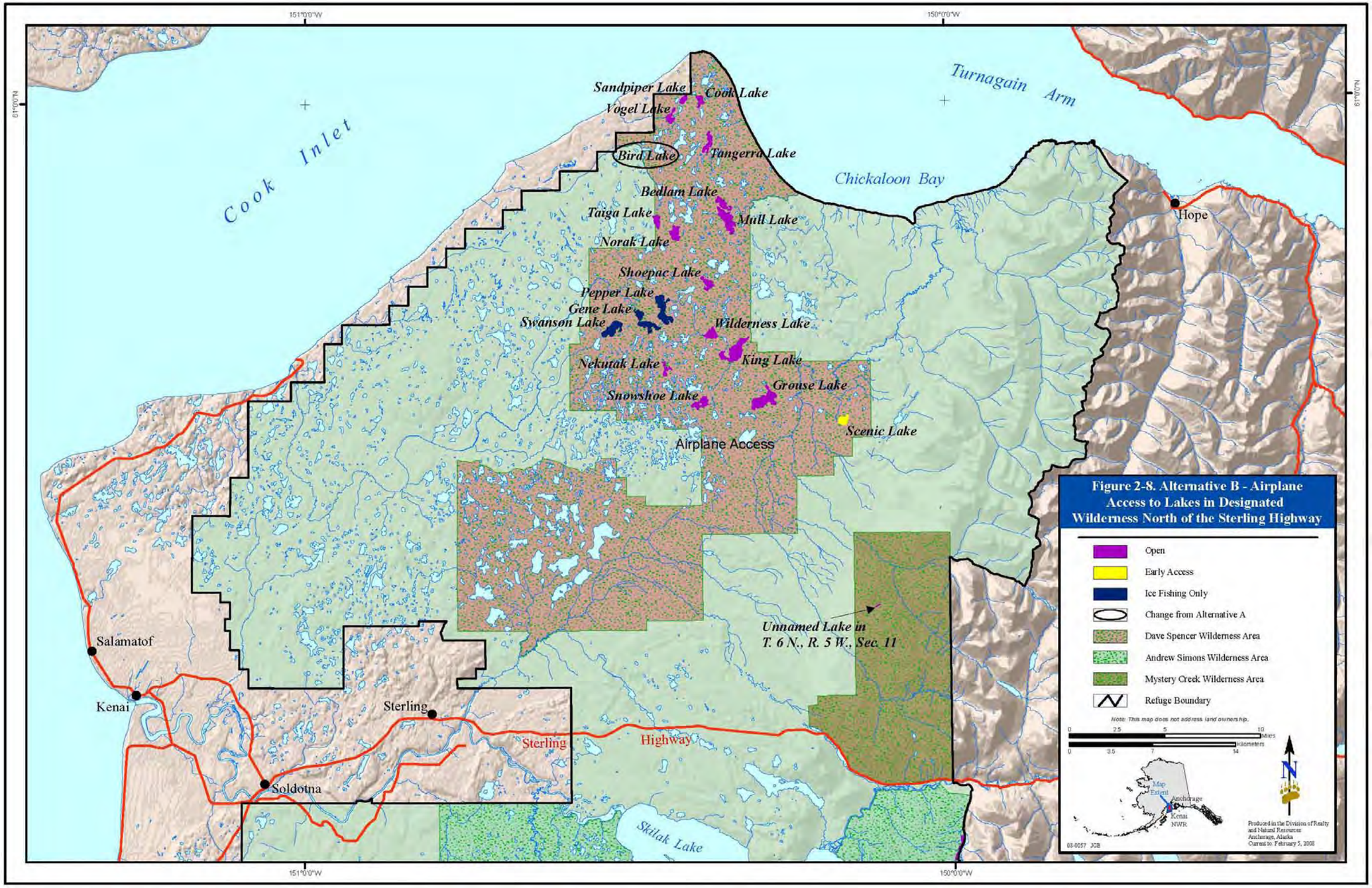

Figure 2-8. Alternative B - Airplane Access to Lakes in Designated Wilderness North of the Sterling Highway

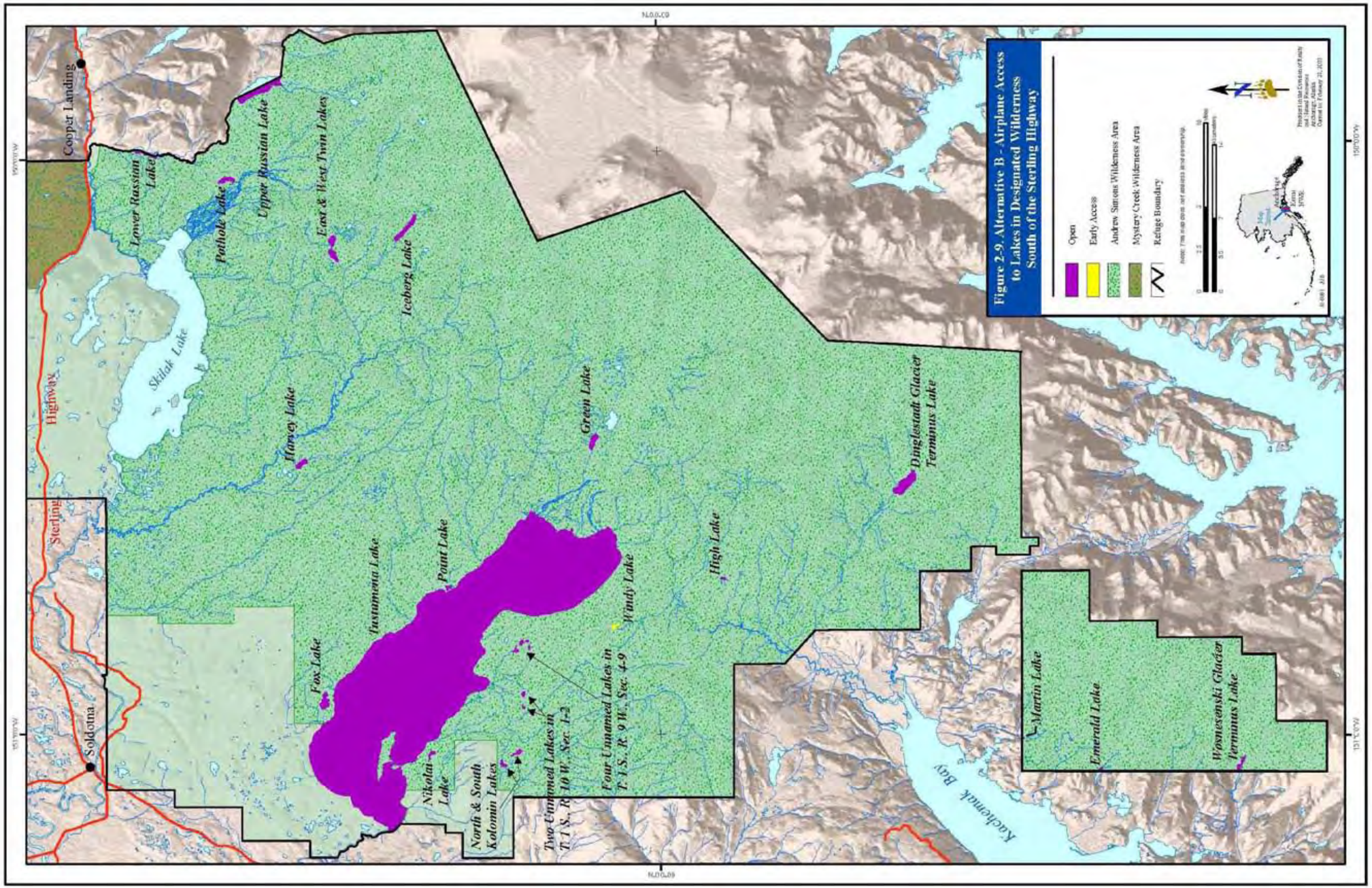

Figure 2-9. Alternative B - Airplane Access to Lakes in Designated Wilderness South of the Sterling Highway

Guided Use: Sportfishing — Special use permits would be required for sportfishing guides. Permits would be limited to 20 issued. The timing of boats and starts for each permit would be managed beyond current conditions.

Guided Use: Sportfishing Incidental Use Program — State-licensed sportfishing guides not having Refuge special use permits may be issued an incidental use permit limited to one trip per year subject to quotas and blackout dates.

Camping — Dispersed camping within 100 yards of the Kenai River would be limited to 24 hours within any 14-day period. Camping would not be allowed within one-quarter mile of the Sterling Highway.

Middle Kenai River (Skilak Lake Downstream to Refuge Boundary)

Non-Guided Public Use — Non-guided public use would be allowed without restriction on the number of users.

Guided Use: Sportfishing — Following the conclusion of the Kenai River-wide guide limitation process conducted by the Alaska Department of Natural Resources, Division of Parks and Outdoor Recreation, the Refuge would evaluate the need to implement a Refuge-specific permitting process similar to the system used on the Upper Kenai River.

Issue 5: How will the Refuge balance motorized access with protection of resources and visitor experiences?

Airplane Access to Lakes in Designated Wilderness

Airplane access would be allowed on 45 lakes in designated Wilderness (Figure 2-8and Figure 2-9).

- Dave Spencer Unit: Scenic, Nekutak, Shoepac, Norak, Grouse, King, Bedlam, Taiga, Snowshoe, Wilderness, Mull, Tangerra, Cook, Sandpiper, and Vogel lakes plus Pepper, Gene, and Swanson lakes would be open for ice fishing only.
- Andy Simons Unit: Upper Russian, East Twin, West Twin, Emerald, High, Dinglestadt Glacier terminus, Lower Russian, Iceberg, Green, North Kolomin, South Kolomin, Wosnesenski Glacier terminus, Pothole, Harvey, Martin, Windy, Tustumena and all wilderness lakes within one mile of the shoreline of Tustumena Lake (Fox, Nikolai, and Point lakes), and all unnamed lakes in sections 1 and 2, T. 1 S., R. 10 W., and sections 4, 5, 8, and 9, T. 1 S., R. 9 W., Seward Meridian, AK (six lakes).
- Mystery Creek Unit: An unnamed lake in Section 11, T. 6 N., R. 5 W., Seward Meridian, AK.

Airplane access would not be allowed from May 1 through September 30 on any lake where nesting trumpeter swans and/or their broods are present except on two lakes in designated Wilderness—Scenic Lake, located within the Dave Spencer unit of the Kenai Wilderness, and Windy Lake, located within the Andy Simons unit of the Kenai Wilderness, where the closure would be May 1 through September 10.

An environmental assessment would be conducted to determine the amount of airplane use and any associated impacts on Refuge resources, recreation opportunities, and Wilderness values.

Airplane Access to Chickaloon Flats

Wheeled airplane access would be allowed year-round on 21 square miles of the Chickaloon Flats area that are unvegetated and the unmaintained Big Indian Creek airstrip; floatplane access would be allowed on 6.5 miles of the Chickaloon River (Figure 2-10)

Snowmachine Access

Snowmachines less than 46 inches wide and less than 1,000 pounds in weight would be allowed in designated areas from December 1 through April 30 if the Refuge manager determines there is adequate snow cover to protect underlying vegetation and soils. Studies with the State of Alaska and other stakeholders would evaluate the effects of use on Refuge resources and visitor experiences, the results of which would be used to support future management decisions.

2.1.6.4 Funding and Personnel Requirements

Base Funding

All current management programs would continue under Alternative B, and some new programs would begin. The base Refuge operational budget ($3,245,000) would continue with additions to cover the new programs. Additional funds necessary to operate Refuge programs received for annual maintenance ($312,000) and fire operations ($528,000) would continue to be needed. To maintain the current level of services and adequately fund new programs, the one-time operations addition in fiscal year (FY) 2007 ($390,000) would continue to be required to operate at FY 2005 levels, and adjustments would be necessary to balance the offsets of fixed costs and inflation.

Current funding levels are inadequate to fully implement existing biological and visitor services programs, so new funds will be necessary.

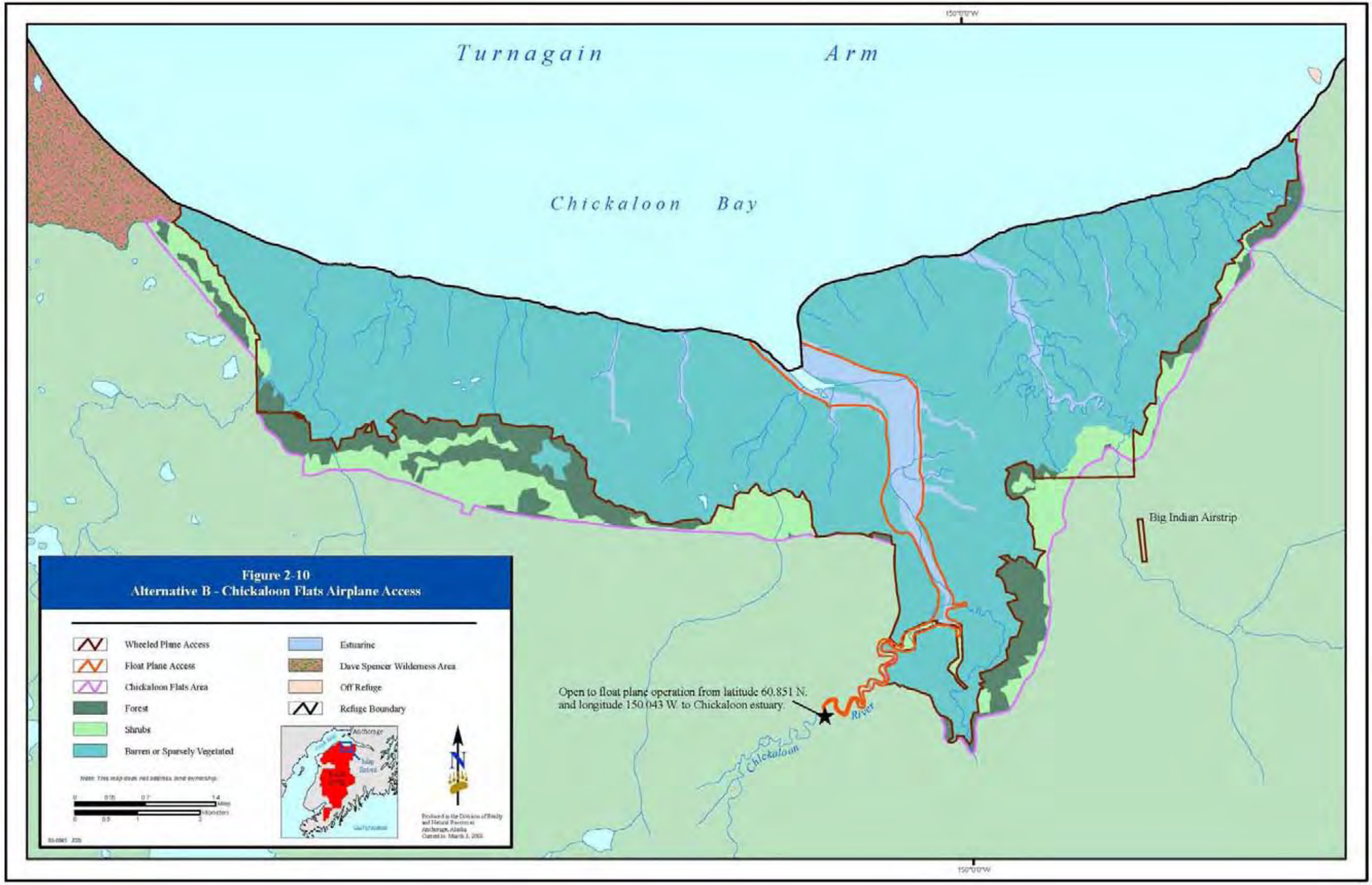

Figure 2-10. Alternative B - Chickaloon Flats Airplane Access

Table 2-4 reflects the funds necessary to implement Alternative B in addition to those base funds already received. The figures demonstrate the level of funding needed to maintain programs plus inflation adjustments for the short term. Long-term adjustments to the base budget reflect not only short-term adjustments, but also implementation of projects currently identified in the RONS database plus those needed to implement this alternative.

Table 2-4. Alternative B Budget Needs Beyond Current Levels

Item	Short-Term Needs (1 – 3 Years)	Long-Term Needs (3 – 15 Years)
Total Annual Budget Needs	$5,515,000	$21,864,410

RONS/SAMMS Projects

A number of RONS and SAMMS projects would need to be funded to achieve the requirements of this alternative.

Other

Management of oil and gas related activities on the Refuge would continue to be manpower intensive and costly under this alternative.

Additional Staffing Needs

Selection of this alternative would require additional staff. One additional law enforcement officer, in addition to those positions currently identified in the RONS package, would be required. Costs for this position would be approximately $150,000 in year one and $80,000 in subsequent years. Year one costs would include a move, vehicle, salary, and necessary equipment. A seasonal trail crew, consisting of five permanent seasonal employees would also be added at a cost of approximately $250,000. Table 2-5 identifies the number of staff needed beyond current levels to fully implement Alternative B.

Table 2-5. Alternative B Staffing Needs Beyond Current Levels

Action Type	Short-Term Needs (1 – 3 Years)	Long-Term Needs (3 – 15 Years)
Permanent Full-Time Employees	1	16
Permanent Seasonal Employees	5	21
Temporary Seasonal Employees	10	50
Volunteers	20	60

2.1.7 Alternative C

2.1.7.1 General Management Direction

Although most of the general management direction described in Alternative A would continue, some specific direction and actions occurring under current management would be altered under Alternative C. The following discussion identifies management direction proposed under Alternative C. Additionally, the Refuge Goals and Objectives presented in Section 2.2 and the Management Direction, Policies, and Guidelines presented in Volume 2, Appendix C apply to this alternative.

2.1.7.2 Management Categories

Four management categories would be applied to Kenai Refuge under Alternative C (Figure 2-11).

Intensive Management – Approximately 54,500 acres (2.7 percent) of the land would be managed under the Intensive management category.

Moderate Management – Approximately 179,000 acres (9.0 percent) of the land would be managed under the Moderate management category.

Traditional Management – This category would be eliminated. All of the 189,000 acres (9.6 percent) of land currently identified as Traditional management would convert to the Minimal management category.

Minimal Management – Approximately 385,000 acres (19.4 percent) of the land would be managed under the Minimal management category.

Wilderness Management – Approximately 1,320,500 acres (66.4 percent) of land would be managed under the Wilderness management category.

2.1.7.3 Management Direction Identified By Issue

The following discussion describes how Alternative C would address the issues identified during the scoping process. It provides management direction for major Refuge programs as they would be implemented under the alternative.

Issue 1: How will the Refuge address large-scale habitat changes and the use of fire?

Fire Management Program

Use of Fire as a Management Tool

Management direction would allow prescribed fire, use of wildland fire, and mechanical treatment as the principle management tools to improve wildlife habitats, reduce hazardous accumulations of wildland fuels, and maintain or restore natural fire regimes (Figure 2-12).

Prescribed fire would be allowed in the Intensive, Moderate, and Minimal management categories (approximately 618,500 acres or 31 percent of the Refuge).

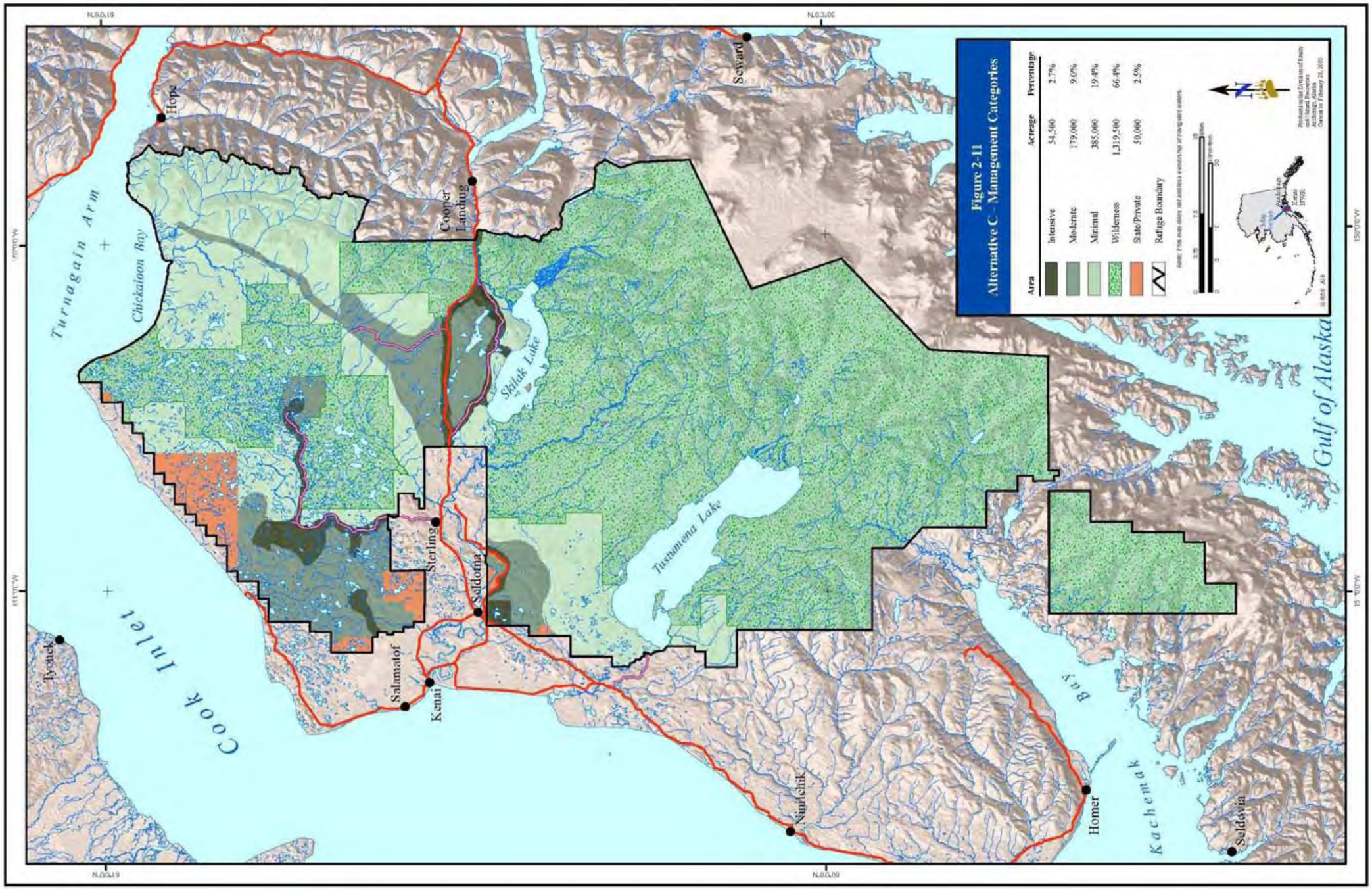

Figure 2-11. Alternative C - Management Categories

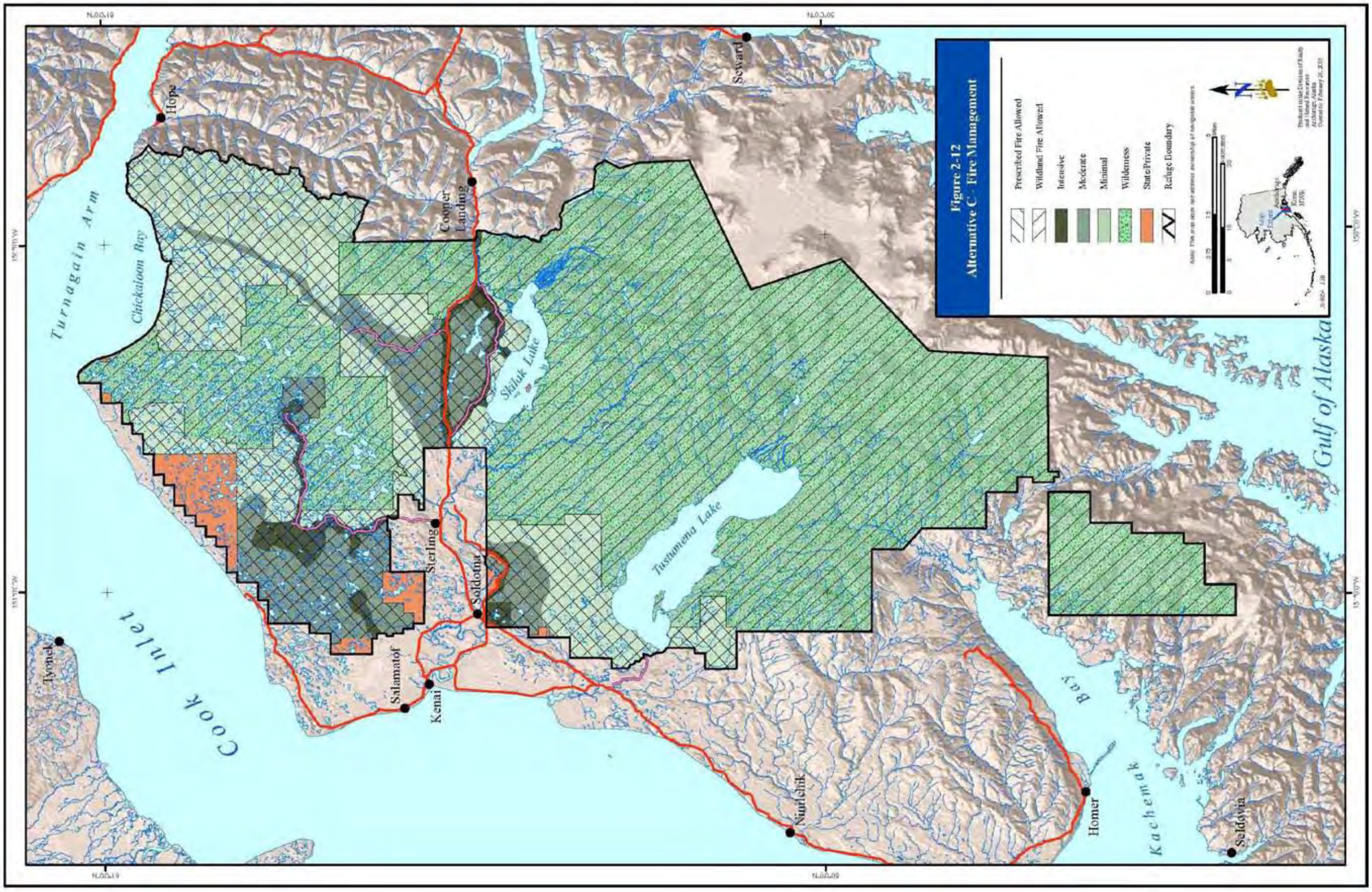

Figure 2-12. Alternative C - Fire Management

Use of wildland fire would be allowed in the Intensive, Moderate, Minimal, and Wilderness management categories (approximately 1,938,000 acres or 97.5 percent of the Refuge), but use would be emphasized in the Minimal management category (approximately 385,000 acres or 19.5 percent of the Refuge) and the default management action in the Wilderness management category (approximately 1,319,500 acres or 66.4 percent of the Refuge) unless safety, resource availability, or other planning objectives dictate a different response is warranted. Undesirable wildfires (i.e., those not contributing to Refuge management goals) would be suppressed through the use of a pre-identified management response.

Issue 2: How will the Refuge manage facilities for public use while ensuring natural resources protection?

Facilities Management Program

Swanson River Oil and Gas Unit

Industrial roads, pipelines, and facilities may be authorized in support of exploration, discovery, development, and production of oil and gas found within the unit by the current unit operator. Such operations would be subject to prior approval of the U.S. Fish and Wildlife Service. An annual Plan of Development and Operations would be required from each unit operator. The Plan would be reviewed by the Service for comment and approved by the BLM authorized officer (AO). The AO's approval, with the Service's concurrence, of specific operations must be obtained prior to commencement of such operations. During the life of the project, the Refuge would request, on a case-by-case basis, that industrial roads, pipelines and associated fixtures, and facilities not needed to support ongoing operations be removed and the sites restored.

After the life of the project, some industrial roads; all pipelines and associated fixtures, regardless of whether they are located along industrial roads, on gravel well pads, or traverse the landscape; and all facilities built to support oil and gas operations would be removed and the sites restored to match the surrounding landscape. Most industrial roads would be converted to trails for pedestrian and horse use at the Refuge manager’s discretion. Although no facilities built to support oil and gas operations would be retained for public and/or administrative uses, up to five primitive camping facilities would be provided for walk-in use only. Bicycles would not be allowed.

Beaver Creek Oil and Gas Unit

Same as *Swanson River Oil and Gas Unit* except up to two primitive camping facilities would be provided for walk-in use only.

Contaminated Sites

Industrial facilities would be required to operate in compliance with all applicable Federal and State environmental statues and regulations,

known contaminant releases are to be cleaned up in a timely manner, and areas no longer in use are to be restored to predevelopment conditions. Industry would be required to investigate, and if necessary, test suspected contaminated sites to confirm the existence and identity of contaminates and to remediate and restore the sites as necessary to acceptable standards agreed upon by Alaska Department of Environmental Conservation (ADEC), Bureau of Land Management (BLM), the Service, and the site owner or operator.

Mystery Creek Road and Pipeline Corridor

Maintenance of the improved access road from the Sterling Highway to the Alaska Pipeline corridor would be conducted by ENSTAR to continue to provide for a backcountry experience. Road improvements would be limited to those necessary for public safety and environmental protection. Public use of the area would require registration at points of entry. Public vehicle use of the improved access road and Alaska Pipeline corridor north to Chickaloon Bay and southwest to the East Fork of the Moose River would be allowed from August 9 through November 30. Pedestrian and horse use would be allowed year-round with no seasonal restrictions. Snowmachine use would be allowed when the Refuge manager determines there is adequate snow cover and when adjacent areas are open. Bicycle use would be allowed when the access road and Alaska Pipeline corridor are opened to public vehicle use (approximately August 9) until snow cover. After the life of the pipeline project, public use and/or restoration opportunities would be re-evaluated. If the improved access road is retained, maintenance would revert to the Refuge.

Ski Hill Road

The Refuge will assume management and maintenance responsibilities for the Ski Hill Road upon its transfer from the State to the Service. Maintenance and road improvements would be conducted by the Refuge upon transfer of the road from the State to the Service. The northern route would remain graveled and open to pedestrian, bicycle, and emergency vehicle use only. The southern route would be improved and hard-surfaced, and open to pedestrian, bicycle, and public vehicle use.

Sterling Highway Pullout

Develop a formal rest stop at milepost 62 through a cooperative effort with the State of Alaska Department of Transportation and Public Facilities.

Trail Maintenance and Planning

Develop a trail needs assessment that identifies and prioritizes construction and/or maintenance needs and construction standards for a variety of trails.

Issue 3: How will the Refuge enhance wildlife-oriented recreation opportunities?

Visitor Services Program

Personal Collection of Natural Resources

Refuge-specific regulations would be amended to allow the personal collection and use of unlimited quantities of berries, mushrooms, and other edible plants. Such collection would be for non-commercial use only and could only be undertaken in a manner that does not unduly damage other resources (e.g., an individual could not cut down live trees to harvest the seeds and/or cones). Additionally, the collection of up to eight naturally shed moose or caribou antlers per person per year for non-commercial purposes would be allowed.

Christmas Tree Harvesting

Refuge-specific regulations would be amended to allow for harvesting one black or white spruce tree no larger than 20 feet in height per family per year between Thanksgiving and Christmas Day. Trees could not be taken within the two-square-mile Refuge Visitor Center area on Ski Hill Road or closer than 150 feet from roads, trails, campgrounds, picnic areas, and waterways (lakes, rivers, streams, or ponds). Additionally, for safety reasons, stumps from harvested trees must be trimmed less than six inches from the ground.

Issue 4: How will the Refuge manage increasing public use to ensure resource and visitor experience protection?

Visitor Services Program

Swan Lake and Swanson River Canoe Systems

All canoeists would be required to register at entrance points. Maximum group size would be limited to 15 individuals without a special use permit. Dispersed camping would be allowed but may not exceed 14 days in any 30-day period. Campsites would be monitored and evaluated regularly using standard protocols. Management actions taken to address resource concerns, including temporary closures of selected campsites to encourage natural rehabilitation, may be implemented as needed. Regulations requiring appropriate disposal of human waste would be adopted.

Upper Kenai River (Russian River to Skilak Lake)

Non-Guided Public Use — Implement a public process to restrict or redirect non-guided public use for the Upper Kenai River if more than 25 percent of anglers surveyed (outside of the confluence area) report difficulty in finding an uncrowded fishing spot.

Guided Use: Sportfishing — Special use permits would be required for sportfishing guides. Permits would be limited to 18 issued through

attrition. Each permit would allow ten 10 starts per week with no more than 4 starts per day. Additional restrictions may be imposed if demand for commercial recreational services increases.

Guided Use: Sportfishing Incidental Use Program — State-licensed sportfishing guides not having Refuge special use permits may be issued incidental use permits for as many as three trips per year subject to additional quotas and blackout dates.

Camping — Dispersed camping within 100 yards of the Kenai River or within one-quarter mile of the Sterling Highway would not be allowed.

Middle Kenai River (Skilak Lake Downstream to Refuge Boundary)

Non-Guided Public Use — Non-guided public use would be allowed without restriction on the number of users until a Limits-of-Acceptable-Change planning process is completed with stakeholders, including the State of Alaska, which would lead to the development of a step-down management plan.

Guided Use: Sportfishing — Special use permits would be required for sportfishing guides. Permits would be limited to the number of permittees existing upon completion of this comprehensive conservation planning process, and existing permittees would be "grandfathered" in.

Issue 5: How will the Refuge balance motorized access with protection of resources and visitor experiences?

Airplane Access to Lakes in Designated Wilderness

Airplane access would be allowed on 50 lakes in designated Wilderness (Figure 2-13 and Figure 2-14).

- Dave Spencer Unit: Falcon, Wren, Neckshorta, Scenic, Nekutak, Shoepac, Norak, Grouse, King, Bedlam, Taiga, Snowshoe, Wilderness, Mull, Tangerra, Bird, Cook, Sandpiper, and Vogel lakes plus Pepper, Gene, and Swanson lakes would be open for ice fishing only.
- Andy Simons Unit: An unnamed lake southwest of Goat Lake in section 28; Upper Russian, East Twin, West Twin, Emerald, High, Dinglestadt Glacier terminus, Lower Russian, Iceberg, Green, North Kolomin, South Kolomin, Wosnesenski Glacier terminus, Pothole, Harvey, Martin, Windy, Tustumena and all wilderness lakes within one mile of the shoreline of Tustumena Lake (Fox, Nikolai, and Point lakes), and all unnamed lakes in sections 1 and 2, T. 1 S., R. 10 W., and sections 4, 5, 8, and 9, T. 1 S., R. 9 W., Seward Meridian, AK (six lakes).
- Mystery Creek Unit: An unnamed lake in section 11, T. 6 N., R. 5 W., Seward Meridian, AK.

Airplane access would not be allowed from May 1 through September 30 on any lake where nesting trumpeter swans and/or their broods are

present except on two lakes in designated Wilderness—Scenic Lake located within the Dave Spencer unit of the Kenai Wilderness, and Windy Lake located within the Andy Simons unit of the Kenai Wilderness, where the closure would be May 1 through September 10.

Airplane Access to Chickaloon Flats

Wheeled airplane access would be allowed year-round on 21 square miles of the Chickaloon Flats area that are unvegetated, regular maintenance would be conducted on the Big Indian Creek airstrip, and floatplane access would be allowed on 6.5 miles of the Chickaloon River (Figure 2-15).

Snowmachine Access

Snowmachines less than 46 inches wide and less than 1,000 pounds in weight would be allowed in certain zones within designated areas from December 1 through April 30, if adequate snow cover is present. The Refuge Manager determines if adequate snow cover is present. Snow cover is necessary to protect vegetation and soils from damage. Studies would be conducted with the State of Alaska and other stakeholders to evaluate the effects of snowmachine use on Refuge resources and visitor experiences, the results of which would be used to support future management decisions.

2.1.7.4 Funding and Personnel Requirements

Base Funding

All current management programs would continue under Alternative C, and some new programs would begin. The base Refuge operational budget ($3,245,000) would continue with additions to cover the new programs. Additional funds necessary to operate Refuge programs received for annual maintenance ($312,000) and fire operations ($528,000) would continue to be needed. To maintain the current level of services and adequately fund new programs, the one-time operations addition in fiscal year (FY) 2007 ($390,000) would continue to be required to operate at FY 2005 levels, and adjustments would be necessary to balance the offsets of fixed costs and inflation. Current funding levels are inadequate to fully implement existing biological and visitor services programs, so new funds would be necessary.

Table 2-6 reflects the funds necessary to implement Alternative C in addition to those base funds already received. The figures demonstrate the level of funding needed to maintain programs plus inflation adjustments for the short term. Long-term adjustments to the base budget reflect not only short-term adjustments, but also implementation of projects currently identified in the RONS database plus those needed to implement this alternative. Significant new funding would be required to implement this alternative to harden roadways ($2,500,000), develop new visitor facilities for wildlife

observation ($1,500,000), and pay salaries for six additional personnel needed to accomplish these new programs ($750,000).

Table 2-6. Alternative C Budget Needs Beyond Current Levels

Item	Short-Term Needs (1 – 3 Years)	Long-Term Needs (3 – 15 Years)
Total Annual Budget Needs	$7,800,000	$21,864,410

RONS / SAMMS Projects

A number of RONS and SAMMS projects would need to be funded to achieve the requirements of this alternative.

Other

Management of oil and gas related activities on the Refuge would continue to be manpower intensive and costly under this alternative.

Additional Staffing Needs

Selection of this alternative would require additional staff. Two additional law enforcement officers, in addition to those positions currently identified in the RONS package, would be required. Costs for these positions would be approximately $300,000 in year one, and $160,000 in subsequent years. Year one costs would include moves, vehicle, salary, and necessary equipment. Other required personnel would include two maintenance professionals (year one costs approximately $250,000; subsequent years approximately $160,000), and two park rangers (Visitor Services) to provide services at new facilities (year one costs approximately $250,000; subsequent years approximately $160,000). A seasonal trail crew consisting of five permanent seasonal employees would also be added at a cost of approximately $250,000. Table 2-7 identifies the number of staff needed beyond current levels to fully implement Alternative C.

Table 2-7. Alternative C Staffing Needs Beyond Current Levels

Action Type	Short-Term Needs (1 – 3 Years)	Long-Term Needs (3 – 15 Years)
Permanent Full-Time Employees	5	16
Permanent Seasonal Employees	5	21
Seasonal Employees	10	50
Volunteers	20	60

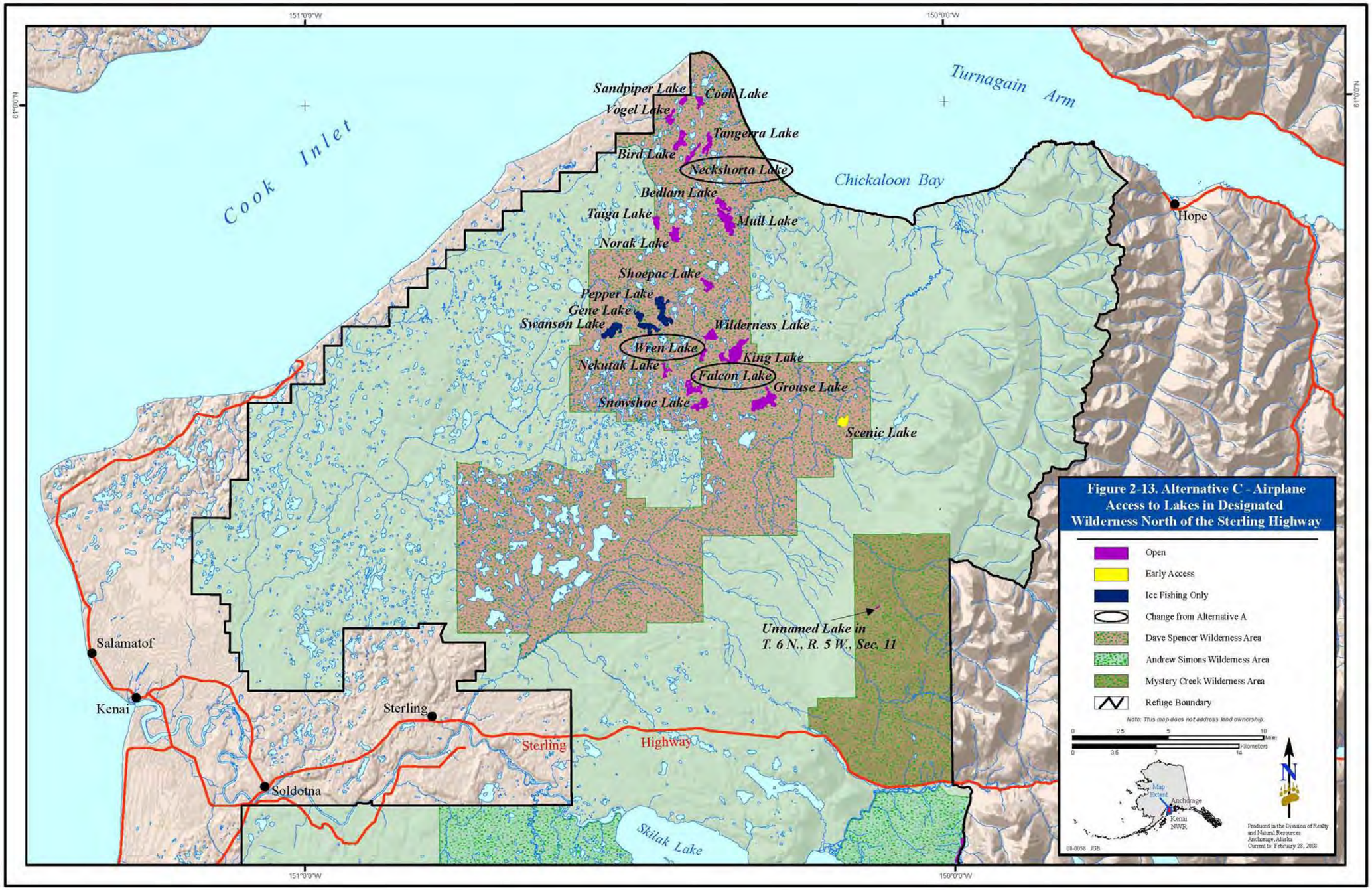

Figure 2-13. Alternative C - Airplane Access to Lakes in Designated Wilderness North of the Sterling Highway

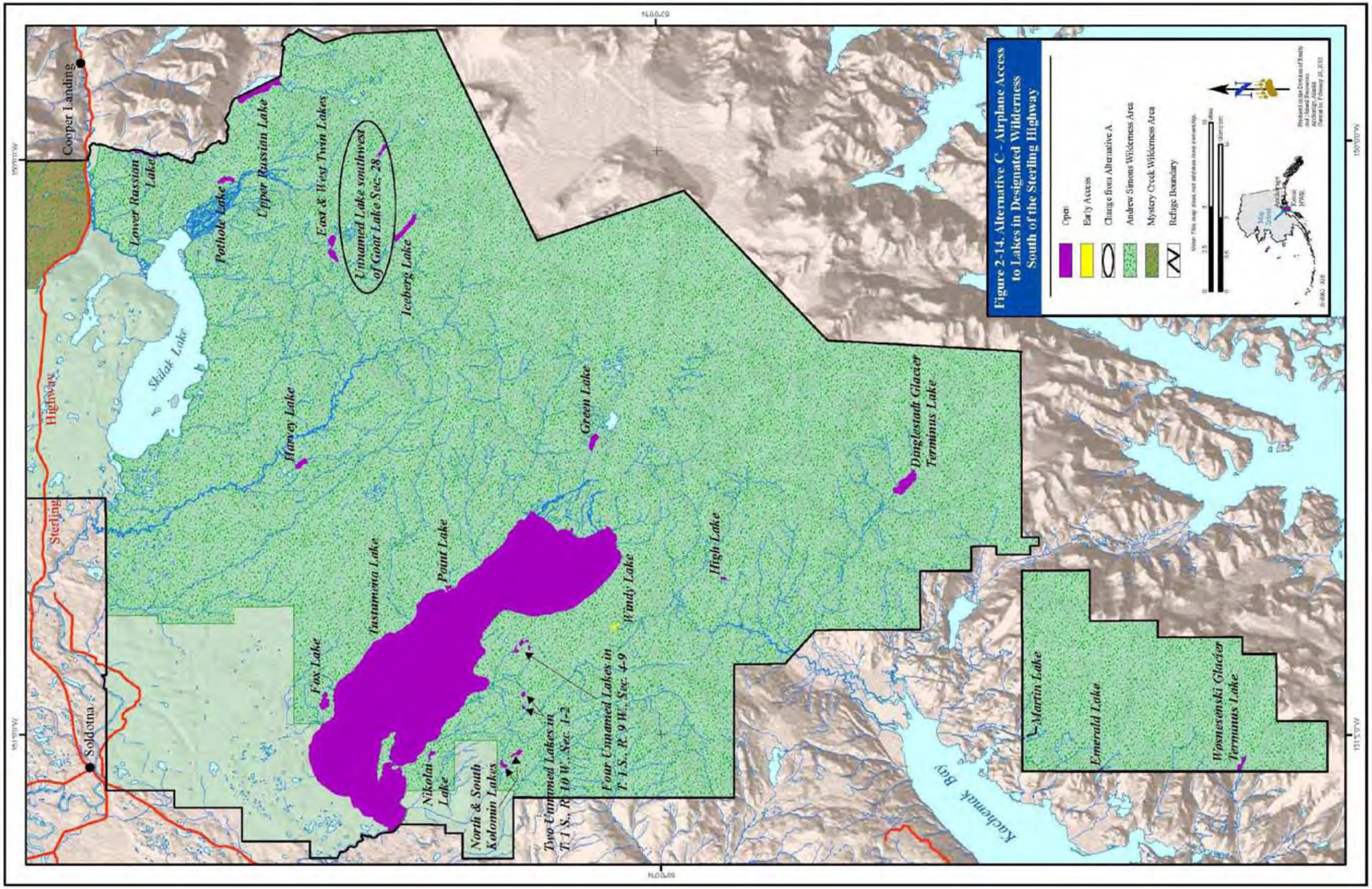

Figure 2-14. Alternative C - Airplane Access to Lakes in Designated Wilderness South of the Sterling Highway

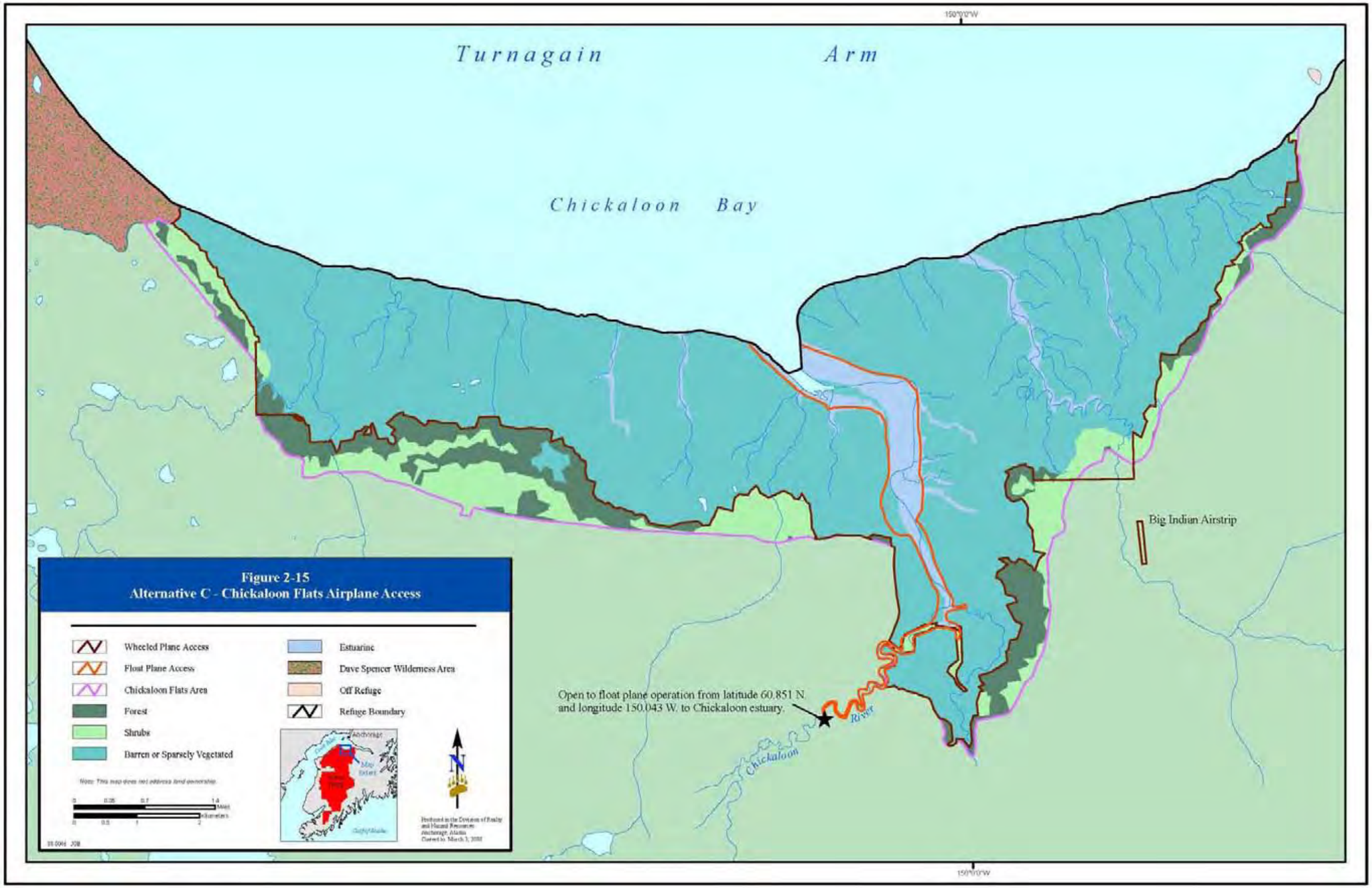

Figure 2-15. Alternative C - Chickaloon Flats Airplane Access

2.1.8 Alternative D

2.1.8.1 General Management Direction

Although most of the general management direction described in Alternative A would continue, some specific direction and actions occurring under current management would be altered under Alternative D. The following discussion identifies management direction proposed under Alternative D. Additionally, the Refuge Goals and Objectives presented in section 2.2 and the Management Direction, Policies, and Guidelines presented in Volume 2, Appendix C apply to this alternative.

2.1.8.2 Management Categories

Four management categories would be applied to Kenai Refuge under Alternative D (Figure 2-16).

Intensive Management – Approximately 54,500 acres (2.7 percent) of the land would be managed under the Intensive management category.

Moderate Management – This category would be reduced and eventually eliminated after the life of the Alaska Pipeline project. Approximately 129,550 acres (6.5 percent) of the land would convert to the Minimal management category immediately. The remaining 49,450 acres (2.5 percent) of land would be retained as Moderate management during the life of the Alaska Pipeline project. These lands would convert to the Minimal management category after the life of that project.

Traditional Management – This category would be eliminated. All of the 189,000 acres (9.6 percent) of land currently identified under this category would convert to the Minimal management category.

Minimal Management – Approximately 514,550 acres (25.9 percent) of the land would be managed under the Minimal management category during the life of the Alaska Pipeline project. After the life of the project, 564,000 acres (28.4 percent) would be managed under the Minimal management category.

Wilderness Management – Approximately 1,320,500 acres (66.4 percent) of the land would be managed under the Wilderness management category.

2.1.8.3 Management Direction Identified By Issue

The following discussion describes how Alternative D would address the issues identified during the scoping process. It provides management direction for major Refuge programs as they would be implemented under the alternative.

Issue 1: How will the Refuge address large-scale habitat changes and the use of fire?

Fire Management Program

Use of Fire as a Management Tool

Management direction would allow prescribed fire, wildfire, and mechanical treatments as the principle management tools to improve wildlife habitats, reduce hazardous accumulations of wildland fuels, and maintain or restore natural fire regimes (Figure 2-17).

Prescribed fire would be allowed in the Intensive, Moderate, Minimal, and Wilderness management categories (approximately 1,938,000 acres or 97.5 percent of the Refuge), though its use in the Wilderness management category would only occur under specific conditions defined in national Wilderness and fire management policies.

Use of wildland fire would be allowed in the Intensive, Moderate, Minimal, and Wilderness management categories (approximately 1,938,000 acres or 97.5 percent of the Refuge), but use would be the default management action in the Minimal and Wilderness management categories (approximately 1,883,500 acres or 95 percent of the Refuge). Undesirable wildfires (i.e., those not contributing to Refuge management goals) would be suppressed through the use of an "appropriate management response."

Issue 2: How will the Refuge manage facilities for public use while ensuring natural resources protection?

Facilities Management Program

Swanson River Oil and Gas Unit

Industrial roads, pipelines, and facilities may be authorized in support of exploration, discovery, development, and production of oil and gas found within the unit by the current unit operator. Such operations would be subject to prior approval of the U.S. Fish and Wildlife Service. An annual Plan of Development and Operations would be required from each unit operator. The Plan would be reviewed by the Service for comment and approved by the BLM authorized officer (AO). The AO's approval, with the Service's concurrence, of specific operations must be obtained prior to commencement of such operations. During the life of the project, the Refuge would request, on a case-by-case basis, that industrial roads, pipelines and associated fixtures, and facilities not needed to support ongoing operations be removed and the sites restored.

After the life of the project, some industrial roads; most pipelines, sections of pipelines, and associated fixtures, regardless of whether they are located along industrial roads, on gravel well pads, or along utility corridors that have not adequately revegetated; and most facilities built to support oil and gas operations would be removed and the sites

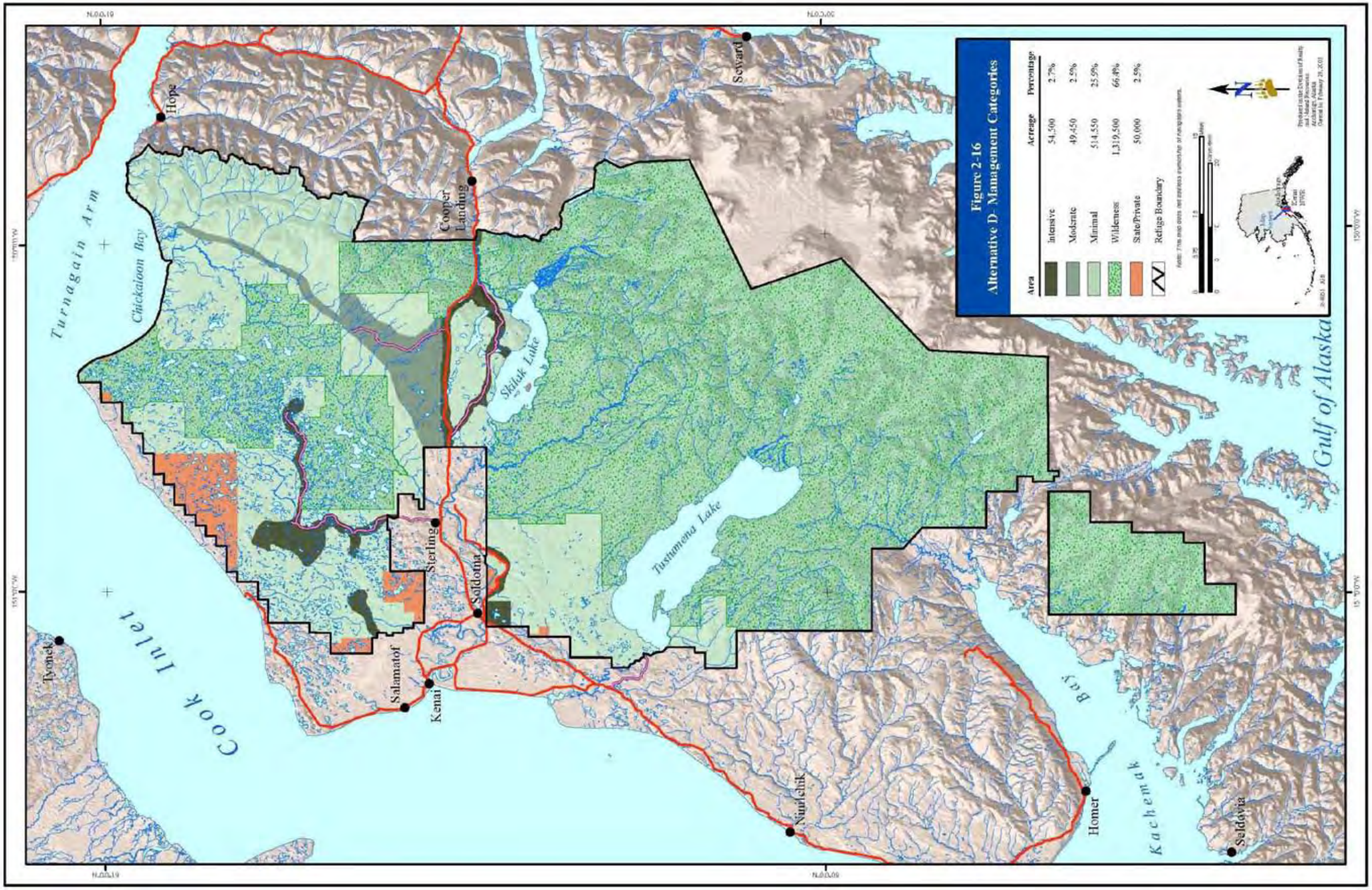

Figure 2-16. Alternative D - Management Categories

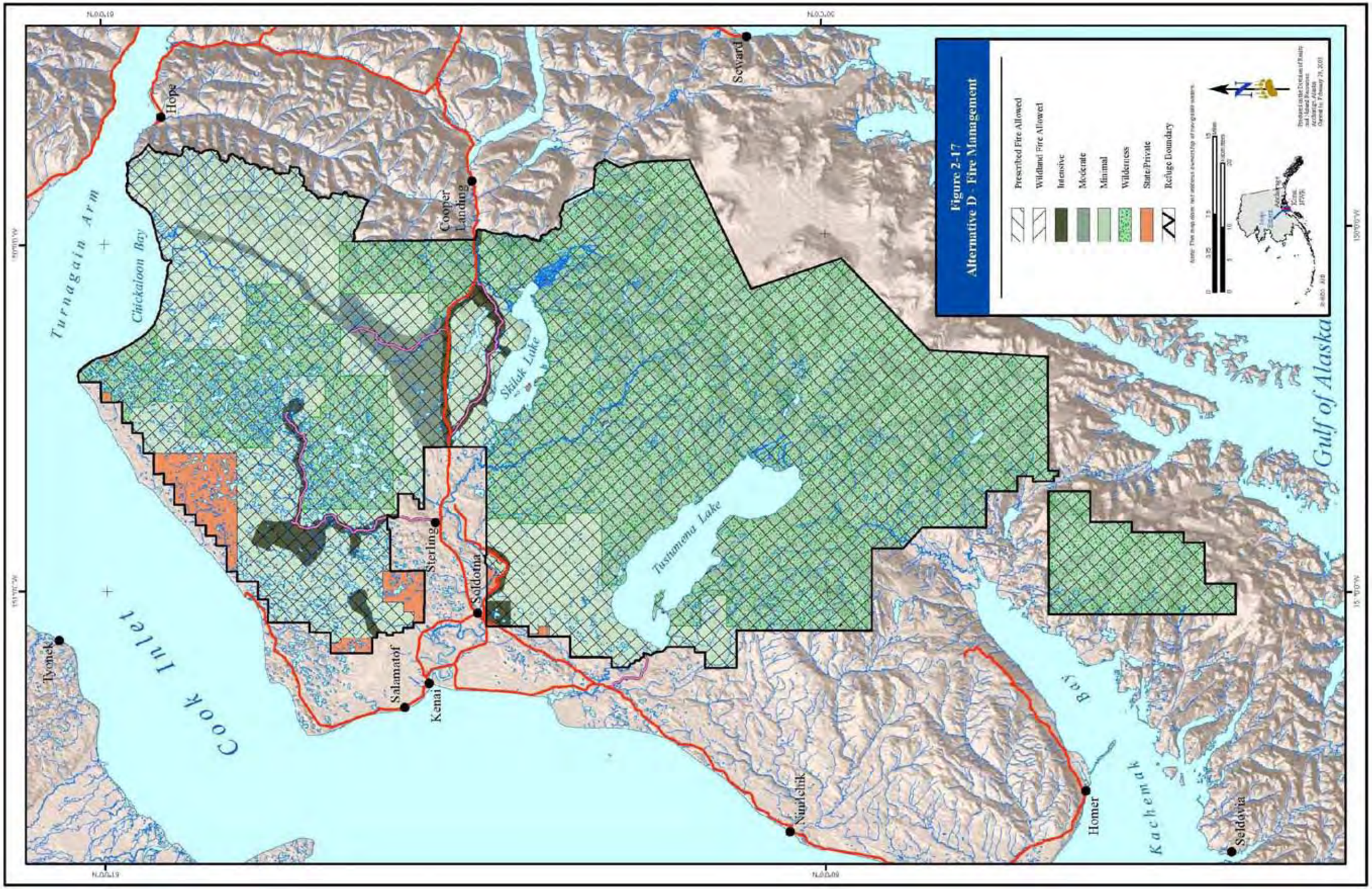

Figure 2-17. Alternative D - Fire Management

restored to match the surrounding landscape. In cases where more environmental damage would occur by removing pipelines (or sections of pipelines) than by leaving them in place, the pipeline (or sections of pipeline) would be cleaned, capped, and left in place. Most industrial roads would be retained and maintained for public and administrative uses at the Refuge manager's discretion. Some facilities built to support oil and gas operations may be retained for administrative uses (e.g., research, law enforcement, or seasonal programs) at the Refuge manager's discretion; and up to two developed campgrounds, consisting of "hardened" campsites, vault toilets, tables, and fire rings, would be provided. Bicycles would be allowed on roads and trails.

Beaver Creek Oil and Gas Unit

Same as *Swanson River Oil and Gas Unit* except up to one developed campground would be provided.

Contaminated Sites

Industrial facilities would be required to operate in compliance with all applicable Federal and State environmental statues and regulations, known contaminant releases are to be cleaned up in a timely manner, and areas no longer in use are to be restored to predevelopment conditions. Industry would be required to investigate, and if necessary, test suspected contaminated sites to confirm the existence and identity of contaminates and to remediate and restore the sites as necessary to acceptable standards agreed upon by Alaska Department of Environmental Conservation (ADEC), Bureau of Land Management (BLM), the Service, and the site owner or operator.

Mystery Creek Road and Pipeline Corridor

Maintenance of the unimproved access road from the Sterling Highway to the Alaska Pipeline corridor would be conducted by ENSTAR during the life of the project. Public use of the area would not require registration. Public vehicle use and bicycles would not be allowed; pedestrian and horse use would be allowed year-round with no seasonal restrictions. Snowmachine use would be allowed when the Refuge manager determines there is adequate snow cover and when adjacent areas are open. After the life of the pipeline project, the unimproved access road and Alaska Pipeline corridor would be restored, and a trail would be constructed for pedestrian and horse use only.

Ski Hill Road

The Refuge will assume management and maintenance responsibilities for the Ski Hill Road upon its transfer from the State to the Service. Maintenance and road improvements would be conducted by the Refuge. The northern route would remain graveled and open to pedestrian, bicycle, and emergency vehicle use only. The southern route would be improved, hard-surfaced and open to public vehicle use,

and a trail would be provided within the road right-of-way for pedestrian and bicycle use.

Sterling Highway Pullout

Develop a formal rest stop at milepost 62 through a cooperative effort with the State of Alaska Department of Transportation and Public Facilities.

Trail Maintenance and Planning

Develop a trail needs assessment that identifies and prioritizes construction and/or maintenance needs and construction standards for a wide variety of trails.

Issue 3: How will the Refuge enhance wildlife-oriented recreation opportunities?

Visitor Services Program

Personal Collection of Natural Resources

Refuge-specific regulations would be amended to allow the personal collection and use of unlimited quantities of berries, mushrooms, and other edible plants. Such collection would be for non-commercial use only and could only be undertaken in a manner that does not unduly damage other resources (e.g., an individual could not cut down live trees to harvest the seeds and/or cones). Additionally, the collection of up to eight naturally shed moose or caribou antlers per person per year for non-commercial purposes would be allowed.

Christmas Tree Harvesting

Refuge-specific regulations would be amended to allow for harvesting one black or white spruce tree no larger than 20 feet in height per family per year between Thanksgiving and Christmas Day. Trees could not be taken within the two-square-mile Refuge Visitor Center area on Ski Hill Road or closer than 150 feet from roads, trails, campgrounds, picnic areas, and waterways (lakes, rivers, streams, or ponds). Additionally, for safety reasons, stumps from harvested trees must be trimmed less than six inches from the ground.

Issue 4: How will the Refuge manage increasing public use to ensure resource and visitor experience protection?

Visitor Services Program

Swan Lake and Swanson River Canoe Systems

All canoeists would be required to register via a reservation system. Maximum group size would be limited to 15 individuals without a special use permit. Camping would be allowed in designated sites only. Regulations requiring the use of outhouses provided at designated campsites would be adopted.

Upper Kenai River (Russian River to Skilak Lake)

Non-Guided Public Use — Implement a limited permit program for the Upper Kenai River to address non-guided sportfishing and scenic float trips between Sportsman's Lodge and Jim's Landing. A public rulemaking process would provide stakeholders an opportunity to make suggestions on how best to implement the system.

Guided Use: Sportfishing — Special use permits would be required for sportfishing guides. Permits would be limited to 15 issued through attrition. Each permit would allow 10 starts per week with no more than 4 starts per day. Additional restrictions may be imposed if demand for commercial recreational services increases.

Guided Use: Sportfishing Incidental Use Program — The Incidental Use Program would be eliminated.

Camping — Dispersed camping within 100 yards of the Kenai River and camping within one mile of the inlet or outlet of the Kenai River and Skilak Lake would be limited to 48 hours within any 14-day period. Camping would not be allowed within one-quarter mile of the Sterling Highway.

Middle Kenai River (Skilak Lake Downstream to Refuge Boundary)

Non-Guided Public Use — A limited permit program for all non-guided public use would be developed. A public rulemaking process would provide stakeholders an opportunity to make suggestions on how best to implement the program.

Guided Use: Sportfishing — Special use permits would be required for sportfishing guides. Permits would be limited to 20 issued through a competitive selection process, and management of the timing of boats and/or starts would be initiated.

Issue 5: How will the Refuge balance motorized access with protection of resources and visitor experiences?

Airplane Access to Lakes in Designated Wilderness

Airplane access would be allowed on 59 lakes in designated Wilderness and 1 additional lake outside of designated Wilderness (Figure 2-18 and Figure 2-19).

- Dave Spencer Unit: Falcon, Wren, Neckshorta, Rabbit Foot, Muskrat, Scenic, Nekutak, Shoepac, Norak, Grouse, King, Bedlam, Taiga, Snowshoe, Wilderness, Mull, Tangerra, Bird, Cook, Sandpiper, and Vogel, plus Angler, Pepper, Gene, and Swanson lakes would be open for ice fishing only.
- Andy Simons Unit: An unnamed lake southwest of Goat Lake in section 28, an unnamed lake west of Kolomin Lake in section 31,

four lakes north of Harvey lake (Round Lake in section 29, an unnamed lake northwest of Round Lake in section 30, an unnamed lake southwest of Round Lake in section 30, and an unnamed lake southwest of Round Lake in section 31), Kaknu, Upper Russian, East Twin, West Twin, Emerald, High, Dinglestadt Glacier terminus, Lower Russian, Iceberg, Green, North Kolomin, South Kolomin, Wosnesenski Glacier terminus, Pothole, Harvey, Martin, Windy, Tustumena and all wilderness lakes within one mile of the shoreline of Tustumena Lake (Fox, Nikolai, and Point lakes), and all unnamed lakes in Sections 1 and 2, T. 1 S., R. 10 W., and Sections 4, 5, 8, and 9, T. 1 S., R. 9 W., Seward Meridian, AK (six lakes).

- Mystery Creek Unit: An unnamed lake in Section 11, T. 6 N., R. 5 W., Seward Meridian, AK.

Airplane access would not be allowed from May 1 through September 30 on any lake where nesting trumpeter swans and/or their broods are present except on five lakes in designated Wilderness—Scenic, King, and Bird lakes located within the Dave Spencer unit of the Kenai Wilderness, and Windy and Harvey lakes located within the Andy Simons unit of the Kenai Wilderness—and one lake outside of designated Wilderness (Beaver Lake), where the closure would be May 1 through September 10.

Airplane Access to Chickaloon Flats

Wheeled airplane access would be allowed year-round on 21 square miles of the Chickaloon Flats area that are unvegetated; an additional 6.8 square miles would be open from September 1 to December 15 (or to coincide with future waterfowl hunting seasons). Regular maintenance of the Big Indian Creek airstrip would be conducted, and floatplane access would be allowed on 6.5 miles of the Chickaloon River (Figure 2-20).

Snowmachine Access

Snowmachines less than 46 inches wide and less than 1,000 pounds in weight would be allowed in certain zones within designated areas, if adequate snow cover is present. The Refuge Manager determines if adequate snow cover is present. Snow cover is necessary to protect vegetation and soils from damage. Studies would be conducted with the State of Alaska and other stakeholders to evaluate the effects of snowmachine use on Refuge resources and visitor experiences, the results of which would be used to support future management decisions.

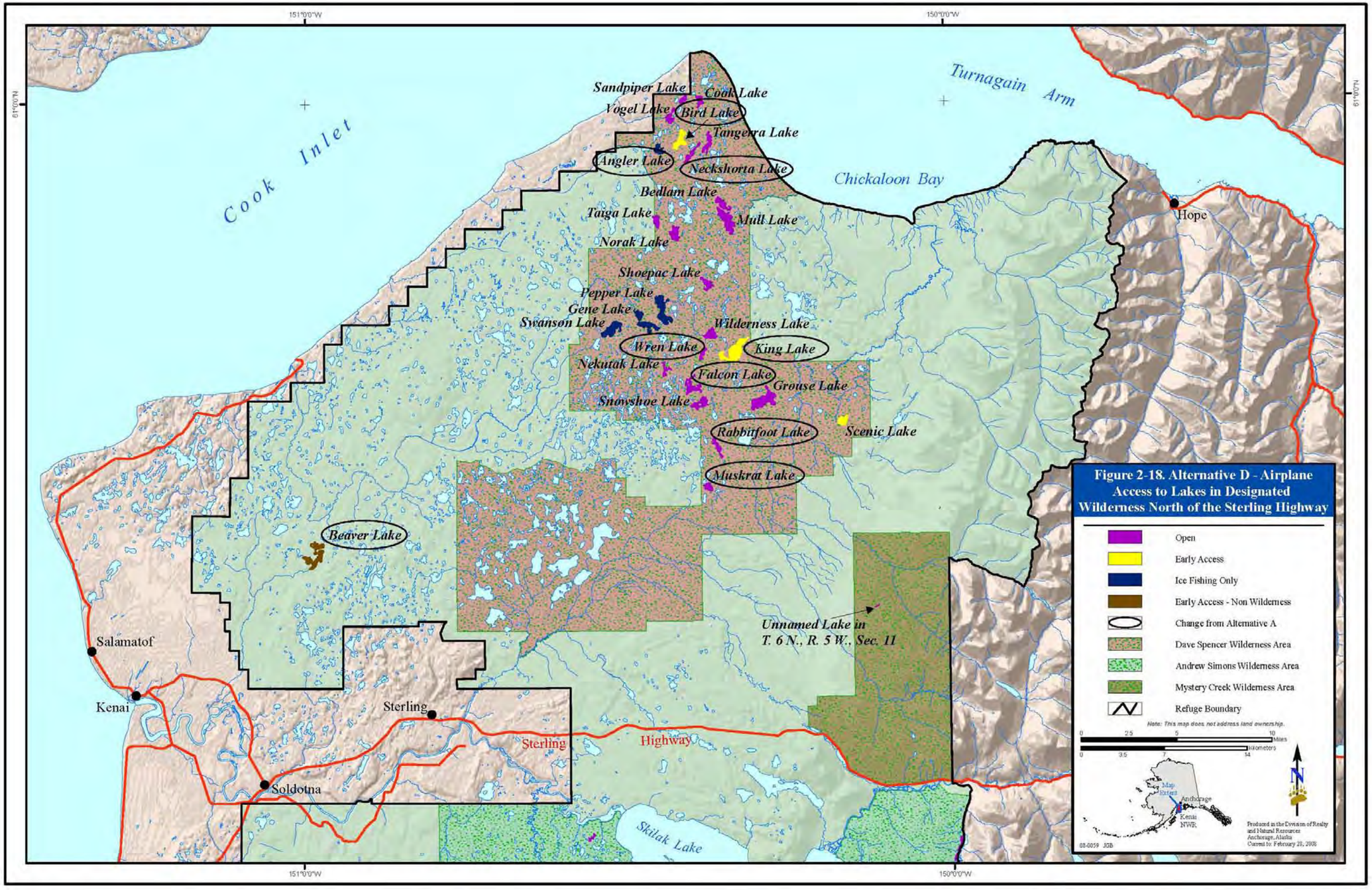

Figure 2-18. Alternative D - Airplane Access to Lakes in Designated Wilderness North of the Sterling Highway

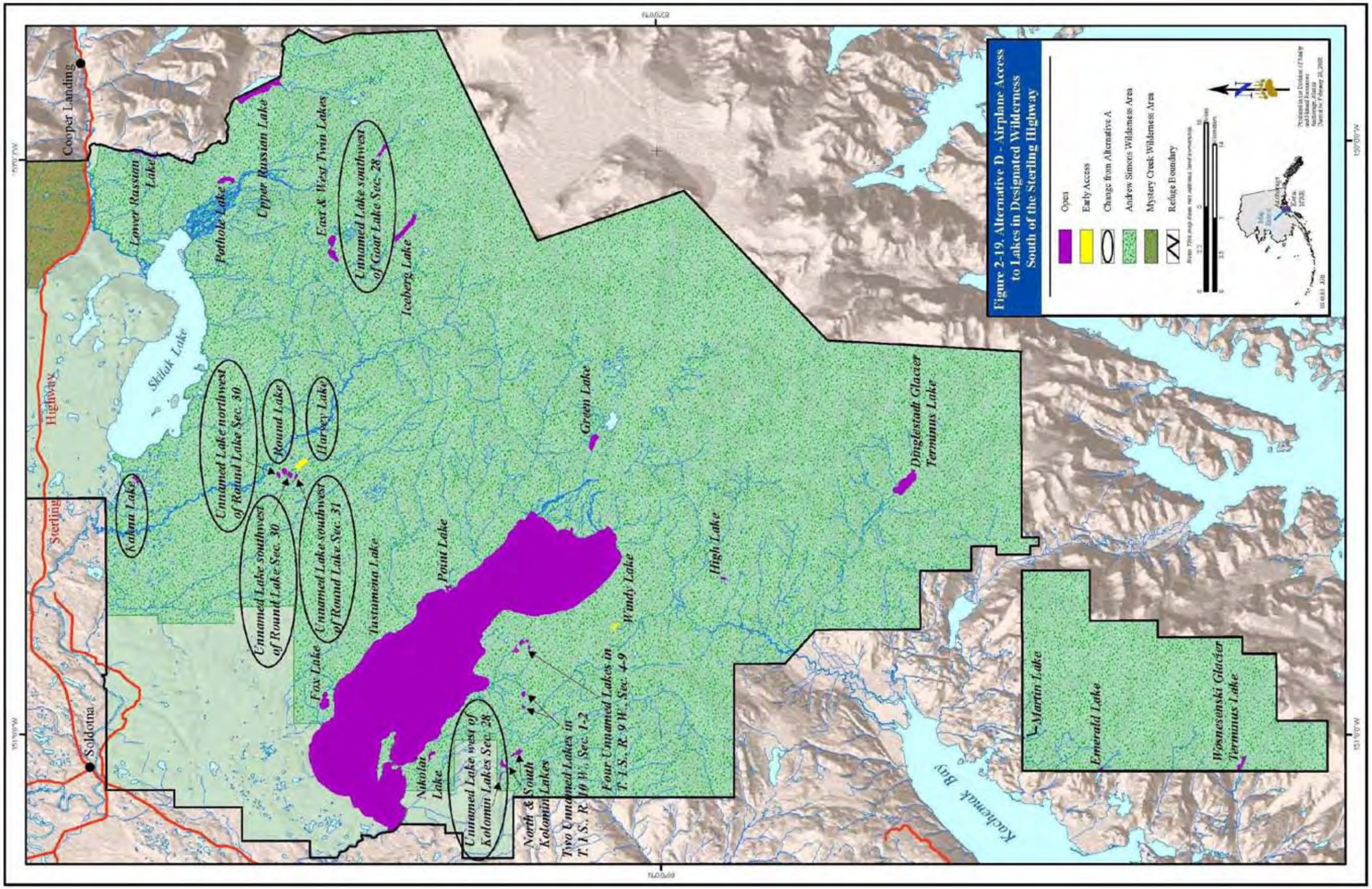

Figure 2-19. Alternative D - Airplane Access to Lakes in Designated Wilderness South of the Sterling Highway

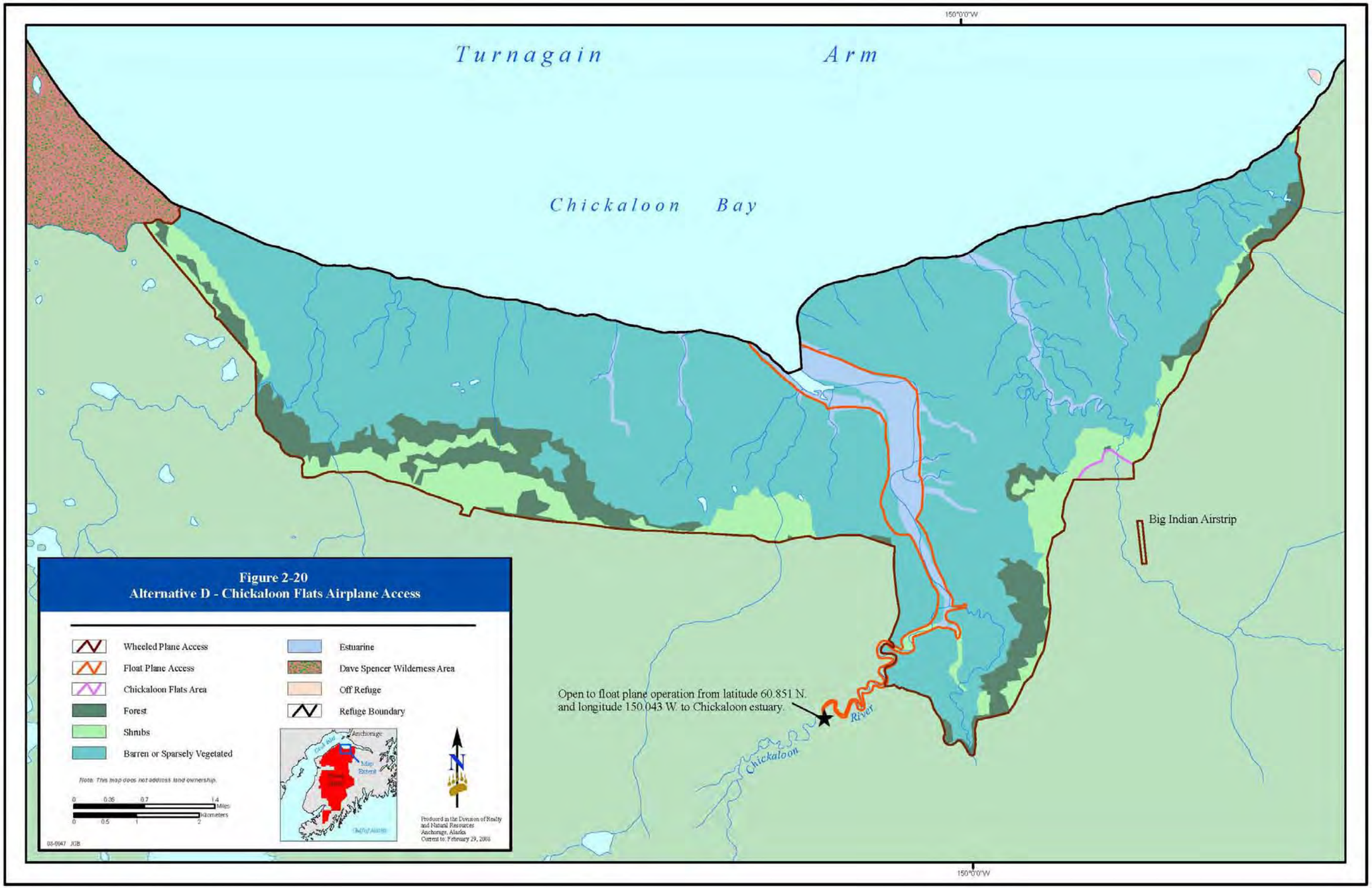

Figure 2-20. Alternative D - Chickaloon Flats Airplane Access

2.1.8.4 Funding and Personnel Requirements

Base Funding

All current management programs would continue under Alternative C, and some new programs would begin. The base Refuge operational budget ($3,245,000) would continue with additions to cover the new programs. Additional funds necessary to operate Refuge programs received for annual maintenance ($312,000) and fire operations ($528,000) would continue to be needed. To maintain the current level of services and adequately fund new programs, the one-time operations addition in fiscal year (FY) 2007 ($390,000) would continue to be required to operate at FY 2005 levels, and adjustments would be necessary to balance the offsets of fixed costs and inflation. Current funding levels are inadequate to fully implement existing biological and visitor services programs, so new funds would be necessary.

Table 2-8 reflects the funds necessary to implement Alternative D in addition to base funds already received. The figures demonstrate the level of funding needed to maintain programs plus inflation adjustments for the short term. Long-term adjustments to the base budget reflect not only short-term adjustments, but also implementation of projects currently identified in the RONS database plus those needed to implement this alternative. Significant new funding will be required to implement this alternative to pave some roadways ($26,000,000), harden surfaces of other roadways ($2,500,000), develop new visitor facilities for wildlife observation ($1,500,000), develop new trails ($1,500,000), and pay salaries for six full time personnel ($750,000) and a seasonal trail crew ($250,000) needed to accomplish these new programs.

Table 2-8. Alternative D Budget Needs Beyond Current Levels

Item	Short-Term Needs (1 – 3 Years)	Long-Term Needs (3 – 15 Years)
Total Annual Budget Needs	$8,050,000	$21,864,410

RONS / SAMMS Projects

A number of RONS and SAMMS projects would need to be funded to achieve the requirements of this alternative.

Other

Management of oil and gas related activities on the Refuge would continue to be manpower intensive and costly under this alternative.

Additional Staffing Needs

Selection of this alternative would require additional staff: Two additional law enforcement officers, in addition to those positions

currently identified in the RONS package, would be required. Costs for these positions would be approximately $300,000 in year one and $160,000 in subsequent years. Year one costs would include moves, vehicle, salary, and necessary equipment. Other required personnel would include two maintenance professionals (year one costs approximately $250,000; subsequent years approximately $160,000), and two park rangers (Visitor Services) to provide services at new facilities (year one costs approximately $250,000; subsequent years approximately $160,000). A seasonal trail crew consisting of five permanent seasonal employees would also be added at a cost of approximately $250,000. Table 2-9 identifies the number of staff needed beyond current levels to fully implement Alternative D.

Table 2-9. Alternative D Staffing Needs beyond Current Levels

Action Type	Short-Term Needs (1 – 3 Years)	Long-Term Needs (3 – 15 Years)
Permanent Full-Time Employees	5	16
Permanent Seasonal Employees	5	21
Seasonal Employees	10	50
Volunteers	20	60

2.1.9 Alternative E — The Preferred Alternative

2.1.9.1 General Management Direction

Although most of the general management direction described in Alternative A would continue, some specific direction and actions occurring under current management would be altered or not pursued under Alternative E. The following discussion identifies management direction proposed under Alternative E. Additionally, the Refuge Goals and Objectives presented in section 2.2 and the Management Direction, Policies, and Guidelines presented in Volume 2, Appendix C apply to this alternative.

2.1.9.2 Management Categories

Four management categories would be applied to Kenai Refuge under Alternative E (Figure 2-21).

Intensive Management – Approximately 54,500 acres (2.7 percent) of the land would be managed under the Intensive management category.

Moderate Management – This category would be reduced and eventually eliminated after the life of the Alaska Pipeline project. Approximately 129,550 acres (6.5 percent) of the land would convert to the Minimal management category immediately. The remaining 49,450 acres

(2.5 percent) of land would be retained as Moderate management during the life of the Alaska Pipeline project. These lands would convert to the Minimal management category after the life of that project.

Traditional Management – This category would be eliminated. All of the 189,000 acres (9.6 percent) of land currently identified under this category would convert to the Minimal management category.

Minimal Management – Approximately 514,550 acres (25.9 percent) of the land would be managed under the Minimal management category during the life of the Alaska Pipeline project. After the life of the project, 564,000 acres (28.4 percent) would be managed under the Minimal management category.

Wilderness Management – Approximately 1,320,500 acres (66.4 percent) of the land would be managed under the Wilderness management category.

2.1.9.3 Management Direction Identified By Issue

The following discussion describes how Alternative E would address the issues identified during the scoping process. It provides management direction for major Refuge programs as they would be implemented under the alternative.

Issue 1: How will the Refuge address large-scale habitat changes and the use of fire?

Fire Management Program

Use of Fire as a Management Tool

Management direction would allow prescribed fire, wildfire, and mechanical treatments as the principle management tools to improve wildlife habitats, reduce hazardous accumulations of wildland fuels, and maintain or restore natural fire regimes (Figure 2-22).

Prescribed fire would be allowed in the Intensive, Moderate, Minimal, and Wilderness management categories (approximately 1,938,000 acres or 97.5 percent of the Refuge), though its use in the Wilderness management category occur under specific conditions defined in national Wilderness and Fire Management policies.

Use of wildland fire would be allowed in the Intensive, Moderate, Minimal, and Wilderness management categories (approximately 1,938,000 acres or 97.5 percent of the Refuge), but use would be the default management action in the Minimal and Wilderness management categories (approximately 1,883,500 acres or 95 percent of the Refuge). Undesirable wildfires (i.e., those not contributing to Refuge management goals) would be suppressed through the use of a pre-identified management response.

Issue 2: How will the Refuge manage facilities for public use while ensuring natural resources protection?

Facilities Management Program

Swanson River Oil and Gas Unit

Industrial roads, pipelines, and facilities may be authorized in support of exploration, discovery, development, and production of oil and gas found within the unit by the current unit operator. Such operations would be subject to prior approval of the U.S. Fish and Wildlife Service (Service). An annual Plan of Development and Operations would be required from each unit operator. The Plan would be reviewed by the Service for comment and approved by the BLM authorized officer (AO). The AO's approval, with the Service's concurrence, of specific operations must be obtained prior to commencement of such operations. During the life of the project, the Refuge would request, on a case-by-case basis, that industrial roads, pipelines and associated fixtures, and facilities not needed to support ongoing operations be removed and the sites restored.

After the life of the project, some industrial roads; most pipelines, sections of pipelines, and associated fixtures, regardless of whether they are located along industrial roads, on gravel well pads, or along utility corridors that have not adequately revegetated; and most facilities built to support oil and gas operations would be removed and the sites restored to match the surrounding landscape. In cases where more environmental damage would occur by removing pipelines (or sections of pipelines) than by leaving them in place, the pipeline (or sections of pipeline) would be cleaned, capped, and left in place. Most industrial roads would be retained and maintained for public and administrative uses at the Refuge manager's discretion. Some facilities built to support oil and gas operations may be retained for administrative uses (e.g., research, law enforcement, or seasonal programs) at the Refuge manager's discretion; and up to two developed campgrounds, consisting of "hardened" campsites, vault toilets, tables, and fire rings, would be provided. Bicycles would be allowed on roads and trails.

Beaver Creek Oil and Gas Unit

Industrial roads, pipelines, and facilities may be authorized in support of exploration, discovery, development, and production of oil and gas found within the unit by the current unit operator. Such operations would be subject to prior approval of the U.S. Fish and Wildlife Service. An annual Plan of Development and Operations would be required from each unit operator. The Plan would be reviewed by the Service for comment and approved by the BLM authorized officer (AO). The AO's approval, with the Service's concurrence, of specific operations must be obtained prior to commencement of such operations. During the life of the project, the Refuge would request, on a case-by-case basis, that industrial roads, pipelines and associated fixtures, and facilities not needed to support ongoing operations be removed and the sites restored.

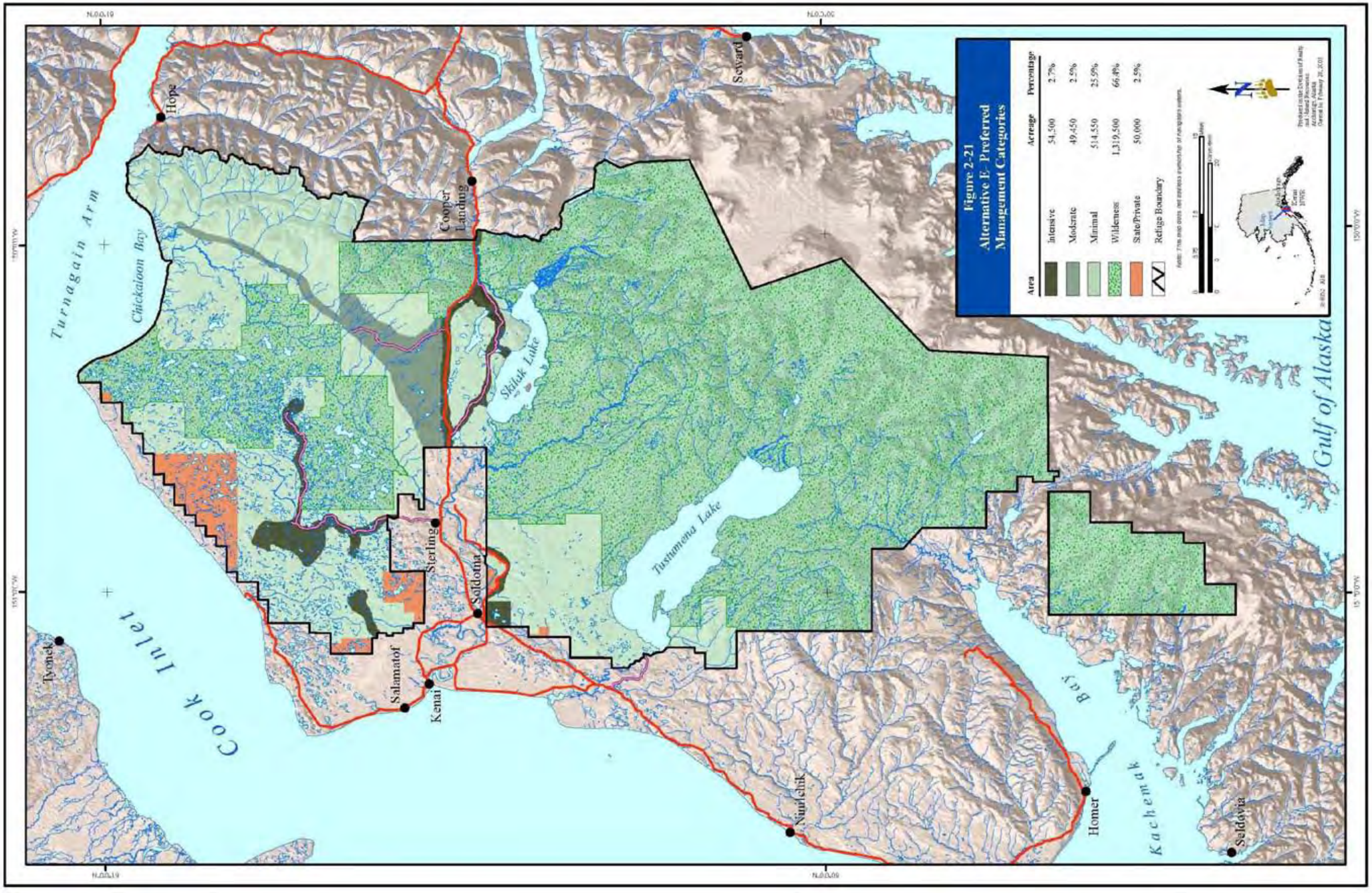

Figure 2-21. Alternative E - Preferred Management Categories

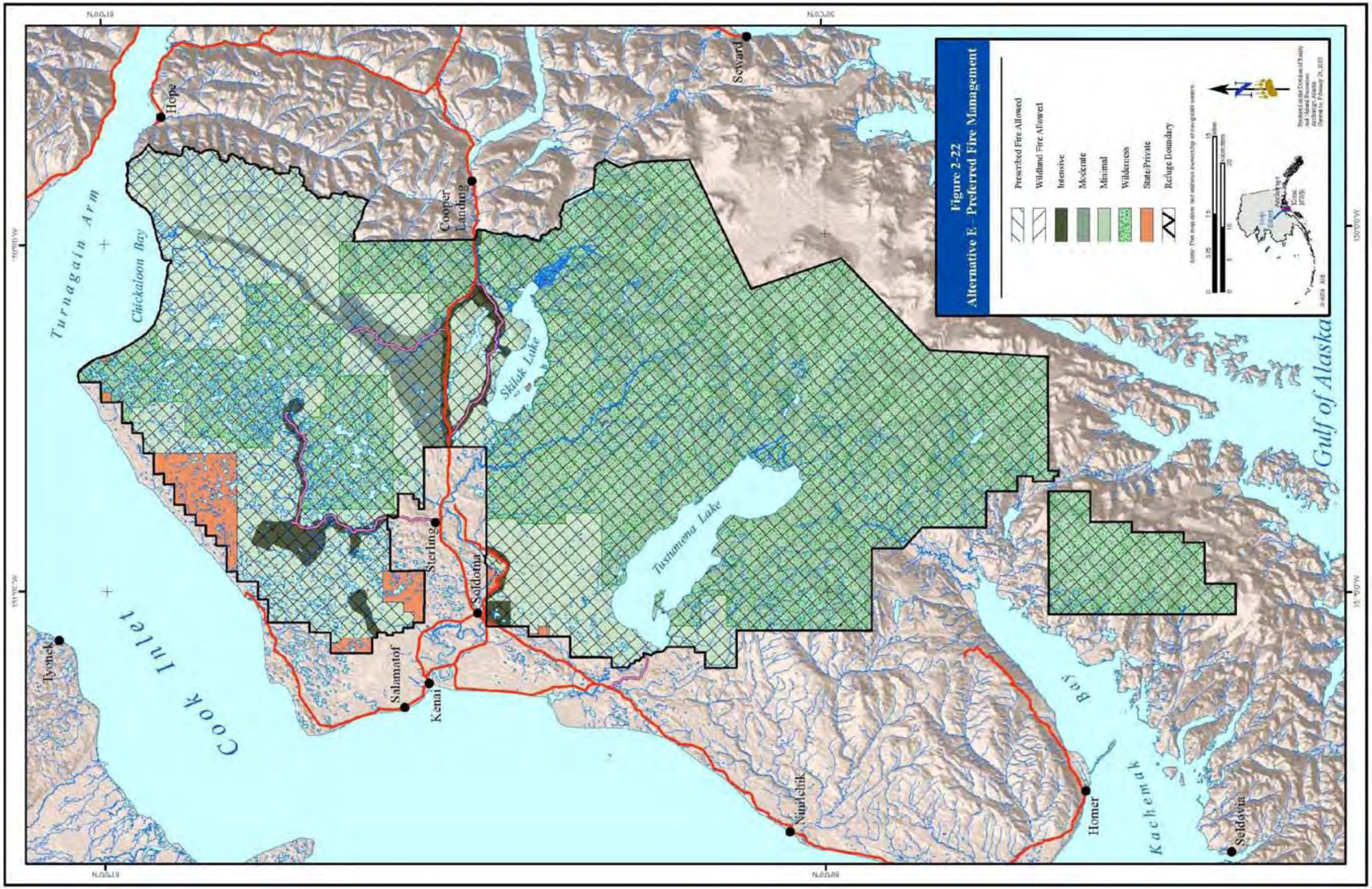

Figure 2-22. Alternative E - Preferred Fire Management

After the life of the project, all industrial roads (except Marathon Road); pipelines and associated fixtures, regardless of whether they are located along industrial roads, on gravel well pads, or traverse the landscape; and all facilities built to support oil and gas operations would be removed and the sites restored to match the surrounding landscape. No industrial roads, or facilities built to support oil and gas operations, would be retained for public and/or administrative uses. Camping facilities would not be provided, and bicycles would not be allowed.

Contaminated Sites

Industrial facilities would be required to operate in compliance with all applicable Federal and State environmental statues and regulations, known contaminant releases are to be cleaned up in a timely manner, and areas no longer in use are to be restored to predevelopment conditions. Industry would be required to investigate, and if necessary, test suspected contaminated sites to confirm the existence and identity of contaminates and to remediate and restore the sites as necessary to acceptable standards agreed upon by Alaska Department of Environmental Conservation (ADEC), Bureau of Land Management (BLM), the Service, and the site owner or operator.

Mystery Creek Access Road and Pipeline Corridor

Maintenance of the improved access road from the Sterling Highway to the Alaska Pipeline corridor would be conducted by ENSTAR to continue to provide for a backcountry experience. This access road would remain largely unimproved and in its current condition except for minimal maintenance to ensure public safety and environmental protection. Road improvements would be limited to those necessary for public safety and environmental protection. ENSTAR is responsible for maintenance consistent with their right-of-way agreement; the Refuge would be responsible for most improvements designed for public use of the area. Public use of the area would require registration at points of entry. Public vehicle use of the improved access road and Alaska Pipeline corridor north to Chickaloon Bay and southwest to the East Fork of the Moose River would be allowed from August 9 through November 30. Pedestrian and horse use would be allowed year-round with no seasonal restrictions. Snowmachine use would be allowed when the Refuge manager determines there is adequate snow cover and when adjacent areas are open. Bicycle use would be allowed when the access road and Alaska Pipeline corridor are open to public vehicle use (approximately August 9) until November 30. After the life of the pipeline project, the unimproved access road and Alaska Pipeline corridor would be restored, and a trail would be constructed for pedestrian and horse use only.

Ski Hill Road

The Refuge will assume management and maintenance responsibilities for the Ski Hill Road upon its transfer from the State to the Service.

Maintenance and road improvements would be conducted by the Refuge. The northern route would remain graveled and open to pedestrian, bicycle, and emergency vehicle use only. The southern route would be improved, hard-surfaced, and open to public vehicle use, and a trail would be provided within the road right-of-way for pedestrian and bicycle use.

Sterling Highway Pullout

Develop a formal rest stop at milepost 62 through a cooperative effort with the State of Alaska Department of Transportation and Public Facilities.

Trail Maintenance and Planning

Continue development of new trails as planned in all management categories except Wilderness. Develop a trail needs assessment that identifies and prioritizes construction and/or maintenance needs and construction standards for a variety of trails through a public involvement process. Trail construction and design will be consistent with the Kenai Peninsula Brown Bear Conservation Strategy.

Issue 3: How will the Refuge enhance wildlife-oriented recreation opportunities?

Visitor Services Program

Personal Collection of Natural Resources

Refuge-specific regulations would be amended to allow the personal collection and use of unlimited quantities of berries, mushrooms, and other edible plants. Such collection would be for non-commercial use only and could only be undertaken in a manner that does not unduly damage other resources (e.g., an individual could not cut down live trees to harvest the seeds/cones). Additionally, the collection of up to eight naturally shed moose or caribou antlers per person per year for non-commercial purposes would be allowed.

Christmas Tree Harvesting

Refuge-specific regulations would be amended to allow for harvesting one black or white spruce tree no larger than 20 feet in height per family per year between Thanksgiving and Christmas Day. Trees could not be taken within the two-square-mile Refuge Visitor Center area on Ski Hill Road or closer than 150 feet from roads, trails, campgrounds, picnic areas, and waterways (lakes, rivers, streams, or ponds). Additionally, for safety reasons, stumps from harvested trees must be trimmed less than six inches from the ground.

Issue 4: How will the Refuge manage increasing public use to ensure resource and visitor experience protection?

Visitor Services Program

Swan Lake and Swanson River Canoe Systems

All canoeists would be required to register at entrance points. Maximum group size would be limited to 15 individuals without a special use permit. Dispersed camping would be allowed but may not exceed 14 days in any 30-day period. Campsites would be monitored and evaluated regularly using standard protocols. Management actions taken to address resource concerns, including temporary closures of selected campsites to encourage natural rehabilitation, may be implemented as needed. Regulations requiring appropriate disposal of human waste would be adopted.

Upper Kenai River (Russian River to Skilak Lake)

Non-Guided Public Use — Implement a program to restrict or redirect non-guided public use for the Upper Kenai River if more than 25 percent of anglers surveyed (outside the confluence area) report difficulty in finding an uncrowded fishing spot.

Guided Use: Sportfishing — Special use permits would be required for sportfishing guides. Permits would be limited to 18 issued through attrition. Each permit would allow 10 starts per week with no more than 4 starts per day. Additional restrictions may be imposed if demand for commercial recreational services increases.

Guided Use: Sportfishing Incidental Use Program — State-licensed sportfishing guides not having Refuge special use permits may be issued incidental use permits for as many as three trips per year subject to additional quotas and blackout dates.

Camping — Dispersed camping within 100 yards of the Kenai River or within one-quarter mile of the Sterling Highway would not be allowed.

Middle Kenai River (Skilak Lake Downstream to Refuge Boundary)

Non-Guided Public Use — Non-guided public use would be allowed without restriction on the number of users until a Limits-of-Acceptable-Change (LAC) planning process is completed with stakeholders, including the State of Alaska, which would lead to the development of a step-down management plan. The LAC process incorporates interested users in defining desired future conditions and actions necessary to achieve those conditions.

Guided Use: Sportfishing — Special use permits would be required for sportfishing guides. Permits would be limited to the number of permittees existing upon completion of this comprehensive conservation planning process, and existing permittees would be “grandfathered” in.

Issue 5: How will the Refuge balance motorized access with protection of resources and visitor experiences?

Airplane Access to Lakes in Designated Wilderness

Airplane access would be allowed on 46 lakes in designated Wilderness (Figure 2-23 and Figure 2-24).

- Dave Spencer Unit: Scenic, Nekutak, Shoepac, Norak, Grouse, King, Bedlam, Taiga, Snowshoe, Wilderness, Mull, Tangerra, Bird, Cook, Sandpiper, and Vogel lakes, plus Pepper, Gene, and Swanson lakes would be open for ice fishing only.
- Andy Simons Unit: Upper Russian, East Twin, West Twin, Emerald, High, Dinglestadt Glacier terminus, Lower Russian, Iceberg, Green, North Kolomin, South Kolomin, Wosnesenski Glacier terminus, Pothole, Harvey, Martin, Windy, Tustumena and all wilderness lakes within one mile of the shoreline of Tustumena Lake (Fox, Nikolai, and Point lakes), and all unnamed lakes in Sections 1 and 2, T. 1 S., R. 10 W., and Sections 4, 5, 8, and 9, T. 1 S., R. 9 W., Seward Meridian, AK (six lakes).
- Mystery Creek Unit: An unnamed lake in Section 11, T. 6 N., R. 5 W., Seward Meridian, AK

Airplane access would not be allowed from May 1 through September 30 on any lake where nesting trumpeter swans and/or their broods are present except on two lakes in designated Wilderness—Scenic Lake located within the Dave Spencer unit of the Kenai Wilderness, and Windy Lake located within the Andy Simons unit of the Kenai Wilderness, where the closure would be May 1 through September 10.

The Refuge will propose a rule change that would allow, but not require, the Refuge Manager to issue special use permits to successful applicants in the State's limited drawing hunt program. This opportunity would allow the Refuge Manager to provide increased access to otherwise closed lakes for hunters who have drawn special permits. Such access would be limited enough in scope that no significant impacts would be anticipated, and no additional environmental analysis would generally be necessary. The specifics of this proposed access opportunity will be addressed in the proposed rulemaking to follow approval of this Plan.

Airplane Access to Chickaloon Flats

Wheeled airplane access would be allowed year-round on 21 square miles of the Chickaloon Flats area that are unvegetated and the Big Indian Creek airstrip (minimal periodic maintenance); and floatplane access would be allowed on 6.5 miles of the Chickaloon River (Figure 2-25).

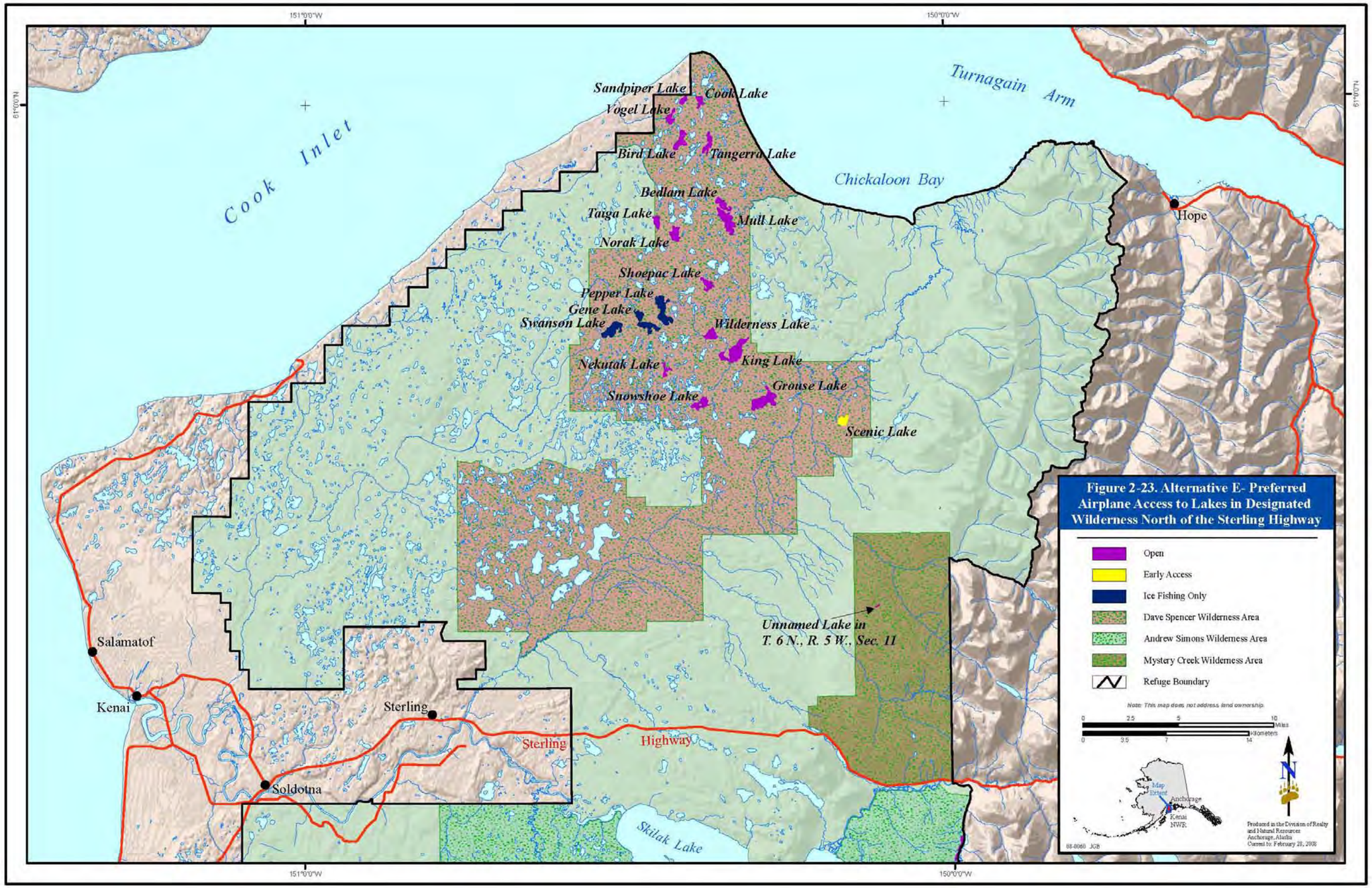

Figure 2-23. Alternative E – Preferred Airplane Access to Lakes in Designated Wilderness North of the Sterling Highway

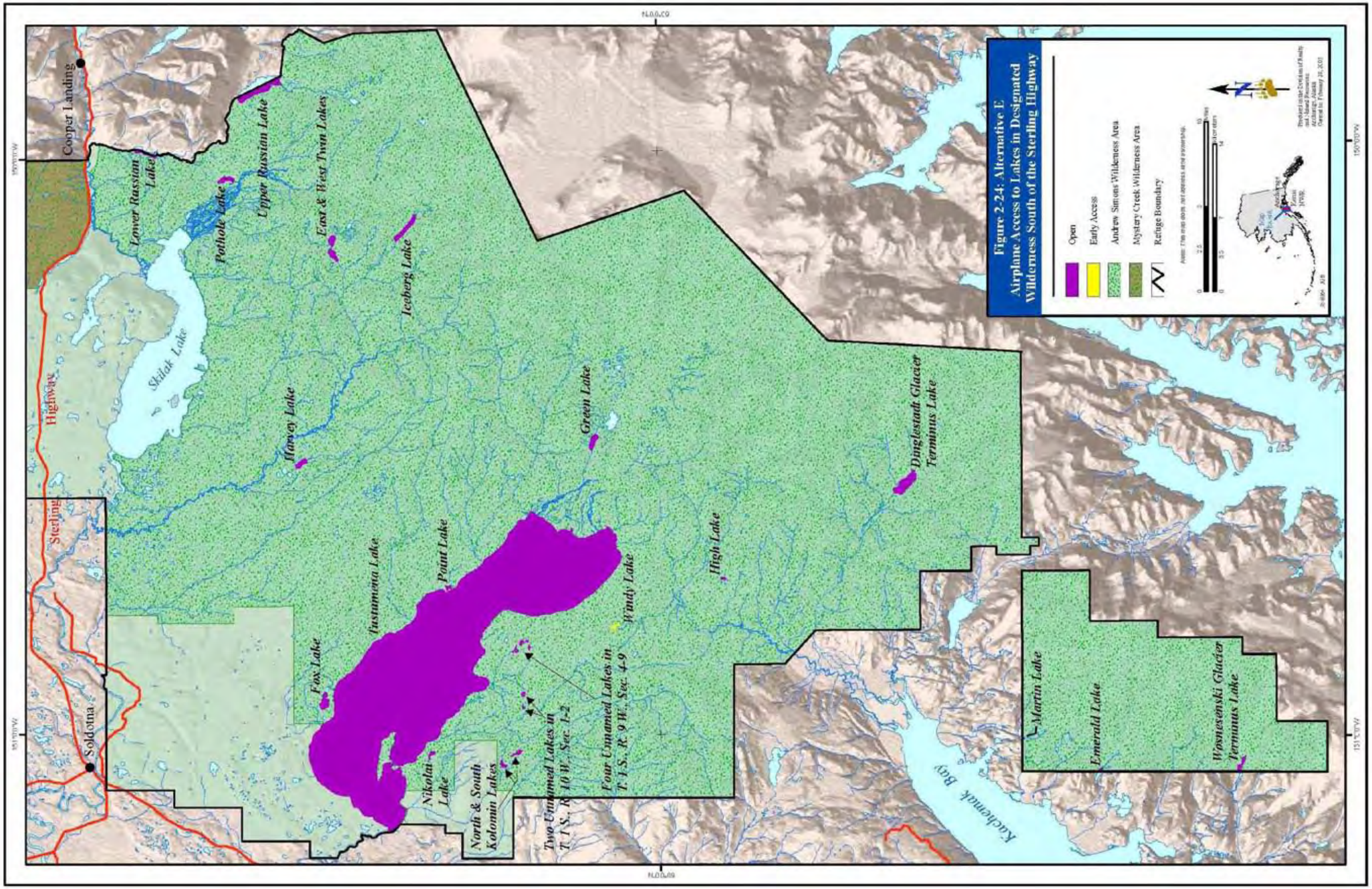

Figure 2-24. Alternative E - Airplane Access to Lakes in Designated Wilderness South of the Sterling Highway

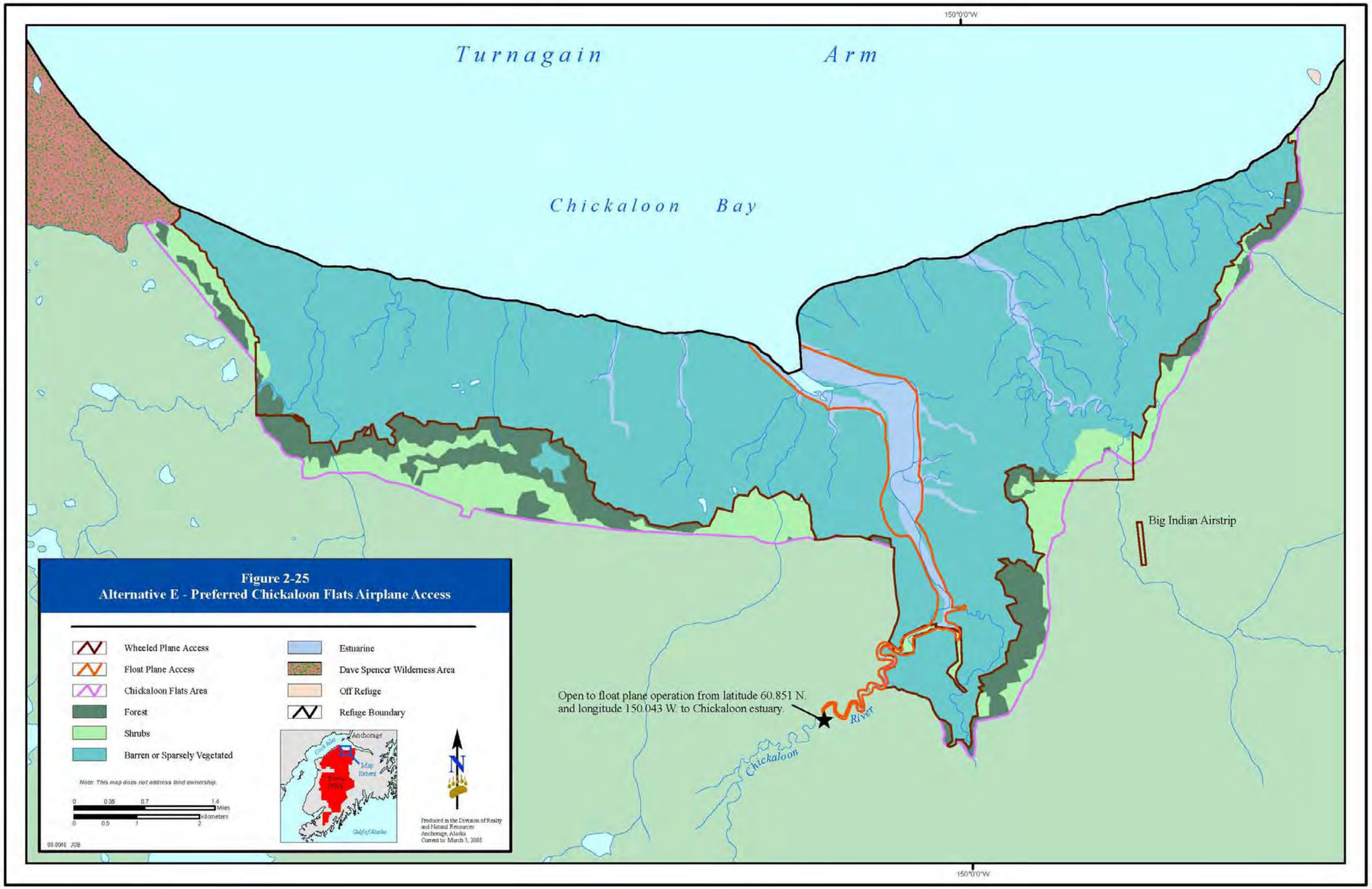

Figure 2-25. Alternative E - Preferred Chickaloon Flats Airplane Access

Snowmachine Access

Snowmachines less than 46 inches wide and less than 1,000 pounds in weight would be allowed in designated areas from December 1 through April 30 when the Refuge manager determines there is adequate snow cover to protect underlying vegetation and soils. Studies would be conducted with the State of Alaska and other stakeholders to evaluate the effects of use on Refuge resources and visitor experiences, the results of which would be used to support future management decisions.

2.1.9.4 Funding and Personnel Requirements

Base Funding

All current management programs would continue under Alternative E, and some new programs would begin. The base Refuge operational budget ($3,245,000) would continue with additions to cover the new programs. Additional funds necessary to operate Refuge programs received for annual maintenance ($312,000) and fire operations ($528,000) would continue to be needed. To maintain the current level of services and adequately fund new programs, the one-time operations addition in fiscal year (FY) 2007 ($390,000) would continue to be required to operate at FY 2005 levels, and adjustments would be necessary to balance the offsets of fixed costs and inflation. Current funding levels are inadequate to fully implement existing biological and visitor services programs, so new funds would be necessary.

Table 2-10 reflects the funds necessary to implement Alternative E in addition to base funds already received. The figures demonstrate the level of funding needed to maintain programs plus inflation adjustments for the short term. Long-term adjustments to the base budget reflect not only short-term adjustments, but also implementation of projects currently identified in the RONS database plus those needed to implement this alternative.

Table 2-10. Alternative E Budget Needs Beyond Current Levels

Item	Short-Term Needs (1 – 3 Years)	Long-Term Needs (3 – 15 Years)
Total Annual Budget Needs	$5,115,000	$22,414,410

RONS / SAMMS Projects

A number of RONS and SAMMS projects would need to be funded to achieve the requirements of this alternative.

Other

Management of oil and gas related activities on the Refuge would continue to be manpower intensive and costly under this alternative.

Additional Staffing Needs

Selection of this alternative would require new staff. One additional law enforcement officer, in addition to those positions currently identified in the RONS package, would be required. Costs for this position would be approximately $150,000 in year one, and $80,000 in subsequent years. Year one costs will include a move, vehicle, salary, and necessary equipment. A seasonal trail crew consisting of five permanent seasonal employees would also be added at a cost of approximately $250,000. Table 2-11 identifies the number of staff needed beyond current levels to fully implement Alternative E.

Table 2-11. Alternative E Staffing Needs beyond Current Levels

Action Type	Short-Term Needs (1 – 3 Years)	Long-Term Needs (3 – 15 Years)
Permanent Full-Time Employees	1	26
Permanent Seasonal Employees	5	16
Seasonal Employees	5	30
Volunteers	20	60

2.1.10 Comparison of the Alternatives

Table 2-12. Comparison of the Alternatives Identified By Issue and Management Action

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Issue 1: How will the Refuge address large-scale habitat changes and the use of fire?					
Management Categories:					
Intensive Management	54,500 acres (2.7%)	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Moderate Management	179,000 acres (9.1%)	204,000 acres (10.3%)	Same as Alternative A	49,450 acres (2.5%) in Mystery Creek area retained during the life of the Alaska Pipeline project. These lands would convert to the Minimal management category after the life of the project	Same as Alternative D
Traditional Management	189,000 acres (9.6%)	0	Same as Alternative B	Same as Alternative B	Same as Alternative B
Minimal Management	196,000 acres (9.7%)	360,000 acres (18.1%)	385,000 acres (19.3%)	514,550 acres (25.9%) during the life of the Alaska Pipeline project; 564,000 acres (28.4%) after the life of the project.	Same as Alternative D
Designated Wilderness	1,320,500 acres (66.4%)	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A

Note: Acreage percentages are based on Service lands within the Refuge Boundary. State and private ownership within the Refuge is approximately 2.5%.

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Use of Fire as a Management Tool:					
	Use of fire allowed to improve habitats for select wildlife species. Prescribed fire allowed in the Intensive, Moderate, Traditional, and Minimal management categories, though its use would be limited in the Minimal management category. Use of wildland fire allowed in the Moderate, Traditional, Minimal, and Wilderness management categories.	Use of fire allowed as the principle management tool to improve wildlife habitats, reduce hazardous accumulations of wildland fuels, and maintain or restore natural fire regimes. Prescribed fire allowed in the Intensive and Moderate management categories. Use allowed in the Minimal management category but only on lands not adjoining designated Wilderness. Use of wildland fire allowed in the Minimal and Wilderness management categories.	Use of fire allowed as the principle management tool to improve wildlife habitats, reduce hazardous accumulations of wildland fuels, and maintain or restore natural fire regimes. Prescribed fire allowed in the Intensive, Moderate, and Minimal management categories. Use of wildland fire allowed in the Intensive, Moderate, Minimal, and Wilderness management categories, but use would be emphasized in the Minimal management category and the default management action in designated Wilderness.	Use of fire allowed as the principle management tool to improve wildlife habitats, reduce hazardous accumulations of wildland fuels, and maintain or restore natural fire regimes. Prescribed fire allowed in the Intensive, Moderate, Minimal, and Wilderness management categories, though its use in Wilderness would only be allowed under specific conditions. Use of wildland fire allowed in the Intensive, Moderate, Minimal, and Wilderness management categories, but use would be the default management action in the Minimal and Wilderness management categories.	Same as Alternative D

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Issue 2: How will the Refuge manage facilities for public use while ensuring natural resources protection?					
Swanson River Oil and Gas Unit:					
	Most industrial roads would be removed and the sites restored, though some may be retained for possible public and administrative uses. Most facilities would be removed and the sites restored, though some would be retained for possible public and administrative uses. Camping facilities would not be provided, and bicycles would not be allowed.	All industrial roads (except Swanson River Road) would be removed and the sites restored. All pipelines and associated fixtures would be removed and the sites restored. All facilities would be removed and the sites restored. Camping facilities would not be provided, and bicycles would not be allowed.	Some industrial roads would be removed and the sites restored, though most would be converted to trails for pedestrian and horse use. All pipelines and associated fixtures would be removed and the sites restored. All facilities would be removed and the sites restored. Up to five primitive camping facilities would be provided for walk-in use only, and bicycles would not be allowed.	Some industrial roads would be removed and the sites restored, though most would be retained and maintained for public and administrative uses. Most pipelines and associated fixtures that have not adequately revegetated would be removed and the sites restored. In cases where more environmental damage would occur by removing pipelines than by leaving them in place, pipelines would be cleaned, capped, and left in place. Most facilities would be removed and the sites restored, though some would be retained for administrative uses. Up to two developed campgrounds would be provided, and bicycles would be allowed on roads and trails.	Same as Alternative D

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Beaver Creek Oil and Gas Unit:					
	Most industrial roads would be removed and the sites restored, though some may be retained for possible public and administrative uses. Most facilities would be removed and the sites restored, though some would be retained for possible public and administrative uses. Camping facilities would not be provided, and bicycles would not be allowed.	All industrial roads (except Marathon Road) would be removed and the sites restored. All pipelines and associated fixtures would be removed and the sites restored. All facilities would be removed and the sites restored. Camping facilities would not be provided, and bicycles would not be allowed.	Some industrial roads would be removed and the sites restored, though most would be converted to trails for pedestrian and horse use. All pipelines and associated fixtures would be removed and the sites restored. All facilities would be removed and the sites restored. Up to two primitive camping areas would be provided for walk-in use only, and bicycles would not be allowed.	Some industrial roads would be removed and the sites restored, though most would be retained and maintained for public and administrative uses. Most pipelines and associated fixtures that have not adequately revegetated would be removed and the sites restored. In cases where more environmental damage would occur by removing pipelines than by leaving them in place, pipelines would be cleaned, capped, and left in place. Most facilities would be removed and the sites restored, though some would be retained for administrative uses. Up to one developed campground would be provided, and bicycles would be allowed on roads and trails.	Same as Alternative B

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Contaminated Sites:					
	Industrial facilities would be required to operate in compliance with all applicable Federal and State environmental statues and regulations. Known contaminant releases are to be cleaned up in a timely manner, and areas no longer in use are to be restored .	Same as Alternative A, plus industry would be required to investigate, and if necessary, test suspected contaminated sites to confirm the existence and identity of contaminates and to remediate and restore the sites as necessary to acceptable standards agreed upon by Alaska Department of Environmental Conservation (ADEC), Bureau of Land Management (BLM), the Service, and the site owner or operator.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
Mystery Creek Access Road and Alaska Pipeline Corridor:					
	Maintenance of the unimproved access road would be conducted by ENSTAR during the life of the pipeline project. Public use registration would not be required. Public vehicle use of the access road and	Maintenance of an improved access road would be increased and conducted by ENSTAR during the life of the pipeline project. Road improvements would facilitate public access, enhance public safety, and ensure environmental	Maintenance of an improved access road would be conducted by ENSTAR during the life of the pipeline project and would continue to provide for a backcountry experience. Road improvements would be limited to those necessary for	Maintenance of the unimproved access road would be conducted by ENSTAR during the life of the pipeline project. Public use registration would not be required. Public vehicle use of the access road and pipeline corridor would not be	Same as Alternative C except after the life of the project, the access road and pipeline corridor would be restored, and a trail would be provided for pedestrian and horse use only.

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
	pipeline corridor north to Chickaloon Bay would be allowed from start of moose hunting season (approximately August 9) until snow cover. Pedestrian, horse, and snowmachine use would be allowed. Bicycle use would be allowed approximately August 9 until snow cover. After the life of the project, the access road and pipeline corridor would be restored.	protection. Public use registration would be required at points of entry. Public vehicle use of the access road and pipeline corridor north to Chickaloon Bay and southwest to the East Fork of the Moose River would be allowed from July 1 through November 30. Pedestrian, horse, and snowmachine use would be allowed. Bicycle use would be allowed generally from May 1 through November 30. Public use and/or restoration opportunities would be re-evaluated after the life of the project.	public safety and environmental protection. Public use registration would be required at points of entry. Public vehicle use of the access road and pipeline corridor north to Chickaloon Bay and southwest to the East Fork of the Moose River would be allowed from August 9 through November 30. Pedestrian, horse, and snowmachine use would be allowed. Bicycle use would be allowed approximately August 9 through November 30. Public use and/or restoration opportunities would be re-evaluated after the life of the project.	allowed. Pedestrian, horse, and snowmachine use would be allowed. Bicycle use would not be allowed. After the life of the project, the access road and pipeline corridor would be restored, and a trail would be provided for pedestrian and horse use only.	
Trail Maintenance and Planning:					
	The development of new trails would be allowed in all management categories except Wilderness. Maintenance decisions would continue to be	In addition to those conditions in Alternative A: Develop a trail needs assessment that identifies and prioritizes construction and/or maintenance needs and	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
	driven by availability of funding.	construction standards for a variety of trails.			
Ski Hill Road:					
	Maintenance of the graveled road conducted by the State of Alaska Department of Transportation and Public Facilities. Pedestrian, bicycle, and vehicle use allowed.	Maintenance of the graveled road conducted by the Service. Pedestrian, bicycle, and vehicle use allowed.	Management and maintenance conducted by the Service. The northern section of the road would remain graveled and open to pedestrian, bicycle, and emergency vehicle use only. The southern section of the road would be improved and hard-surfaced, and open to pedestrian, bicycle, and public vehicle use.	Management and maintenance conducted by the Service. The northern section of the road would remain graveled and open to pedestrian, bicycle, and emergency vehicle use only. The southern section of the road would be improved and hard-surfaced for public vehicle use, and a trail would be constructed in the road right-of-way for pedestrian and bicycle use.	Same as Alternative D.
Sterling Highway Pullout (milepost 62.5):					
	Maintenance not conducted, and public use facilities not provided.	Develop a formal rest stop at MP 62 through a cooperative effort with the State of Alaska Department of Transportation and Public Facilities.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Issue 3: How will the Refuge enhance wildlife-oriented recreation opportunities?					
Personal Collection of Natural Resources:					
	Personal collection of berries, mushrooms, and other edible plants, and/or the collection of shed antlers would not be allowed.	Personal collection and use of unlimited quantities of berries, mushrooms, and other edible plants; and up to eight naturally shed moose or caribou antlers per person per year would be allowed.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
Christmas Tree Harvesting:					
	Harvesting one black or white spruce tree no larger than 20 feet in height per family per year between Thanksgiving and Christmas Day for personal use would be allowed upon general announcement.	Amend Refuge-specific regulations to allow for harvesting one black or white spruce tree no larger than 20 feet in height per family per year between Thanksgiving and Christmas Day for personal use.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
Issue 4: How will the Refuge manage increasing public use to ensure resource and visitor experience protection?					
Swanson River / Swan Lake Canoe System:					
	Public use registration would be required. Maximum group size would be limited to 15 individuals without a special use permit.	Public use registration would be required, and enforcement would be increased. Maximum group size would be limited to 15 individuals	Public use registration would be required. Maximum group size would be limited to 15 individuals without a special use permit.	All visitors would be required to register via a reservation system. Maximum group size would be limited to 15 individuals without a	Same as Alternative C.

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
	Dispersed camping would be allowed but may not exceed 14 days in any 30-day period.	without a special use permit. Dispersed camping would be allowed but may not exceed 14 days in any 30-day period. Conduct a Limits-of-Acceptable Change (LAC) framework with stakeholders to guide future management actions.	Dispersed camping would be allowed but may not exceed 14 days in any 30-day period. Dispersed campsites would be monitored and evaluated regularly using standard protocols. Management actions may be implemented as needed. Regulations requiring appropriate disposal of human waste would be adopted.	special use permit. Camping would be allowed in designated sites only. Regulations requiring the use of outhouses provided at designated campsites would be adopted.	
Upper Kenai River (Russian River to Skilak Lake):					
	Non-guided public use would be allowed without restriction. Sportfishing guides would be required to have special use permits. Permits would be limited to 20 issued. Each permit would allow 10 starts per week with no more than 4 starts per day. Additional restrictions may be imposed if demand for commercial recreational services increases. State-licensed sportfishing	Work cooperatively with stakeholders to modify, as needed, existing management agreements or plans (or develop new ones) to address Upper Kenai River crowding issues related to non-guided public use. Sportfishing guides would be required to have special use permits. Permits would be limited to 20 issued. The timing of boats and starts for each permit would be	Implement a public process to restrict or redirect non-guided public use for the Upper Kenai River if more than 25% of anglers surveyed (outside of the confluence area) report difficulty in finding an uncrowded fishing spot. Sportfishing guides would be required to have special use permits. Permits would be reduced to 18 through attrition and issued competitively.	Implement a limited permit program to address non-guided public use. A public rulemaking process would provide stakeholders an opportunity to provide input on the program. Sportfishing guides would be required to have special use permits. Permits would be reduced to 15 through attrition and issued competitively. Each permit would	Same as Alternative C.

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
	guides not having Refuge special use permits may be issued incidental use permits for as many as three trips per year subject to quotas and blackout dates. Dispersed camping would be allowed but may not exceed 14 days in any 30-day period. Camping would not be allowed within one-quarter mile of the Sterling Highway.	managed beyond current levels. State-licensed sportfishing guides not having Refuge special use permits may be issued an incidental use permit for as many as one trip per year subject to quotas and blackout dates. Dispersed camping within 100 yards of the Kenai River would be limited to 24 hours within any 14-day period. Camping would not be allowed within one-quarter mile of the Sterling Highway.	Each permit would allow 10 starts per week with no more than 4 starts per day. Additional restrictions may be imposed if demand for commercial recreational services increases. State-licensed sportfishing guides not having Refuge special use permits may be issued incidental use permits for as many as three trips per year subject to additional quotas and blackout dates beyond current levels. Dispersed camping within 100 yards of the Kenai River or within one-quarter mile of the Sterling Highway would not be allowed.	allow 10 starts per week with no more than 4 starts per day. Additional restrictions may be imposed if demand for commercial recreational services increases. The Incidental Use Permit Program for State-licensed sportfishing guides not having Refuge special use permits would be eliminated. Dispersed camping within 100 yards of the Kenai River plus camping within one mile of the inlet or outlet of the Kenai River and Skilak Lake would be limited to 48 hours within any 14-day period. Camping would not be allowed within one-quarter mile of the Sterling Highway.	
Middle Kenai River (Skilak Lake Downstream to the Refuge Boundary):					
	Non-guided public use would be allowed without restriction. Sportfishing guides	Non-guided public use would be allowed without restriction. Following the	Non-guided public use would be allowed without restriction on the number of users	Non-guided public use would be managed by a limited permit program. A public rulemaking	Same as Alternative C.

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
	would be required to have special use permits. Permits would be issued without limit.	conclusion of the Kenai River-wide guide limitation process, evaluate the need to implement a Refuge-specific permitting process for guided sportfishing.	until a Limits-of-Acceptable-Change (LAC) planning process is completed with stakeholders (See 2.1.9.3 Issue 4). Sportfishing guides would be required to have special use permits. Permits would be limited to the number of existing permittees, current permittees would be "grandfathered" in for a limited time following regulatory changes."	process would provide stakeholders an opportunity to provide input on the program. Sportfishing guides would be required to have special use permits. Permits would be limited to 20 through a competitive selection process, and management of the timing of boats and/or starts would be initiated.	
Issue 5: How will the Refuge balance motorized use with resource and visitor experience protection?					
Airplane Access to Lakes Located in Designated Wilderness:					
	Airplane access would be allowed on 46 lakes in designated Wilderness. Airplane access would not be allowed from May 1 through September 30 on any lake where nesting trumpeter swans and/or their broods are present except on two lakes in designated Wilderness—Scenic	Airplane access would be allowed on 45 lakes in designated Wilderness, plus an environmental assessment would be conducted to determine the amount of airplane use and any associated impacts on Refuge resources, recreation opportunities, and Wilderness values. Airplane access would	Airplane access would be allowed on 50 lakes in designated Wilderness. Airplane access would not be allowed from May 1 through September 30 on any lake where nesting trumpeter swans and/or their broods are present except on two lakes in designated Wilderness—Scenic	Airplane access would be allowed on 59 lakes in designated Wilderness plus one additional lake. Airplane access would not be allowed from May 1 through September 30 on any lake where nesting trumpeter swans and/or their broods are present except on five lakes in designated	Same as Alternative A. Except: The Refuge will propose a rule change that could allow the Refuge Manager to issue access permits to successful applicants in the State's limited drawing hunt program. (See 2.1.9.3 Issue 5)

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
	Lake, located within the Dave Spencer unit of the Kenai Wilderness, and Windy Lake, located within the Andy Simons unit of the Kenai Wilderness, where the closure would be May 1 through September 10.	not be allowed from May 1 through September 30 on any lake where nesting trumpeter swans and/or their broods are present except on two lakes in designated Wilderness—Scenic Lake, located within the Dave Spencer unit of the Kenai Wilderness, and Windy Lake, located within the Andy Simons unit of the Kenai Wilderness, where the closure would be May 1 through September 10.	Lake, located within the Dave Spencer unit of the Kenai Wilderness, and Windy Lake, located within the Andy Simons unit of the Kenai Wilderness, where the closure would be May 1 through September 10.	Wilderness—Scenic, King, and Bird lakes, located within the Dave Spencer unit of the Kenai Wilderness; Windy and Harvey Lake, located within the Andy Simons unit of the Kenai Wilderness; plus one lake outside of designated Wilderness—Beaver Lake—where the closure would be May 1 through September 10.	
Airplane Access to Chickaloon Flats:					
	Wheeled airplane access would be allowed year-round within designated areas, including three upland landing zones, a designated beach landing zone, and the unmaintained Big Indian Creek airstrip. Floatplane access would be allowed on 6.5 miles of the Chickaloon River.	Wheeled airplane access would be allowed on 21 square miles of the Chickaloon Flats area that are unvegetated and the Big Indian Creek airstrip (minimal periodic maintenance). Floatplane access would be allowed on 6.5 miles of the Chickaloon River.	Wheeled airplane access would be allowed on 21 square miles of the Chickaloon Flats area that are unvegetated and the maintained Big Indian Creek airstrip. Floatplane access would be allowed on 6.5 miles of the Chickaloon River.	Wheeled airplane access would be allowed on 21 square miles of the Chickaloon Flats area that are unvegetated and the maintained Big Indian Creek airstrip, an additional 6.8 square miles of the flats from September 1 to December 15 (or to coincide with future waterfowl hunting	Same as Alternative B.

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
				seasons). Floatplane access would be allowed on 6.5 miles of the Chickaloon River.	
Snowmachine Access:					
	Snowmachines would be allowed in designated areas from December 1 through April 30 if the Refuge manager determines there is adequate snowcover.	Snowmachines would be allowed in designated areas from December 1 through April 30 if the Refuge manager determines there is adequate snowcover. Studies with stakeholders would evaluate the effects of use on Refuge resources and visitor experiences, the results of which would be used to support future management decisions.	Snowmachines would be allowed in designated areas from December 1 through April 30 if the Refuge manager determines there is adequate snowcover except certain zones within designated areas may be opened earlier or later, depending on local snow conditions. Studies would be conducted with stakeholders to evaluate the effects of use on Refuge resources and visitor experiences, the results of which would be used to support future management decisions.	Snowmachines would be allowed in designated areas when the Refuge manager determines there is adequate snowcover; certain zones within designated areas would be opened earlier or later depending on local snow conditions. Studies would be conducted to evaluate the effects of use on Refuge resources and visitor experiences, the results of which would be used to support future management decisions.	Same as Alternative B.

	Alternative A (Current Management)		Alternative B		Alternative C		Alternative D		Alternative E (Preferred Alternative)	
Staffing and Budget Needs: (Beyond Current Levels)										
	Short-Term	Long-Term	Short-Term	Long-Term	Short-Term	Long-Term	Short-Term	Long-Term	Short-Term	Long-Term
Permanent Full-Time Employees	5	20	1	16	5	16	5	16	1	26
Permanent Seasonal Employees	4	14	5	21	5	21	5	21	5	16
Temporary Seasonal Employees	25	45	10	50	10	50	10	50	5	30
Volunteers	20	60	20	60	20	60	20	60	20	60
Total Staff	54	139	36	147	40	147	40	147	31	132
Annual Budget Needs	$5,115,000	$21,489,410	$5,515,000	$21,864,410	$7,800,000	$21,864,410	$8,050,000	$21,864,410	$5,115,000	$22,414,410

2.2 Refuge Purposes, Goals, and Objectives

The Refuge purposes and vision statement provide the framework for developing goals and objectives. The goals and objectives provide direction for managing the Refuge and are an integral part of each action alternative. Goals describe broad general direction for Refuge management; objectives provide specific measurable ways through which the Refuge can move toward achieving its goals and determine how well the intent of individual alternatives is being achieved. Refuge goals do not vary among alternatives; they are common to all. The objectives, which have been developed for each goal, generally apply to all of the alternatives. A few objectives may require modification, or new objectives may be incorporated into one or more alternatives based on particular issue-driven actions under a specific alternative.

To avoid unnecessary duplication, each objective is listed only under the goal that represents the clearest connection. Objectives are numbered and organized in priority order under each goal.

2.2.1 Refuge Purpose (i)

To conserve the fish and wildlife populations and habitats in their natural diversity, including but not limited to moose, bear, mountain goats, Dall sheep, wolves and other furbearers, salmonoids and other fish, waterfowl and other migratory and nonmigratory birds.

GOAL 1: Research—Increase the Service's knowledge of fish and wildlife populations, their habitats, and their interrelationships.

Cooperation with State and Federal Agencies and other organizations is a critical component to successfully meeting most of the objectives.

Objective 1.1: Natural Processes/Disturbance Regimes—Continue long-term monitoring of vegetative responses to fire at: Hakala plots (every 5 years), Fire Monitoring Handbook plots (every 3–5 years), and Forest Inventory and Analysis plots (every 10 years).

Rationale: The Refuge is monitoring long-term changes in plant diversity and structure as a result of wildland and prescribed fire on three sets of permanent plots. Nine plots were established by John Hakala in 1950 to evaluate the 1947 Skilak Lake fire. Following protocols in the National Park Service's Fire Monitoring Handbook, 71 rectangular plots were established by the Refuge from 1994 through 2001 to evaluate several wildfires (1991 Pot Hole Lake, 1996 Hidden Creek, 1994 Windy Point) and several prescribed fires (Mystery Creek, Moose Pens, Lilly Lake, East Road). The Forest Inventory and Analysis program has also established 176 permanent sites on the Refuge to monitor forest resources and fuel loads nationwide. All three of these data sets contribute significantly to the Refuge's understanding of how boreal forest vegetation responds to fire.

Objective 1.2: Capacity Building—Continue to support the research plans identified and/or developed by the Interagency Brown Bear Study Team (IBBST).

Rationale: A 1984 Memorandum of Understanding (MOU) established the IBBST—a partnership between the Refuge, Alaska Department of Fish and Game (ADF&G), and Chugach National Forest. Kenai Fjords National Park was included in the partnership when the MOU was revised in 2003. The IBBST is charged to act as a data source for information gathered on brown bear, its habitat, and management actions on the Kenai Peninsula (Peninsula) that may affect this species. It provides a mechanism whereby the four agencies can work cooperatively on brown bear studies across jurisdictional boundaries. The team identifies, develops, and executes data collection efforts that are responsive to each agencies management needs.

Objective 1.3: Natural Processes/Disturbance Regimes—Continue annual monitoring of snowshoe hare populations on five established sites.

Rationale: The 10-year snowshoe hare cycle drives predator-prey relationships in the boreal forest biome. Lynx and several raptors respond favorably to increasing populations of snowshoe hares. The Refuge established five grids for sampling the number of hare pellets as a population index in mid-successional (1947 burn) and early successional forest habitats (1969 burn). These grids are located near the Swanson River, Funny River, Campfire Lake, Skilak Lake, and Swanson Oil Field. Pellet counts have been sampled annually from 1983 through 1992. These data are critical for helping the Refuge interpret wildlife population trends.

Objective 1.4: Capacity Building—Actively seek to fund at least one cooperative fire research project every three to five years on the Refuge to maintain established working relationships with the fire science community (universities, research stations and other agencies) and to improve the working knowledge of Refuge fire managers and ecologists in boreal ecosystems.

Rationale: The Refuge has been at the forefront of fire research in Alaska since its establishment. Its accessible location, ecological diversity, and rich history make it ideal for the scientific study of wildlfires. Fire research projects on the Refuge have made and are expected to make a real contribution of fire science information to Alaskan and other land managers in the northern hemisphere.

Objective 1.5: Biological Inventories—Within two years of the Comprehensive Conservation Plan's (Plan) approval, complete the ongoing population assessment of steelhead trout in the Kasilof River watershed.

Rationale: The only streams within the Refuge known to provide spawning habitat for steelhead trout are Crooked and Nikolai creeks in the Kasilof River watershed. The total number of fish that spawn in

these areas is unknown. This project will use video weirs to determine the run size and timing of steelhead trout populations in these streams.

Objective 1.6: Natural Processes/Disturbance Regimes—Within two years of Plan's approval, establish five permanent stations in peatlands to measure the annual accumulation rate of peat moss.

Rationale: The central and northern parts of the Kenai Peninsula have thousands of acres of peatlands (fens or "muskegs"), typically underlain by several meters of *Sphagnum* peat. These peatlands probably represent a much larger pool of sequestered carbon than do the rather low-volume forests of the Kenai.

At present, we have no systematic monitoring of peat accumulation or loss. Net Sphagnum accumulation or loss rates can be monitored with mechanical sensors that are read at periodic intervals throughout the growing season. Current rates of accumulation or loss can be compared with long-term average accumulation derived from radiocarbon dating of peat cores taken at the monitoring sites. Such comparisons could show how far present peatland growth conditions deviate from conditions of the last several thousand years and provide a basis for making forecasts about the future vegetation of the peatlands.

Objective 1.7: Supporting Geographic Information System (GIS) Databases—Within two years of Plan's approval, develop a supervised classification of vegetation communities on the Kenai Peninsula from LANDSAT imagery (30-meter resolution).

Rationale: Species such as caribou, brown bear, wolves, and wolverines do not confine their home ranges to the administrative boundaries of the Refuge. They range freely inside and outside the Refuge and on both sides of the Kenai Mountains. Consequently, the Refuge needs both the current distribution of habitats on the Peninsula and a cost-effective way to monitor changes in those habitats. Although Ducks Unlimited developed a digital habitat classification of the Peninsula in 1989, the classification is course and the error rate high. Among the Federal agencies are sufficient field data to train a supervised re-classification of vegetation communities on the Peninsula from LANDSAT imagery at minimal expense, with higher resolution, and with reduced error.

Objective 1.8: Supporting GIS Databases—Within two years of Plan's approval, complete the archiving of all historical fisheries and limnological information in a database that will be compatible with the Refuge's GIS.

Rationale: GIS can be a powerful tool for assembling, storing, manipulating, and displaying geographically referenced information. Volumes of fishery information currently reside in file folders and various electronic files. Assembling this information into a database that is compatible with the Refuge's GIS will make the information

readily accessible to more users, minimize duplication of effort, and maximize the potential for successful GIS implementation as a management tool.

Objective 1.9: Capacity Building—Within two years of Plan's approval, enhance the Peninsula-wide meteorological station network by increasing the number and quality of stations in cooperation with interagency partners.

Rationale: Knowledge of the water budget is important for predicting fire risk and fire behavior, vegetation growth, streamflow and fish habitat, groundwater recharge, and wildlife habitat quality. There are currently six Remote Automated Weather Stations (RAWs) on the Kenai Peninsula, three of which are on the Refuge. They are capable of measuring and recording wind speed and direction, precipitation, air temperature and relative humidity, solar radiation, barometric pressure, fuel moisture and temperature, and soil moisture. Ideally, additional sensors would measure soil temperature at several depths, soil heat flow, soil moisture, and duff moisture (for fire behavior forecasting). These data would allow us to estimate potential evapotranspiration, and hence the daily water and energy budgets of the site. The availability of these types of consistent, high-quality data would help make the Refuge attractive to university and interagency scientists.

Objective 1.10: Capacity Building—Within two years of Plan's approval, develop a Research Natural Area Management Plan. The plan will include discussions of related policy and law and identify goals and objectives to incorporate the designated areas on the Refuge into an integrated ecological monitoring and research program.

Rationale: RNAs are reserves where natural processes are allowed to dominate and where management is designed to preserve a given ecosystem or feature. The Refuge has 5 of 16 RNAs designated in Alaska. RNAs on National Wildlife Refuges are part of a national network of reserved areas under various Federal ownerships and are catalogued by the Federal Committee on Ecological Reserves. RNAs receive no special legislative protection other than what the agency provides. Activities on RNAs are limited to research study observations, monitoring, and educational activities that are non-destructive and non-manipulative, and maintain unmodified conditions. Policy specifically encourages scientific use by responsible scientists and educators. The Refuge clearly has a responsibility to better utilize RNAs.

Objective 1.11: Supporting GIS Databases—Within three years of Plan's approval, complete fuels classification mapping to meet national fire plan goals for the LANDFIRE, Fire Regime/Condition Class (FRCC), and Fire Program Analysis (FPA) projects.

Rationale: LANDFIRE is a multi-agency research project developing methods and products for mapping fuels, vegetation, and fire regimes

across the United States. The FRCC is a landscape and project level classification system used to quantify the departure of a given area from its natural historical condition. FPA is a national wildfire program assessment and budget system that has been used since 2007 to allocate national fire funds to Federal fire management agencies. Completion of fuels mapping will allow Refuge fire managers and incident management teams to use proven fire behavior and fire effects predictive modeling tools such as FARSITE, FOFEM, CONSUME, and others to better manage wildland and prescribed fires and make better, more informed decisions.

Objective 1.12: Biological Inventories—Within three years of Plan's approval, complete a population assessment of rainbow trout in the Kenai River below Skilak Lake.

Rationale: The popularity of the rainbow trout fishery in the Kenai River below Skilak Lake has increased substantially in recent years. Abundance information is needed to assist managers in determining sustainable levels of catch and harvest.

Objective 1.13: Natural Processes/Disturbance Regimes—Within five years of Plan's approval, improve precision by 25 percent on estimates of historical wildfire rates in black and white spruce.

Rationale: Based on charcoal carbon dating and dendrochronology, historic wildfire return intervals in black and white spruce are estimated to be 70–88 years (95 percent confidence interval (CI) and 590–1140 years (95 percent CI), respectively. Additional sampling in both forest types, particularly in white spruce, will improve these estimates and the Refuge's understanding of the natural wildfire regime.

Objective 1.14: Natural Processes/Disturbance Regimes—Within five years of Plan's approval, improve precision by 25 percent on estimates of historical bark beetle outbreaks in white and Lutz spruce.

Rationale: Based on dendrochronology, bark beetle outbreaks have historically occurred every 44–60 years (95 percent CI) in white and Lutz spruce. Additional sampling will improve these estimates and the Refuge's understanding of the spruce bark beetle as a natural process on the landscape.

Objective 1.15: Supporting GIS Databases—Within five years of Plan's approval, complete a high-resolution Digital Elevation Model (DEM) of the Refuge.

Rationale: Currently, the Refuge uses the standard U.S. Geological Survey (USGS) Alaska DEM that has a resolution of 60 meters. Since the topography of the Refuge is largely flat to rolling in the areas of greatest spruce bark beetle mortality and black spruce forest type, we cannot adequately model fire behavior or the underlying hydrology in these areas.

Acquiring a DEM with a resolution of 2–5 meters would greatly increase our ability to model potential wildfire behavior in all forest and fuel types. Topographic variations influence fire behavior. With a high-resolution DEM, we could evaluate the severity of recent burns as related to post-fire habitat within the Refuge. A functional hydrographic model will assist in forecasting impacts to the aquatic ecology from sources such as climate change, contaminants, and development.

Objective 1.16: Capacity Building—Within five years of Plan's approval, re-establish a remote-sensing, lightning detection capability for the Kenai Peninsula.

Rationale: Wildfire managers on the Kenai Peninsula and in the greater Cook Inlet area have had access to accurate lightning detection mapping in the past, but this is no longer available to them. Without reliable lightning detection, fire managers are generally unable to respond quickly to lightning-caused fires. With a rapidly expanding human population and associated development along Refuge boundaries, the threat to human life and property from lightning-caused fires is increasing. Re-establishment of a lightning detection system for Cook Inlet and the Kenai Peninsula will help fire managers mitigate the threat.

Objective 1.17: Biological Inventories—Within seven years of Plan's approval, complete a population assessment of lake trout in Hidden Lake.

Rationale: Hidden Lake supports the most popular sport fishery for lake trout on the Kenai Peninsula. Sport harvest of lake trout from Hidden Lake has historically averaged 1,247 fish annually from 1977 through 1999. However, annual harvest in recent years has steadily declined, and annual sport harvest since 2000 has averaged 240 fish. Abundance information is needed to determine sustainable levels of catch and harvest.

Objective 1.18: Biological Inventories—Within 10 years of Plan's approval, complete a comprehensive inventory of vascular flora, vertebrate fauna, and selected invertebrate taxa as part of the Long-Term Ecological Monitoring Program (LTEMP).

Rationale: One of the primary purposes of the Refuge, as specified by ANILCA, is to conserve fish and wildlife populations in their natural diversity. Also, the National Wildlife Refuge System Baseline Inventory Team recommended the development of vertebrate fauna and vascular flora inventories on each refuge. With more than 200 vertebrate species and 300 vascular plant species on the Refuge, inventorying and monitoring using a single-species approach is not logistically or financially feasible. A new, cost-effective approach to inventorying and monitoring species will be implemented. The LTEMP will sample the occurrence of biota on approximately 350 permanent, systematically-distributed points at five-kilometer intervals across the

Refuge. This sampling framework will enable us to model species distribution and monitor future change. Additionally, the LTEMP is linked to the U.S. Forest Service's Forest Inventory and Analysis program, allowing us to cost-share inventory and monitoring efforts.

Objective 1.19: Capacity Building—Within 15 years of Plan's approval, establish a nonprofit research institute to establish and manage research opportunities on the Refuge.

Rationale: The Refuge has inadequate funding to meet its research and monitoring needs. As the Refuge implements its vision to be a regional training facility for land management and monitoring in the boreal forest biome (Goal 6.2), it is reasonable to consider developing a non-profit [501c(3) status] research institute to complement this effort. Because the Refuge is the only one in Alaska to have been mandated under ANILCA to provide opportunities for fish and wildlife-oriented recreation, land management training, and scientific research, this institute would focus on research associated with the goals of a boreal forest biome training facility and the Moose Research Center, and on examining human-wildlife interactions.

Objective 1.20: Supporting GIS Databases—Within two years of funding, convert all historic aerial photography into geo-referenced, orthorectified digital images.

Rationale: Historic photography is a valuable asset to managers and researchers monitoring changes in Refuge resources caused by natural or anthropogenic disturbances, and it provides valuable information when baseline information is lacking. Due to the extent and frequent coverage, historic Refuge photography is of exceptional value. Additionally, the photography is valuable from a strictly historic perspective, and the digital reproduction will help preserve the original photography from damage and loss. The Refuge holds two complete sets of historic aerial photography and several partial sets. Complete sets include 1975 color resource photography (1:15,840) and 1988 color infrared (1:15,840). Partial sets include black and white resource photography from 1963 and 1968, color resource photography from 1969 and 1991, and color infrared from 1980.

Objective 1.21: Supporting GIS Databases—Within two years of funding, complete a spatially-explicit soil survey.

Rationale: A soil survey includes definitions of land characteristics that may affect soil management. The survey identifies areas where wind or water erosion is a major concern and what can be done to control it; soils are rated for their potential to produce trees and provide habitat for wildlife; and soils are rated for their suitability for recreation, such as camping areas, picnic areas, and paths and trails for hiking and horseback riding. The proposed surveys will be agricultural/forestry surveys as generally conducted by the Natural Resources Conservation

Service (NRCS) in contrast to the engineering/geology surveys generally conducted by the US Geological Survey (USGS) or Alaska Division of Geological and Geophysical Surveys (ADGGS).

Objective 1.22: Natural Processes/Disturbance Regimes—Within two years of funding, initiate research to estimate annual variation in marine-derived nutrient input and assess effects on terrestrial wildlife and habitat.

Rationale: Salmon and other anadromous fish, whether they are eaten or decay, bring nitrogen and other nutrients into rivers and streams within the Refuge. This nutrient pulse is so great that vegetation and bird diversity are known to be greater on streams with anadromous populations in southeast Alaska than on streams without anadromous populations. Also, there is some concern that anadromous fish may be transporting contaminants, particularly PCBs, from the marine environment into the freshwater system. Stable isotope analysis can be used to determine the contribution of marine-derived inputs to terrestrial wildlife and habitat.

Objective 1.23: Biological Inventories—Within four years of funding, enter into cooperative studies, with ADF&G, that may remain necessary to assess populations of early-run Chinook salmon in the Kenai River. Some of these tasks are underway or have been completed.

Rationale: Chinook salmon return to the Kenai River as two runs. An early run typically enters the river during May and June, and a late run enters the river in July and early August. The early run is the smaller of the two runs with annual spawning escapements ranging from 5,331 to 18,682 since 1986. Based on radio telemetry studies conducted in the 1980s and early 1990s, early-run Chinook salmon primarily spawn in tributaries of the Kenai River, such as the Funny and Killey rivers. These fish can hold in confluence areas or the mainstem into July before ascending tributaries to spawn. Early-run Chinook salmon that are in the mainstem after July 1 are vulnerable to anglers targeting late-run fish. A temporal and spatial assessment of early-run Chinook salmon in the Kenai River watershed is needed to help formulate strategies for managing them.

Objective 1.24: Biological Inventories—Within five years of funding, initiate four weir projects to enumerate anadromous fish populations returning to the Swanson River, Chickaloon River, Big Indian Creek, and Little Indian Creek.

Rationale: Effective management and conservation of fish populations and their habitats within the Refuge is largely dependent on the availability of current and accurate information on status of the stocks, trends in their numbers, and an understanding of the environmental

factors affecting them. Salmon stocks in the streams listed previously face potential threats from oil and gas activities, utility corridors, etc.

Objective 1.25: Natural Processes/Disturbance Regimes—Within five years of funding, estimate new rate trajectories for the wildfire regime, spruce bark beetle outbreaks, wetland drying, water budget, carbon budget, and biota redistribution in response to climate change predictions during the next 50 to 200 years.

Rationale: Average temperatures have risen in Alaska and elsewhere in the Arctic at twice the global rate during the past 50 years. Increasing temperatures and changes in weather patterns are already known to have affected the rate and duration of spruce bark beetle outbreaks, evaporated wetlands and small ponds, and likely accelerated the mean fire return interval. It is critical to estimate these new rate trajectories so that Refuge management and public expectations are consistent with changes that are occurring on the landscape.

Objective 1.26: Data Sharing — Within two years of Plan approval complete a list of opportunities for sharing survey and research data with university, State, and other partners.

Rationale: A variety of data sets have been developed over time; we will cooperate with partners to maximize the utility of new data by sharing the information and ideas with partners.

GOAL 2: Conservation and Management—Ensure natural diversity and viability of species, habitats, and ecosystems.

Objective 2.1: Habitat and Population Management—Continue to develop and maintain partnerships with the public, other governmental agencies, and private organizations to increase the ability of the Refuge and those agencies with management responsibilities that overlay the Refuge to conserve fish, wildlife, and their habitats.

Rationale: A Refuge primary purpose is to conserve fish and wildlife populations and habitats in their natural diversity. With over 200 vertebrate species and 480 vascular plant species, the Refuge does not have the personnel, expertise, or funding to effectively monitor, research, or manage these populations and their habitats. The only effective strategy for ensuring long-term conservation of these resources is to continue to develop and maintain partnerships with the public, universities, and other agencies and organizations.

Objective 2.2: Habitat and Population Management—Continue cooperative and independent efforts to protect and restore riparian habitats along the Kenai River (including addressing human waste).

Rationale: The Kenai River is an important recreational fishery and a popular fishing spot. The usage of the river in recent years has increased at a substantial rate. With increased use comes increased

impact to the river banks and riparian areas. Trampling of banks and riverside vegetation leads to bank erosion and loss of important riparian vegetation. Protection, restoration, and a better understanding of the contribution of river banks and riparian areas is important to many fish and wildlife species, including juvenile salmon and migratory birds. With increased understanding, biologists could develop better restorative techniques that provide improved nearshore habitat.

Objective 2.3: Habitat and Population Management—Continue to maintain a rehabilitation program for injured bald eagles, owls, and other raptors.

Rationale: Refuge facilities have served as a "halfway house" for raptors (and other birds) that are injured on the Peninsula and ultimately rehabilitated at the Bird Treatment and Learning Center in Anchorage. The Refuge maintains a Federally-licensed wildlife rehabilitator on staff, a community network of volunteers and interagency personnel, a flight pen, and holding/transfer cages. The Refuge specifically targets the rehabilitation of bald eagles that are electrocuted on power lines and transformers.

Objective 2.4: Monitoring—Continue contributions to regional and national monitoring efforts, including but not limited to the Christmas Bird Count (CBC), Alaska Landbird Monitoring System (ALMS), and Breeding Bird Survey (BBS).

Rationale: The Service Policy (601 FW 3) dictates that each refuge should consider its contribution to the biological integrity, diversity, and environmental health at multiple landscape scales, including regionally, nationally, and globally. To better understand our contribution, the Refuge will continue to participate in regional and national monitoring programs that have a larger perspective. The CBC in the Soldotna area has been conducted intermittently since 1983. Two BBS routes have been completed annually since 1982. An ALMS site at Birch Lake was implemented in 2003. CBC and BBS data are maintained by the Patuxent Wildlife Research Center; ALMS data are maintained by the Anchorage Science Center.

Objective 2.5: Habitat and Population Management—Continue to work with the oil and gas industry to remediate and restore well pads, pipeline corridors, and roads to their natural condition within two years of well plugging and abandonment.

Rationale: The Federal oil and gas units on the Refuge have been in operation for over 45 years. Numerous roads, well pads, wells, pipelines, and utility corridors have been developed to support production. Over the years, a variety of activities and events within these units have introduced contaminants into the environment. These activities and events include well drilling operations; accidental releases from pipelines, tanks, and equipment; pipeline failure; and solid waste

disposal practices. Chemical use and disposal, spill reporting requirements, and solid waste disposal practices and regulations have changed considerably throughout the years. It was not until the 1970s and 1980s when chemicals and potential contaminant-related activities were more closely regulated on the Refuge. Since that time, known contaminated sites have been remediated or are under long-term monitoring to ensure that contamination is not spreading into nearby areas while remediation measures are being developed. Several pads, roads, and an airstrip have been reclaimed throughout the years. Continuing such efforts will help reduce the footprint of the oil and gas units on the landscape.

Objective 2.6: Monitoring—At five-year intervals after Plan's approval or after a significant natural perturbation, monitor landscape changes of both vegetation and physical features using pixel-by-pixel change analysis (30-meter resolution) from supervised classification of LANDSAT imagery.

Rationale: LANDSAT imagery is composed of small 30 x 30-meter cells or pixels. Once the spectral signature within each one of these pixels is assigned a vegetation or habitat type based on field data (i.e., a supervised classification), the Refuge can automatically generate a vegetation and habitat map. The completion of a supervised classification of LANDSAT imagery with in-house expertise will allow the Refuge to detect landscape-level changes in vegetation by analyzing subsequent changes in spectral signatures in each pixel. The significance of developing this expertise in-house is that analytical costs are reduced to the acquisition cost of new LANDSAT scenes. This technology will give us an extremely cost-effective and reasonably accurate method for assessing vegetation and wildlife habitat change on the Peninsula.

Objective 2.7: Monitoring—At five-year intervals after Plan's approval, assess and report fire occurrence, fire cause, fire behavior, and fire effects trends using the best available technology to provide fire managers the information necessary to revise the Refuge's Fire Management Plan.

Rationale: The Refuge's Fire Management Plan (a step-down plan from the Comprehensive Conservation Plan, the National Fire Plan, and the Alaska Interagency Wildfire Management Plan) needs annual updates and revision every five years to respond to a changing social, physical, and ecological landscape.

Objective 2.8: Habitat and Population Management—Maintain caribou populations at or below two caribou per square kilometer for 10 years after Plan's approval.

Rationale: Since the initial reintroduction of 15 caribou from the Nelchina herd to the Refuge in 1965, the caribou population has

increased to more than 1,100 individuals in four herds. Recent observations of caribou on nunataks in the Harding Ice Field and in a large group near Exit Glacier suggest that caribou are continuing to disperse over the Peninsula. The carrying capacity of available habitat on the Peninsula is unknown. However, the 2003 Caribou Management Plan, developed by the Refuge, Alaska Department of Fish and Game (ADF&G), and the Chugach National Forest, specifically caps desired caribou population densities at two caribou per square kilometer to prevent degradation of alpine tundra. This objective and/or management plan may be revised by the partner agencies based on new data or analysis.

Objective 2.9: Monitoring—Maintain Dall sheep and mountain goat populations within their natural diversity, consistent with natural habitat changes and natural variation within three count areas (Twin Lakes 355, Indian Creek 356, and Tustumena Glacier 357) within the Refuge boundaries. The Refuge will coordinate the establishment of sheep and goat population goals with ADF&G. In addition, the Refuge will work cooperatively with Chugach National Forest, Kenai Fjords National Park, and the ADF&G to ensure that a Peninsula-wide survey is completed every three years.

Rationale: ADF&G divides the Kenai Peninsula into 35 count areas that coincide with hunt permit areas for Dall sheep and mountain goats. Since 1968, aerial counts of adults and young-of-year have been conducted on some of these areas annually during July and early August (i.e., pre-hunt). Three count areas (numbers 355, 356, and 357) from Skilak Glacier to Fox River were designated in 1987 for assessing Dall sheep population trends. These three count areas are completely within Refuge boundaries and have relatively high Dall sheep counts. These three areas will continue to be used to index populations of both species for the purposes of maintaining natural diversity on the Refuge.

Objective 2.10: Habitat and Population Management—Within one year of Plan's approval, initiate a rulemaking process to clearly describe prohibited actions and any exceptions to the non-development easement held on much of the Kenai riverfront property in the Moose Range Meadows Subdivision.

Rationale: Over 100 private property owners whose is property within the Refuge boundaries and adjacent to the Kenai River are affected by restrictive conditions of a non-development easement held by the United States. The restrictions are found in title and deed documents but are not clearly identified in any Refuge-specific regulation. Violations of the easement are punishable under the general provisions of the National Wildlife Refuge System Administration Act; however, the restrictions would be far more understandable if they were included in specific regulations and included such things as definitions (e.g., of "structures") and described the process to permit exceptions (e.g., such as to protect riverbank habitat by constructing certain seasonal structures meeting

specific requirements). Related regulations describing the prohibitions associated with public access easements may also be enhanced to include protection of habitat adjacent to Refuge-constructed walkways. Such collective regulatory changes would increase public awareness and improve shoreline habitat protection.

Objective 2.11: Monitoring—Within two years of Plan's approval, develop an interagency program to monitor population trends and/or health of wolves, wolverines, and brown and black bears on the Peninsula.

Rationale: Wolves, wolverines, and bears, because of their large home ranges that can straddle both sides of the Kenai Mountains, require interagency cooperation to ensure that populations are estimated and monitored over the entire Kenai Peninsula. Presently, the Refuge has the Wolf Management Operational Plan (1988) for GMU 15A and a Memorandum of Agreement to support the Interagency Brown Bear Study Team (2003). In addition, an interagency survey to estimate the Peninsula-wide population of wolverines was completed in 2006. However, none of these actions have resulted in a statistically-rigorous survey design with agency commitments to continue long-term monitoring. The Refuge will work with partners to develop an interagency program to monitor the population and/or health of these species.

Objective 2.12: Habitat and Population Management—Within two years of Plan's approval, revise the 1995 Fisheries Management Plan.

Rationale: Research and management tasks identified in the 1995 Fisheries Management Plan were developed for 1995 through 2000. Although there has been a great deal of progress in implementing this plan, much remains incomplete, largely due to inadequate funding. Additionally, new issues have arisen in the past decade, including heightened concern about the expanding distribution of northern pike, declining weights of sockeye fry in apparent response to increasing siltation from glacier melt water, effects on spawning due to increasing stream temperatures, increasing demand on rainbow trout sport fisheries below Skilak Lake, and increasing awareness of possible endemism in arctic char and longnose sucker populations. To address these issues and others raised in this Plan, the Refuge will revise the existing Fisheries Management Plan.

Objective 2.13: Habitat and Population Management—Within two years of Plan's approval, revise the 1996 Moose Management Plan.

Rationale: The 1996 Moose Management Plan will be revised to comply with the Service's Habitat Management Policy (620 FW 1). This revised Moose Management Plan will include updated goals and objectives that are consistent with new information about changing wildfire regimes, drying wetlands, and increased vehicle-moose collisions. In addition, goals and objectives will include environmental variation and the uncertainty inherent in statistical sampling.

Objective 2.14: Habitat and Population Management—Within two years of Plan's approval, evaluate historical, current, and potential distributions of marten and red fox populations in the absence of active management, and identify possible actions to enhance habitats or populations on the Refuge.

Rationale: Both marten and red fox are currently poorly distributed on the Refuge, though marten are more common elsewhere on some portions of the Peninsula. The 1985 Comprehensive Conservation Plan and the 1988 Furbearer Management Plan called for further study of both species to determine population status and trends, and to clarify taxonomy. Review of results of studies in the 1980s will assist in the formulation of cooperative management agreements.

Objective 2.15: Habitat and Population Management—Within three years of Plan's approval, complete a Wildfire Monitoring Plan that will include monitoring purposes, goals, objectives, and proposed activities for wildfire, prescribed fire, use of wildland fire, mechanical treatments, hazard fuels, and wildland-urban interface projects. This monitoring plan will become an amendment or an appendix to the Refuge Fire Management Plan.

Rationale: An approved Wildfire Monitoring Plan will help fire managers improve the coordination and effectiveness of project implementation. It will also allow for the use of fire funds to accomplish long-term fire monitoring activities. Without an approved monitoring plan, national policy limits the use of fire funds to only monitoring first order fire effects (one year pre- and post-burn monitoring).

Objective 2.16: Habitat and Population Management—Within three years of Plan's approval, initiate development of a restoration and recreation plan for oil and gas units on the Refuge identified in this and other planning processes.

Rationale: Two existing Federal lease units on the Refuge have large industrial footprints on the landscape that consist of roads, well pads, utility corridors, and various buildings. Once industry is no longer in the area, some of these items could be used for recreational purposes such as trails, camping, or wildlife viewing areas, or used to support Refuge needs such as research training facilities, seasonal housing, or law enforcement substations. A plan needs to be developed for both areas to guide the Refuge and industry, outlining what will be fully restored to natural conditions and what will remain in a modified state for future use by the Refuge and the public.

Objective 2.17: Habitat and Population Management—Within five years of Plan's approval, complete the development of a Terrestrial and Aquatic Invasive Species Management Plan.

Rationale: Exotic plants and animals transplanted to new areas outcompete native species, destroy established commercial and

recreational fisheries, and alter the existing ecosystems. Perhaps the best-known invasive species in southcentral Alaska today is the northern pike. Pike are a desired game and subsistence fish throughout much of Alaska, but in southcentral Alaska and the Kenai Peninsula, where they are not native, northern pike consume young wild salmon and negatively affect other native fish populations.

Objective 2.18: Habitat and Population Management—Within five years of Plan's approval, use prescribed fire or mechanical treatments to maintain (condition class 1) or improve (condition class 2 or 3) the condition class on 2,000 to 4,000 acres of non-Wilderness per year in at least three out of the five years. Use of prescribed fire or mechanical treatments will continue at that rate until the 1996 Moose Management Plan is revised.

Rationale: The 1996 Moose Management Plan recommended a moderate level of prescribed fire treatment in late-successional habitats (2,000 to 4,000 acres per year). Despite Refuge plans to accomplish the Plan's objectives, less than 3,000 acres have been successfully treated with prescribed fire since 1996. Given the barriers to successful prescribed fire implementation (narrow prescriptive windows, unfavorable weather or fuel conditions, lack of sufficient staffing or firefighting resources and wildfires), the 2,000 to 4,000-acre target may not be realistic. However, the Refuge has taken steps in recent years to improve its ability to complete prescribed fire plans.

Objective 2.19: Monitoring—Within two years of funding, further expand the Long-Term Ecological Monitoring Program (LTEMP) to detect spatial and temporal changes in selected biota, including but not limited to vascular plant community, breeding landbirds, mesocarnivores, selected insect assemblages and exotic, invasive, and injurious species.

Rationale: After the initial inventory of flora and fauna on approximately 350 points on the LTEMP grid, selected biota will continue to be monitored. Selection criteria will consider the Refuge's legal mandates (trust resources; exotic, invasive and injurious species), ecological processes (keystone species; species indicative of processes such as global climate change), and statistical constraints. Based on a 2004 Memorandum of Understanding (MOU) with the Forest Inventory and Analysis Program, 20 percent of LTEMP points will be sampled collaboratively every other year such that all points are sampled at 10-year intervals. This serial alternating panel design will ensure that the Refuge gets continual feedback for early change detection.

Objective 2.20: Climate Change—Within one year of Plan adoption, develop internal policies to emphasize long-term management needs associated with climate change.

Rationale: Climate change is recognized as the biggest long-term threat to sustaining natural diversity and viability of species, habitats, and ecosystems. Increased commitments to planning, monitoring, and employing adaptive management strategies are necessary to address long-term climate change issues.

GOAL 3: Resource Assessment—Ensure that the integrity of ecological systems is protected and unimpaired for future generations.

Objective 3.1: Resource Assessment—Continue and expand research on abnormal wood frogs to understand the potential cause(s) of their abnormalities.

Rationale: Wood frog populations have been monitored on the Refuge since 2000 as part of the National Abnormal Amphibian Program. Wood frogs on the Refuge have rates of abnormalities (greater than 10 percent) that are several times higher than what are considered ambient levels (0–2 percent) elsewhere in North America. High rates of abnormalities (typically missing or shrunken hind limbs) are generally associated with environmental contamination from anthropogenic sources but may occasionally be from natural sources. Because amphibians are considered early harbingers of environmental problems that may be ecosystem-wide, it is important that the causes of abnormalities be identified.

Objective 3.2: Resource Assessment—Continue and expand research on local bird populations to understand the potential cause(s) of bill abnormalities.

Rationale: Since 1991, when abnormal bills were first found on black-capped chickadees in King Salmon, the documentation of these abnormalities has expanded throughout southcentral Alaska and now includes 27 species. Most malformed birds on the Kenai Peninsula have been black-capped chickadees, but 10 other species are represented. Typically, the upper mandible is greatly elongated, curved down, and may be crossed with the lower mandible. This abnormality may be the result of a contaminant, a virus, or even nutritional stress; but the current hypothesis is that the causal agent is likely of local origin because most of the species are nonmigratory. As with abnormal wood frogs, abnormal bill development in resident bird populations may be the harbinger of a larger environmental problem and clearly warrants further research.

Objective 3.3: Resource Assessment—Continue to work with Alaska Department of Environmental Conservation (ADEC) and industry to monitor, assess, and remediate contaminated sites in existing oil and gas units.

Rationale: Numerous known contaminated sites exist on the oil and gas fields. These areas were contaminated years ago when environmental practices were not as restrictive as today, and most of the United States' environmental laws did not exist. These sites have groundwater

monitoring wells around them to ensure that the contamination is not migrating further than the already contaminated area. Reports are submitted to the Refuge and ADEC showing the sampling results from these wells. Remediation efforts continue on these sites, and the goal is to have clean closure of all areas.

Objective 3.4: Resource Assessment—Within two years of Plan's approval, evaluate current management practices and infrastructure improvements to ensure that the ecological integrity of the five designated Research Natural Areas on the Refuge are not compromised.

Rationale: Research Natural Areas (RNAs) are reserves where natural processes are allowed to dominate and where management is designed to preserve a given ecosystem or feature. RNAs receive no special legislative protection other than what the agency provides. Service policy (8 RM 10.1) states that "RNAs must be reasonably protected from any influence that could alter or disrupt the characteristic phenomena for which the area was established." Activities on RNAs are limited to research study observations, monitoring, and educational activities that are non-destructive, non-manipulative, and maintain unmodified conditions. Furthermore, use of RNAs should be governed by a natural area management plan that is compatible with Refuge objectives. The Refuge will protect the ecological integrity of the RNAs.

Objective 3.5: Resource Assessment—Within two years of Plan's approval, complete the development of landscape models at two scales (Refuge-wide and Peninsula-wide) to evaluate the cumulative effects of natural processes and anthropogenic perturbations on wildlife habitat.

Rationale: Although the Refuge has a well-developed Geographic Information System (GIS), it does not have the capability to forecast future impacts well. The Refuge recently partnered with several agencies and organizations to develop a model that is capable of projecting the cumulative effects of natural and anthropogenic processes in the boreal forest landscape on the Kenai Peninsula over 100 years. ALCES, (A Landscape Cumulative Effects Simulator), is spatially stratified whereby GIS data are input by user-defined strata, and output is in tabular or graphic format for each spatial stratum. The user can track the number, area, and length of each land use footprint (e.g., seismic lines, roads) within each landscape stratum (e.g., coniferous forest, tundra). The Refuge will develop models at two scales because external issues can only be characterized well at the Peninsula-level, but internal issues are better characterized in a Refuge-specific model.

Objective 3.6: Resource Assessment—Within two years of Plan's approval, complete a Wildlife Inventory and Monitoring Plan that will include statistical benchmarks and/or management action threshold for trust, harvested, and indicator species that are currently monitored. Trust species include but are not limited to fish, wildlife, and plants on

Service lands. Indicator species include those specifically highlighted in ANILCA and those chosen for specific research and monitoring programs.

Rationale: The Refuge has conducted surveys of trust species and other species of concern for decades. The Refuge has monitored trumpeter swan and bald eagle nests and their productivity since 1957 and 1979, respectively. In cooperation with ADF&G, the Refuge has monitored caribou and moose populations since 1964. The Service's Migratory Birds Program has flown three transects of the annual breeding waterfowl survey on the Refuge since 1957. Wolf and lynx populations were intensively studied from the 1970s through early 1990s. However, data from several of these surveys have not been rigorously analyzed, and standardized protocols have not been established. In particular, there is a need to determine management action thresholds for each of these surveys. Per Service policy (701 FW 2), an inventory and monitoring plan for fish, wildlife, and plants will be developed.

Objective 3.7: Resource Assessment—Within one year of completing an inventory, develop statistical models to explain how biotic and abiotic factors affect the distribution of species and communities at the landscape level.

Rationale: The collocation of floral and faunal sampling on the LTEMP grid will enable the Refuge to model species distribution over the landscape. In particular, we will be able to model how wildlife distribution and abundance are affected by habitat, topography, elevation, and human-caused changes to the landscape. The development of species-habitat models will allow us to better assess the impacts of development on the Refuge and global climate change, and to use habitat management tools such as prescribed fire better.

Objective 3.8: Resource Assessment—Within five years of Plan's approval and after completion of a Refuge-wide fuels assessment (fire regime and condition class), develop a project plan to evaluate the fire suppression history of the Refuge and adjacent lands on the Kenai Peninsula with emphasis on the suppression of natural ignitions in Wilderness and Limited Fire Management Option areas.

Rationale: Since Refuge establishment, many naturally-ignited wildfires are known to have been suppressed within designated Wilderness, Limited Management Option and other areas—both within and outside Refuge boundaries. Regardless of the need for a suppression response in any given situation, the suppression of lightning-ignited fires alters natural ecosystem processes and may create unnatural conditions in certain areas of the Refuge. A geospatial assessment of the fire suppression history for the western Kenai Peninsula, combined with forest fuels and fire regime and condition class information, will provide the data necessary to predict and/or

model natural vegetation patterns on the landscape. Subsequently, this information could be used to develop spatially-explicit wildfire and prescribed fire plans to restore natural conditions in those areas where natural fire has been excluded.

Objective 3.9: Resource Assessment—Within one year of funding, establish one air quality monitoring site within designated Wilderness to measure the concentration of fine (PM 2.5) particles for mass, optical absorption, major and trace elements, organic and elemental carbon, and nitrate; and measure the concentration of PM 10 particles for mass. Equipment and protocols should be consistent with the Interagency Monitoring of Protected Visual Environments (IMPROVE) program.

Rationale: Air quality has become an increasing concern in the Cook Inlet in recent years. The Refuge is designated as a Class II air quality area under the Clean Air Act because it was established prior to 1977. The 1990 Clean Air Act amendments clarified that Class II "floor" area boundaries, which include National Wildlife Refuges and wilderness areas greater than 10,000 acres, are to conform to boundary changes in the underlying park or wilderness area. Service Policy (563 FW 2) states that information on air-quality and air-quality related values (AQRVs) of a Class II area is important for comprehensive management of these Refuge resources. Although the Environmental Protection Agency (EPA) or delegated State authority is not required to notify the federal land manager of proposed projects that may affect Class II areas, the EPA or State is required to evaluate whether such projects may cause an exceedance of the National Ambient Air Quality Standards (NAAQS) or prevention of significant deterioration (PSD) Class II increments in these areas.

Objective 3.10: Resource Assessment—Within one year of funding, initiate research to determine the effects of roads within and/or adjacent to the Refuge on local moose, caribou, and brown bear movements and survival—specifically, to identify important crossings and/or high collision areas and recommend appropriate mitigation and management measures.

Rationale: In the last few years, several major highway projects (e.g., Cooper Landing bypass, Sterling Highway expansion along mileposts 60 to 79, and the Kenai Spur extension) have been proposed in or adjacent to the Refuge. On the Kenai, collisions with vehicles kill 200–300 moose annually, mostly on the Sterling Highway. Vehicle traffic on the Sterling Highway, the Spur Highway, and the Bridge Access Road frequently interferes with the Kenai Lowlands caribou herd as they migrate to their calving grounds on the Kenai River Flats. Public use and access associated with roads (and other linear features) increases the likelihood of brown and black bear mortalities due to defense of life and property (DLP) and may significantly interfere with bear movement. There is a need to better monitor incidents and to identify

important wildlife crossings and/or high collision areas to mitigate for roads and associated traffic.

Objective 3.11: Resource Assessment—Within two years of funding, determine baseline levels of selected contaminants, specifically organochlorines, organophosphates, and heavy metals that may have originated from the nonrenewable resource extraction, long-range atmospheric deposition, and/or past management practices.

Rationale: Kenai Refuge was the first National Wildlife Refuge in Alaska to complete the Contaminant Assessment Process (CAP). The CAP identified numerous point and nonpoint contaminant sources—a comprehensive but incomplete list of known spills from the oil and gas industry—and specifically recommended that a baseline contaminants survey be completed. These data would be helpful in assessing the effects of potential contamination events on and near the Refuge and could be used to establish the contaminant contribution from off-Refuge sources, including atmospheric and biotic transport mechanisms.

Objective 3.12: Resource Assessment—Within two years of completing baseline contaminant assessment, initiate research to evaluate uptake of identified contaminants by selected indicator species (e.g., brown bears, black bears, sculpins, salmonids).

Rationale: The immediate monitoring of point and nonpoint sources of contaminants and water quality does not fully address the potential effects of anthropogenic pollutants on Refuge fish and wildlife. Environmental contaminants from local and distant sources are subject to short- and long-range transport. Arctic and subarctic environments are especially vulnerable to the long-range air and water transport of environmental contaminants because once chemicals reach colder climates, less volatilization occurs. Contaminants of particular concern within the Arctic are persistent organic pollutants, polycyclic aromatic hydrocarbons, heavy metals, and radionuclides. Anadromous fish and migratory birds are also possible biotic sources of contaminants. Because these taxa are highly mobile, they may be exposed to contaminants outside of the Refuge boundaries. Brown bears, for example, may be exposed to PCBs by ingesting salmon that accumulate PCBs at sea. Similarly, migratory birds may be exposed to potentially toxic chemicals on their wintering grounds in the contiguous 48 states and in other countries, including organochlorines that are banned in the United States. This migratory transport of contaminants provides a potential exposure pathway to other organisms that would otherwise likely not be exposed to these chemicals.

2.2.2 Refuge Purpose (ii)

To fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats.

GOAL 4: International Treaties—Ensure that Refuge management practices affecting bird species contribute to the successful implementation of the Migratory Bird Treaty Act.

Objective 4.1: International Treaties—During the 15 years after Plan approval, continue to seek guidance and context for Refuge management and scientific actions from regional, national, and international programs and plans (including but not restricted to the North American Bird Conservation Initiative [NABCI] and the Conservation of Arctic Flora and Fauna [CAFF], Area V).

Rationale: NABCI, the umbrella organization for the North American Waterfowl Management Plan, Partners in Flight, the U.S. Shorebird Conservation Plan, and Waterbird Conservation for the Americas, clearly provides guidance and context for migratory bird management and research on the Refuge. CAFF provides a circumpolar framework for biodiversity monitoring. Area V of the U.S.–Russia agreement on cooperation in the Field of Environmental Protection (1972, revised 1994) addresses *"protection of nature and the organization of reserves."* It specifically identifies several subject areas that are relevant to the Refuge's mandates: U.S.–Russia Convention Concerning the Conservation of Migratory Birds and their Environment (1976); Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES); biosphere reserves, conservation education, marine mammals, and salmonids. Russian, Canadian, United States, and Provincial and State resource agencies are important partners of the Pacific Flyway Council, which has management plans for a variety of migratory bird populations such as the Pacific Coast population of trumpeter swans.

Objective 4.2: International Treaties—Continue to participate in and support international, national, and regional scientific information sharing, including making data available on the Refuge Web site, presenting papers at conferences, and publishing journal articles.

Rationale: The Refuge has one of the largest biological staffs in the National Wildlife Refuge System and is one of only two refuges in Alaska with a purpose to provide opportunities for scientific research. Consistent with national and regional guidance to conduct peer-reviewed monitoring and provide a scientific basis for management, the Refuge is clearly obligated to ensure that data are of high scientific merit and disseminated appropriately. Web site access, presentations at conferences, and published journal articles are avenues for ensuring that data are widely shared.

Objective 4.3: International Treaties—Continue to provide information and permitting services to the public for Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) protected species.

Rationale: The Refuge will continue to provide information and permitting services to the public for species listed under CITES (1973). Most of the species protected under CITES that are relevant to the Refuge are furbearers or marine mammals.

2.2.3 Refuge Purpose (iii)

To ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (i), water quality and necessary water quantity within the Refuge.

GOAL 5: Water Resources—Ensure natural function and condition of water resources necessary to conserve fish and wildlife populations and habitats in their natural diversity.

Objective 5.1: Water Resources—Within two years of Plan's approval, evaluate the need to increase the number of U.S. Geological Survey (USGS) stations in cooperation with interagency partners.

Rationale: In 1996, the USGS concluded the *Evaluation of the Streamflow-Gaging Network of Alaska in Providing Regional Streamflow Information* (Brabets, 1996). The primary purpose of the gauging network is to provide peak flow, average flow, and low flow characteristics through a series of regional equations. The objective is part of a large-scale effort to provide regional streamflow characteristics to users for all regions of the State. Regional equations exist for southcentral Alaska, but fully implementing the gauging network in southcentral Alaska would decrease sampling errors.

The USGS's evaluation proposed adding 12 new stream-gauging sites and reactivating 11 historic sites in the southcentral region. Sampling error would decrease by 3 percent for the peak discharge equation, 10 percent for the average discharge equation, and 20 percent for the low flow equation (Brabets, 1996). With the rapid population growth and development occurring in southcentral Alaska, the information provided by the network would assist land managers and resource developers in their planning and decision making processes. Fully implementing the proposed network would require cooperation from Federal, State and local agencies and/or watershed groups. Partial implementation will provide the Refuge with site-specific information that could support the development of a water budget and support instream-flow water right reservations.

Objective 5.2: Water Resources—Within two years of Plan's approval, develop a prioritized list of culverts, bridges, and other river and/or stream structures that need to be replaced or modified to restore fish passage and normal stream function.

Rationale: Bridges and poorly designed or installed culverts and other stream structures alter the character and continuity of a stream. Changes in stream velocity, channel migration, sedimentation, erosion,

and barriers to fish migration can result from such structures. Poorly designed structures within a stream channel often block upstream passage of fish, effectively eliminating the area upstream of the structure for spawning and/or rearing. Evaluating and prioritizing culverts on the Refuge would be the first step in eliminating this problem. Alaska Department of Fish and Game (ADF&G) completed an inventory and assessment of culverts on the Kenai Peninsula maintained by Alaska Department of Transportation and Public Facilities (ADOT), most of which were not on the Refuge. No report has been published, but the high priority culverts are being addressed. A cooperative effort with ADF&G would be invaluable towards resolving this potentially detrimental problem.

Objective 5.3: Water Resources—Within two years of funding, design and implement a groundwater monitoring program.

Rationale: The interaction of groundwater and surface water is often poorly understood. This poor understanding is a historical result of managing the two water resources as separate entities, when in fact they are connected. Implementing a groundwater monitoring program would incorporate the quantity, quality, and movement of groundwater and is one of the key components of developing a water budget. Monitoring the groundwater will provide the Refuge with valuable information related to groundwater recharge, sources of recharge, water quality and contaminants, and the impacts of land use changes on Refuge resources.

Objective 5.4: Water Resources—Within two years of funding, design and initiate a water quality monitoring program for waters within the Refuge, including the Kenai and Swanson River watersheds.

Rationale: A majority of the resources Kenai Refuge was established to protect are dependent on the natural condition of water quality, quantity, and timing. Resource development and public use on the Refuge and surrounding areas is increasing, and the potential effect of these uses on water quality is unknown. Initiating a program to monitor water quality over time and location provides a baseline from which change can be monitored, impacts can be assessed, and future decisions can be made. Initiating a water quality program and working with the local watershed groups of Cook Inlet, who monitor Peninsula conditions, will establish a collective knowledge base and provide a tool to identify local and regional changes. The Refuge will additionally be able to address any potential causes and effects, and mitigate for identified changes when necessary.

Objective 5.5: Water Resources—Within five years of funding, develop a water budget and hydrologic models for the Refuge's 10 major watersheds.

Rationale: A water budget tracks the input, storage, movement, and output of water within a basin. Changes within a basin due to fire,

climatic change, development, or water or land use practices result in changes to the water budget. Understanding the water budget and its interaction with Refuge resources is a key component to understanding ecosystems and the dynamic process that occur. Developing water budgets and hydrologic models will increase the existing knowledge base, provide a valuable tool to help guide future research, and enable informed management decisions. Common components of a water budget include input, primarily from precipitation; storage in the form of glaciers, lakes, rivers, wetlands, groundwater, soil moisture, and plants; movement, which includes snow or glacier melt and runoff, infiltration into soils and groundwater, diversions, spring flow, and plant absorption; common outputs are streams discharge, evaporation, transpiration, sublimation, and industrial or municipal use.

2.2.4 Refuge Purpose (iv)

To provide, in a manner consistent with subparagraphs (i) and (ii), opportunities for scientific research, interpretation, environmental education, and land management training.

GOAL 6: Environmental Education and Training—Natural resource professionals, students, and the public value opportunities to increase their knowledge of Refuge ecosystems, issues, and management practices.

Subgoal 6.1: Environmental Education and Interpretation—Diverse audiences will have equal opportunity to understand and appreciate all management programs and support the Refuge's efforts to maintain and enhance wildlife populations and habitats.

Objective 6.1.1: Effective Environmental Education Programming— Continue to maintain and develop the partnership with Alaska Natural History Association (ANHA) and/or other cooperating associations to provide interpretive and environmental sales products on the natural and cultural history of Kenai Refuge and surrounding public lands.

Rationale: Public use is one of the enabling legislative principles for the Refuge. Partnerships with cooperating associations are essential in fulfilling this mandate and are an important element in enabling visitors to engage in wildlife-dependent recreation opportunities on the Refuge.

Objective 6.1.2: Effective Environmental Education Programming— Continue cooperative efforts with area educators to increase the number of effective resource conservation education programs focusing on key Refuge resource issues.

Rationale: Continued cooperation with area educators in providing effective resource conservation programs and increasing the number of those programs by 50 percent will build a base of support for Refuge programs and support for the Service and Department programs.

Objective 6.1.3: Effective Environmental Education Programming— Within six months of the Plan's approval and annually thereafter, conduct a review of the Visitor Service's operating procedures, outreach information, and program content.

Rationale: Review and appropriate adjustment of Visitor Service programs and outreach efforts will benefit visitors and Refuge planning efforts to meet the needs of user groups.

Objective 6.1.4: Effective Environmental Education Programming— Within one year of Plan's approval, develop and make accessible for public use a Web-based information system that hosts current and comprehensive information about the Refuge, its regulations, safety tips, and recreation opportunities.

Rationale: Increased information about Refuge resources, opportunities, and facilities was identified during the public scoping process while developing this Plan. The availability of an Internet-based information system will enhance and increase the availability of current and comprehensive information available to the public to maximize their Refuge experience.

Objective 6.1.5: Effective Environmental Education Programming— Within one year of Plan's approval, work with The Friends of Kenai National Wildlife Refuge to define annual goals and objectives.

Rationale: The Friends of Kenai National Wildlife Refuge is a vital partner in the Refuge's effort to increase public knowledge and understanding of Refuge purposes and management activities. The ability of this group will be significantly enhanced through a growth in membership.

Objective 6.1.6: Effective Environmental Education Programming— Within two years of the Plan's approval, hire a permanent seasonal employee to assist the education specialist and Student Conservation Association (SCA) conservation associate at the Environmental Education Center and the Outdoor Education Center.

Rationale: Currently, the education staff is at maximum service level and is unable to provide additional education opportunities, including the Leave No Trace Program, without additional staff. To achieve this education objective, the most important need is increased staffing for environmental education.

Objective 6.1.7: Effective Environmental Education Programming— Within two years of Plan's approval, curate objects from historic cabins, and catalog and manage them properly (including interpretation of the objects).

Rationale: Many historic artifacts were recovered when the cabins were restored. They are valuable documentation of the early activities

and uses of the cabins. It is an aspect of responsible research to properly record and store the remains recovered from these cabins for future generations.

Objective 6.1.8: Effective Environmental Education Programming— Within two years of Plan's approval, develop an interpretive strategy for including cultural heritage in the Refuge's interpretive efforts.

Rationale: Efforts to include cultural heritage and Refuge history into interpretive programs will help the Service fulfill the wildlife-dependent recreation goals identified in the Service's strategic plan, *Fulfilling the Promise*.

Objective 6.1.9: Effective Environmental Education Programming— Within three years of Plan's approval, develop and increase by 30 percent outreach materials on Refuge resources that reflect the importance of responsible management practices.

Rationale: Fiscal restraints do not allow the Refuge to meet current demands for outreach materials. Increasing the number, variety, and effectiveness of outreach materials that explain the importance of Refuge natural resources and management of those resources will increase public support for Refuge programs. Visitors have also requested information on subjects for which we have not developed outreach materials; developing materials to meet those requests will improve the effectiveness of our efforts.

Objective 6.1.10: Effective Environmental Education Programming— Within three years of Plan's approval, review all interpretive, educational, and information materials, and update them utilizing state-of-the-art media.

Rationale: Interpretive and educational media are dynamic systems that undergo constant change and improvement. It is a Service responsibility to insure use of the most up-to-date media possible to effectively communicate with visitors.

Objective 6.1.11: Effective Environmental Education Programming— Within three years of Plan's approval, form partnerships with the Kenaitze Indian Tribe and Cook Inlet Region, Inc., (CIRI) to interpret their cultural history.

Rationale: Humans have been an integral part of the Kenai Peninsula environment for thousands of years, attracted by the same things that draw many visitors today—animals and fish. The Kenaitze Tribe and CIRI hold a unique perspective on many aspects of the human history of the Kenai Refuge. Partnering with these organizations will incorporate Native voices in interpretation and increase Refuge staff and visitors' understanding of the role of humans on this environment and how environment shapes culture.

Objective 6.1.12: Effective Environmental Education Programming— Within three years of Plan's approval, establish a formal relationship with the Kenaitze tribe by supporting the Kenaitze Indian Tribe's Susten Camp.

Rationale: Susten Camp goals include fostering pride in the Kenaitze heritage and exposing tribal youth to cultural and natural resource careers. Susten Campers renew their ties to the land and their culture and can learn about Refuge management. Much of the available information about the archaeology in the Russian River area is due to the 13-year partnership between the Refuge and the Kenaitze Indian Tribe. A formal relationship would allow better integration of camp goals and Refuge needs.

Objective 6.1.13: Effective Environmental Education Programming— Within five years of the Plan's approval, provide the opportunity for at least 50 percent of central Peninsula kindergarten through sixth grade students to participate in at least one of the current environmental education programs focusing on key Refuge resource conservation issues.

Rationale: During the 2003–2004 school year, 41 percent of central Peninsula kindergarten through sixth grade students participated in at least one of the Refuge's environmental education programs. The goal of the environmental education program is to instill responsible environmental behavior, provide a sense of connection to the environment, and promote stewardship. In addition, expanding the education opportunities to a larger group of central Peninsula students will provide more dissemination of key resource issues on the Refuge.

Objective 6.1.14: Effective Environmental Education Programming— Within five years of Plan's approval, increase wildlife interpretive programs such as guided hikes, campfire programs, and wayside exhibits by 50 percent.

Rationale: Refuge interpretive programs, which have consistently met with visitor approval, will help fulfill one of six wildlife-dependent recreation opportunities on the Refuge. Increasing the number of programs will provide visitors with more information on wildlife, habitats, cultural resources, recreation opportunities, and other aspects of Refuge management.

Objective 6.1.15: Effective Environmental Education Programming— Within five years of Plan's approval, record the Refuge's human history, including but not limited to the Swanson River and Beaver Creek oil and gas fields and the Russian River Ferry area by finalizing the oral history collection currently underway.

Rationale: Recording aspects of Refuge history was identified as a priority during preparation of the Guide for Managing Cultural Resources on the Kenai National Wildlife Refuge. Events occurring on the Kenai Peninsula,

and within the Refuge, are a microcosm of events across Alaska. Oil and gas development on Kenai Refuge helped facilitate Alaska's statehood and played a major role in management of the Refuge. Tourism, especially as represented by the fishery at the Russian River, is also a critical theme in Kenai Refuge history.

Objective 6.1.16: Effective Environmental Education Programming— Within 10 years of the Plan's approval, provide a larger variety of environmental education opportunities, including but not limited to day camps and after school programs, through the environmental education program.

Rationale: Expanding the environmental education program from the current field trip format to include opportunities such as day camps, after school programs, and programs for the home school community will enable the Refuge to reach more youth in the community.

Objective 6.1.17: Effective Environmental Education Programming— Within 15 years of the Plan's approval, provide the opportunity for at least 20 percent of students in grades 7 through 12 from the central Peninsula schools to participate in at least one environmental education program on the Refuge as part of their school's curriculum.

Rationale: During the 2003–2004 school, no central Peninsula students in grades 7 through 12 participated in a Refuge environmental education program. Currently, the environmental education program curriculum targets students in kindergarten through sixth grade. Expanding to higher grade levels will help the education program meet its goal of providing quality education opportunities to the entire kindergarten through twelfth grade community.

Subgoal 6.2 Land Management Training—Land managers, scientists, and other partners learn practices and techniques to study, manage, and monitor the boreal forest biome.

Objective 6.2.1: Land Management Training—When nominations are again accepted, establish the Refuge as a designated National Wildlife Refuge System *Fulfilling the Promises* Land Management Research Demonstration Site (LMRD).

Rationale: Goal WH18 in the U.S. Fish and Wildlife Service's (Service) strategic plan, *Fulfilling the Promises*, specifies the designation of Land Management Research Demonstration Areas to facilitate the development, testing, teaching, publishing, and demonstration of state-of-the-art management techniques. As the only unit in Alaska—and perhaps in the National Wildlife Refuge System—that has a specific purpose to provide opportunities for land management training, Kenai Refuge will be designated an LMRD site.

Objective 6.2.2: Land Management Training—Annually survey Refuge staff to identify and nominate potential candidates for the national

Technical Fire Management (TFM) program, a two-year continuing education and career development program that provides sufficient college credits within a natural science and fire curriculum to qualify the student in the 0401 job series (general biology/fire management).

Rationale: The TFM program has successfully produced qualified fire management personnel for permanent positions with the Service and other land and fire management agencies. The Service and other agencies need to continue the development of new fire management personnel to respond to the attrition caused by an aging workforce.

Objective 6.2.3: Land Management Training—Annually, to the extent practicable, host and/or conduct interagency fire management training (wildfire, prescribed fire, use of wildland fire, and fire aviation) in conjunction with fire management projects and/or wildland fire incidents when possible.

Rationale: Fire management training opportunities in Alaska are limited, and the cost of travel for training are often prohibitive. Alaskan fire managers must cooperatively use every opportunity to provide local training to their staff to maintain or improve the qualifications necessary to manage a program. Cooperative interagency training builds camaraderie and familiarity across agencies, improving communications and operational capabilities within the interagency fire community.

Objective 6.2.4: Land Management Training—Within two years of Plan's approval, develop a program that establishes the Refuge as a boreal forest biome regional training facility.

Rationale: The Kenai Refuge is the only unit in Alaska—and perhaps in the National Wildlife Refuge System—that has a specific purpose to provide opportunities for land management training. Of the two Alaskan refuges that have a specific purpose to provide opportunities for research (Alaska Maritime being the other), the Kenai Refuge is the only one on the highway system in close proximity to a major metropolitan area and with reasonably good road access to Refuge habitats. Additionally, the Refuge has one of the largest biology programs in the National Wildlife Refuge System, the largest fire management program among Alaskan refuges, the internationally recognized Moose Research Center, and one of the most diverse landscapes. As such, the Refuge has a clear mandate and is positioned well to serve as a regional training facility for management and monitoring of the boreal forest biome.

Objective 6.2.5: Land Management Training—Within three years of Plan's approval, develop a step-down management plan for the Stepanka (Skilak Outlet) Archaeological District to mitigate damage to cultural resources.

Rationale: This area is experiencing many of the same pressures as the Sqilantnu Archaeological District. The development of a specific step-

down management plan for Stepankas Archaeological District will identify specific problems and actions to address them.

Objective 6.2.6: Land Management Training—Within four years of Plan's approval, identify priority areas to survey and begin to support fieldwork in cooperation with the University of Alaska tribes and other cooperators conducting cultural resource related studies.

Rationale: Many areas of the Refuge have never been surveyed for prehistoric or historic archaeological sites. The National Historic Preservation Act requires all Federal landowners to identify important sites on their lands. This project has also been identified in the Guide for Managing Cultural Resources on the Kenai National Wildlife Refuge.

Objective 6.2.7: Land Management Training—Within five years of Plan's approval, develop a step-down management plan for the Sqilantnu (Russian River) Archaeological District to mitigate damage to cultural resources.

Rationale: In 1996, Refuge staff and the Service's regional archaeologist developed a Guide for Managing Cultural Resources on the Kenai National Wildlife Refuge to identify cultural resource management needs for the Refuge. Because of the intense public use of the Russian River area, the guide identified development of a step-down management plan as a priority to assist the Service in managing and protecting the area's cultural resources. A step-down management plan for the Sqilantnu Archaeological District will identify specific problems and actions to address them.

Objective 6.2.8: Land Management Training—Within five years of Plan's approval, develop interagency agreements with universities and agencies to use the Refuge as a designated center for research on boreal forest ecology and management (including global climate change), recreational use of boreal forest, wildlife, and habitats, and wilderness management.

Rationale: Despite the high level of public use, proximity to urban development, and accessibility to roads, the Refuge also has 1.32 million acres of designated Wilderness that helps sustain a relatively high degree of ecological integrity. There is a real opportunity to capitalize on these competing demands of Refuge resources by choosing to develop the Refuge into a designated center for research on boreal forest ecology and management, including recreational impacts on wildlife, habitat, and Wilderness character. The funds and expertise needed to develop this program can only be achieved with collaborative partnerships with other agencies and universities.

2.2.5 Refuge Purpose (v)

To provide, in a manner compatible with these purposes, opportunities for fish and wildlife-oriented recreation.

GOAL 7: Wildlife-Oriented Recreation—Visitors of all skills and abilities enjoy wildlife-oriented recreation opportunities in safe and secure settings.

Objective 7.1: Wildlife-Oriented Recreation—Continue to meet annually with Alaska Department of Fish and Game (ADF&G) to review State and Federal regulations that affect Refuge users and to identify actions that may improve opportunities for wildlife-dependent opportunities.

Rationale: The National Wildlife Refuge Improvement Act requires the Refuge to provide wildlife-dependent recreation opportunities. Coordination with ADF&G will help the Refuge meet that purpose by allowing staff members to coordinate up-to-date information on wildlife-dependent opportunities, and will enhance efforts to provide wildlife-dependent opportunities by preparing information materials in advance of seasonal activities such as hunting and fishing.

Objective 7.2: Wildlife-Oriented Recreation—Annually develop a trail maintenance plan to review current visitor use and identify maintenance needs of all foot, ski, water, and horse trails.

Rationale: The Refuge has more than 250 miles of foot and water trails. A review of the past year's work will improve the Refuge's efforts to maintain these trails efficiently for visitor safety and enjoyment.

Objective 7.3: Wildlife-Oriented Recreation—Annually review the Kenai Law Enforcement Plan and institute necessary revisions within one month of review.

Rationale: A review of the Refuge Law Enforcement Plan will ensure efficient use of Refuge enforcement resources by providing managers with up-to-date information on illegal activities and areas that may need additional deployment of officers in the short-term. This will enable them to make adjustments in patrols areas, patrol times, and the allotment of staff time.

Objective 7.4: Wildlife-Oriented Recreation—Within two years of Plan's approval, patrol and maintain the Canoe Trails Systems weekly during the intensive visitor use period of May through October.

Rationale: The Kenai Wilderness Canoe Trails are National Recreation Trails enjoyed by thousands of visitors each year. Regular patrols and maintenance will enhance visitor enjoyment and safety by providing visitors with improved maintenance of the portages, campsites, informative signs, and other associated facilities. The ability of staff to provide current information to visitors about wildlife movements and

other activity will also be enhanced through this increase in time spent in the canoe systems.

Objective 7.5: Wildlife-Oriented Recreation—Within two years of Plan's approval, organize the Visitor Services program into three districts (north, central, and south) for operational efficiency.

Rationale: The large land area and diverse visitor uses require an efficient means of providing visitor services. Instituting a three-district management program will ensure there is at least one staff person for each of the primary visitor use areas who will have the responsibility for coordinating facility maintenance and visitor information, and providing law enforcement officers with current information.

Objective 7.6: Wildlife-Oriented Recreation—Within three years of plan's approval, develop a Trail Needs Assessment by reviewing current and projected visitor use patterns and other appropriate information.

Rationale: Assessing trail needs will assist staff in planning annual trail maintenance. Using available staff and equipment in the most efficient manner will improve Refuge efforts to provide visitors with the opportunity to participate in wildlife-dependent activities such as hunting, fishing, wildlife observation, etc.

Objective 7.7: Wildlife-Oriented Recreation—Within three years of Plan's approval, make available 75 percent of visitor services staff for full implementation and operation of all interpretation, education, information, and recreation programs identified in this plan.

Rationale: The current Visitor Services staff cannot meet all of the demands of providing interpretive, educational, information, and recreation programs identified by visitors in the scoping process. Assessing the staffing requirements and identifying shortages will assist managers in meeting the purposes identified in the Refuge Improvement Act, public demands, and other objectives identified in this Plan.

Objective 7.8: Wildlife-Oriented Recreation—Within three years of Plan's approval, place information materials at all trailheads, boat ramps, and campgrounds, including but not limited to current use regulations; "Leave No Trace" recreation practices; and bear awareness, fire prevention, and backcountry safety topics.

Rationale: Placing the most current information available on Refuge resource issues at the identified facilities will improve visitor awareness and safety, and enhance their Refuge experience.

Objective 7.9: Wildlife-Oriented Recreation—Within three years of Plan's approval, repair or replace Refuge directional, regulatory, and location signs as necessary. Signs will be inspected on an annual basis.

Rationale: Refuge visitors expect to find the most current information. Providing correct, undamaged signs will improve visitor awareness and safety, and will enhance visitor experiences.

Objective 7.10: Wildlife-Oriented Recreation—Within five years of Plan's approval, increase patrol intervals on the Kenai River and all backcountry areas so that 25 percent of Refuge visitors report seeing and/or talking with a Refuge employee.

Rationale: Refuge backcountry users should feel safe while in those areas. Increasing the number of staff patrols will benefit Refuge visitors and enhance their safety.

Objective 7.11: Wildlife-Oriented Recreation—Within five years of Plan's approval, post boundary signs every 1,000 feet within one mile of all roads, trails, winter routes, and right-of-ways within or adjacent to the Refuge. Boundary signs will be inspected every two years and replaced as needed.

Rationale: Regular posting and inspection of boundary signs will assist Refuge visitors with safety concerns and help further delineate regulatory boundaries.

Objective 7.12: Wildlife-Oriented Recreation—Within 10 years of Plan's approval, improve overall recreation-related visitor satisfaction in the Skilak Wildlife Recreational Area to 90 percent or higher. Recreationists surveyed will include but not be limited to wildlife viewers, photographers, campers, and hikers.

Rationale: The National Wildlife Refuge Improvement Act requires the Refuge to provide wildlife observation opportunities. Providing additional facilities and up-to-date information on wildlife observation opportunities will assist staff in meeting that purpose for the benefit of Refuge visitors.

Objective 7.13: Wildlife-Oriented Recreation—Within 10 years of Plan's approval, implement the Refuge's approved law enforcement deployment model. Enforcement officers will patrol frontcountry and backcountry areas 365 days a year.

Rationale: A need for, and an expectation of, a Refuge law enforcement presence was identified during the Plan's public scoping process and in various national visitor satisfaction surveys. Implementation of the approved deployment model will provide managers, the staff, and other resources to meet the needs and expectations of Refuge users.

Objective 7.14: Wildlife-Oriented Recreation—Implement Executive Order 13443 to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat.

Rationale: Executive Order 13443, signed August 16, 2007, directs Federal agencies that have programs and activities that have a measureable effect on public land management, outdoor recreation, and wildlife management to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat.

GOAL 8: Facilities—Visitors and Refuge personnel value and enjoy safe, well-maintained facilities and quality programs.

Objective 8.1: Facilities—Continue to manage hazardous forest fuels, especially in the wildland-urban interface where beetle kill trees and other fuel hazards increase the threat of wildfire to communities or private lands. Adjacent private lands, inholdings, and Refuge structures will continue to receive the maximum possible fire protection through interagency agreements.

Rationale: In response to the President's direction, the Secretaries of Agriculture and the Department of the Interior developed the National Fire Plan (2001). One of the five key points of the National Fire Plan is hazardous fuel reduction. The National Fire Plan provides funding to the U.S. Forest Service and to Interior Agencies, including the U.S. Fish and Wildlife Service (Service), to manage hazardous fuels and reduce dense forest vegetation resulting from decades of wildfire suppression and fire exclusion on Federal lands. The National Fire Plan specifies that fuel reduction activities will be focused "on wildland-urban interface areas to reduce risk to people and property."

The Refuge's Fire Management Plan combines this national direction with the direction provided in the Comprehensive Conservation Plan to develop a coordinated response to hazardous fuel accumulations in the wildland-urban interface. The Refuge collaborates with its interagency fire management partners in an effort to protect communities from wildfires and to promote "Firewise" principles. In following national Firewise principles, by reducing hazard fuels and creating defensible space, Refuge managers are also mitigating the potential impacts of unwanted wildfires to Refuge facilities and structures.

Objective 8.2: Facilities—Continue to ensure fulfillment of obligations associated with maintaining the Moose Research Center as specified in the 2004 Memorandum of Understanding between ADF&G and the Refuge.

Rationale: The Memorandum between the Refuge and ADF&G states that the Refuge will be jointly responsible for the maintenance and operation of this unique research facility. Through entering and maintaining appropriately ranked Maintenance Management System projects, the Refuge will ensure that its contributions to this center continue into the future and that research promoted at the center is properly supported by a sound infrastructure.

Objective 8.3: Facilities—Continue monthly and annual meetings with industry, Alaska Department of Environmental Conservation (ADEC), and Bureau of Land Management (BLM) to plan plugging and abandonment of wells; removal or abandonment of pipelines; remediation of known contaminant sites; and identification of potential contaminated sites on existing oil and gas units.

Rationale: As oil and gas reservoirs near depletion in some areas, planning for plugging and abandonment of wells and clean up of the sites needs to take place. It is more financially feasible to clean up individual sites as they become available than to wait until the whole unit is out of production and then clean up everything at once. Each site needs to be looked at on a case-by-case basis, and a clean up plan needs to be developed as to how the site will be sampled, remediated, restored, and closed to the satisfaction of ADEC, BLM, industry, and the Refuge.

Objective 8.5: Facilities—Within two years of Plan approval, complete a wildfire hazard and risk assessment for known historic cabins and cultural sites; then develop and implement a strategic 10-year plan to mitigate identified hazardous fuel conditions around cabins and sites where full protection is selected as the appropriate management option.

Rationale: There are more than 100 known historic cabins and cultural sites on the Refuge. Many have yet to be surveyed, but some are known to be at risk from wildfire due to hazardous fuel conditions (beetle-killed white spruce or black spruce forest in close proximity). Once sites have been surveyed, a determination of the appropriate protection level can be made and hazard mitigation can be implemented.

Objective 8.4: Facilities—Within two years of Plan's approval, implement the programmatic agreement for managing historic cabins.

Rationale: The Programmatic Agreement between the Refuge and the State Historic Preservation Officer outlines the steps needed to maintain and preserve the historic cabins rehabilitated for recreational use. Implementation of the Agreement is evidence that the Refuge has met its legal requirements under the National Historic Preservation Act for protecting the historic values of the cabins.

Objective 8.6: Facilities—Within three years of Plan approval, construct two six-bed cabin kits for additional educational group housing at the Outdoor Education Center.

Rationale: Housing at the Outdoor Education Center is currently limited to six four-person buildings; this includes space for youth group leaders. Most classes on the Kenai Peninsula are larger than 24 students. The addition of an additional 12 beds will increase educational opportunities for students at this facility.

Objective 8.7: Facilities—Within three years of Plan approval, develop a Kenai Refuge Sign Plan. The plan will contain location and graphic information for every sign used on the Refuge and will establish maintenance and replacement schedules and procedures.

Rationale: Completion of a comprehensive Sign Plan will provide staff with an inventory of signs currently used to identify Refuge boundaries and to inform and direct Refuge users as to available facilities and opportunities; maintenance schedules and procedures will ensure that those signs are available to users.

Objective 8.8: Facilities—Within three years of Plan's approval, complete and submit to the State Historic Preservation Officer the nomination form to have the Stepanka Archaeological District listed on the National Register.

Rationale: The cultural resources sites in the Stepanka Archaeological District are a unique record of Kenai Peninsula Native history dating back 4,000 years. The Service agreed to recognize and manage the archaeological values of the area when the land was purchased to be incorporated into the Kenai Refuge. This recognition was spelled out in the 1997 Omnibus Parks Act, which transferred ownership of the Stepanka district to the Kenai Refuge and required the Service to have the area listed on the National Register of Historic Places.

Objective 8.9: Facilities—Within five years of Plan's approval, service all campground restrooms at least once a week.

Rationale: Campground restrooms are not always serviced on a weekly basis. In an effort to improve the sanitary condition of these important public use facilities, maintenance staff will be directed to use pressure sprayers to clean these facilities on a weekly basis.

Objective 8.10: Facilities—Within five years of Plan's approval, begin to patrol, service, and/or restock all frontcountry trailheads with appropriate information materials daily by Refuge staff.

Rationale: Frontcountry trailheads are not always serviced on a daily basis. To improve the physical condition, safety, and environmental education and interpretation opportunities at these important public use facilities, Refuge staff and/or volunteers will be directed to attend to these facilities on a daily basis.

Objective 8.11: Facilities—Within five years of Plan's approval, begin to check, service, maintain, and/or restock all backcountry facilities and trails with information materials as needed by assigned backcountry staff.

Rationale: Currently, all backcountry facilities and trails do not receive weekly attention. Service and attention on a regular, recurring schedule

will ensure these facilities are in the best possible condition for use by Refuge visitors.

Objective 8.12: Facilities—Within five years of Plan's approval, develop and implement best management practices to reduce waste, pollution, and energy inefficiency by 50 percent across all Refuge programs.

Rationale: The Refuge—a highly visible conservation organization—has the responsibility to lead by example in conserving all resources that it reasonably can while implementing Refuge programs. The Refuge will work to achieve this objective by using technological advances, purchasing "green" materials, increasing recycling efforts, and conducting regular reviews of operational programs to ensure the use of environmentally friendly practices.

Objective 8.13: Facilities—Within five years of Plan's approval, upgrade (as appropriate) and increase maintenance of Refuge roads, including but not limited to grading, snow removal, vegetation and invasive species control, dust control, and culvert replacement.

Rationale: Current maintenance of Refuge roadways has been inadequate due to shortages of manpower and equipment, generating deserved criticism from the public. Increased maintenance of Refuge roadways will assist in overcoming this perception from the public and will assist in preventative maintenance of these facilities.

Objective 8.14: Facilities—Within five years of Plan's approval, construct facilities to house up to 60 summer interns, volunteers, and seasonal employees, including Kenai Fish and Wildlife Field Office (KFWFO).

Rationale: Many Refuge and KFWFO programs rely on the use of seasonal and intermittent employees and volunteers to achieve their goals, but inadequate housing has hindered these programs. Through the addition and expansion of adequate seasonal housing, some Refuge purposes will be easier to achieve by assuring that sufficient manpower is available to meet current and future needs.

Objective 8.15: Facilities—Within seven years of Plan's approval, construct a new visitor center with capacity for 150 visitors.

Rationale: The current Visitor Center, co-located with the Refuge Administrative Headquarters, is extremely limited in floor space for displays and exhibits, and lacks adequate area for audiovisual and/or staff interpretive programming. Additionally, visitor parking is limited to 10–15 vehicles, dependent on size. A new facility will enhance the Refuge's ability to provide increased interpretive and audiovisual programming, sufficient office space for staff needs, and parking for visitors.

Objective 8.16: Facilities—Within seven years of Plan's approval, complete a 6,000-square-foot warehouse for storage of Refuge equipment.

Rationale: Accountability of equipment, supplies and materials is difficult with a large, diverse staff. To assure this accountability and eliminate redundancy of purchases to maximize available dollars, the construction of a warehouse is needed. This structure will allow for the addition of a property custodian that will take custody of all available property on the Refuge and manage this property in a responsible and accountable manner.

Objective 8.17: Facilities—Within one year of funding, renovate the Refuge laboratory and equip it with new facilities and analytical equipment.

Rationale: The Refuge has a 650-square-foot laboratory that is equipped with counter space, storage for hazardous chemicals and registered drugs, convection oven, centrifuge, weight scales, and other bench-top analytical equipment. However, most of the existing equipment is outdated, and there are analytical needs for a freeze-dryer (nutritional analyses), soxhlet apparatus (lipid content), and super-cold laboratory freezer (blood serum). Furthermore, Occupational Safety and Health Administration (OSHA) requires that the laboratory have a fume hood with an exhaust that is independent of the office system.

2.2.6 The Wilderness Act Purpose for the Kenai Wilderness Area

To secure an enduring resource of wilderness, to protect and preserve the wilderness character of areas within the National Wilderness Preservation System, and to administer [the areas] for the use and enjoyment of the American people in a way that will leave them unimpaired for future use and enjoyment as wilderness.

GOAL 9: Wilderness Stewardship—Preserve and where necessary, restore the character and integrity of Wilderness for present and future generations.

Objective 9.1: Wilderness Stewardship—Immediately following Plan's approval, develop a Wilderness Stewardship Plan for the Refuge.

Rationale: The Wilderness Act requires that the Refuge maintain the wilderness character of designated Wilderness areas. As a step-down management plan, the Wilderness Stewardship Plan will provide detailed strategies and implementation schedules for protecting wilderness character and meeting the specific wilderness objectives identified in this Comprehensive Conservation Plan.

Objective 9.2: Wilderness Stewardship—Immediately following Plan's approval, begin conducting Minimum Requirements Analyses on all administrative activities in designated Wilderness.

Rationale: A Minimum Requirements Analyses (MRA) is a documented procedure for identifying, reviewing, and approving administrative activities that are proposed in designated Wilderness areas. The recommended tool for conducting an MRA in Alaska is the Alaska

Supplement of the Minimum Requirements Decision Guide, which was developed by the interagency Arthur Carhart National Wilderness Training Center to help natural resource managers assess whether a proposed action in Wilderness is necessary, and if so, what the minimum tool is to accomplish the proposed action in the least intrusive manner.

Objective 9.3: Wilderness Stewardship—Within three years of Plan's approval, initiate a program to assess and model the natural soundscape of designated Wilderness and other areas.

Rationale: Natural sounds are an essential component of functional habitats. Additionally, they may influence the human experiential opportunities of some users in Wilderness. Natural sounds can be affected by public use of the Refuge. Careful measurement and description of the natural soundscape is needed to assess impacts and formulate an approach for addressing this issue.

Objective 9.4: Wilderness Stewardship—Within five years of Plan's approval, initiate research to assess and model motorized and non-motorized human-wildlife interactions as a result of recreational activities, including snowmachines, boats, road traffic, campgrounds, and trail use in Wilderness.

Rationale: Public use of designated Wilderness is increasing, as are problems and issues associated with this use. Refuge management must have the best science possible to evaluate the impact of these uses and their effects on the wilderness character of the area.

Objective 9.5: Wilderness Stewardship—Within five years of Plan's approval, develop a model that evaluates human-caused disturbances on wilderness character.

Rationale: The integrity of the 1.32 million acres of Congressionally-designated Wilderness on the Kenai Refuge is threatened by various human-caused activities both on and off the Refuge. To better understand these cumulative effects and to forecast how they will likely change in the near future, the Refuge will develop the capabilities to model human-caused disturbances and associated impacts on the Wilderness character. Examples of disturbances of interest to the Refuge include motorized vehicle traffic (including airplane and snowmachines); wildfire management; increased public use, including new trails, cabins, smog from Anchorage, and residential development and associated road construction adjacent to the Wilderness boundary. The Refuge will initiate and participate in partnerships with other organizations and agencies in the research, development, and implementation of appropriate monitoring systems and models to better evaluate degradation of wilderness character.

Objective 9.6: Wilderness Stewardship—Within 15 years of Plan's approval, identify or purchase inholdings from willing sellers to

minimize landowner conflicts, protect Refuge resources, and provide for priority recreation activities.

Rationale: Purchase of private lands within Refuge boundaries will assist in preserving wildlife habitat and will reduce conflicts among landowners by establishing consistent access, and where appropriate, may increase access opportunity for recreation activities.

2.3 Common Management Direction, Policies, and Guidelines

The management direction, policies, and guidelines described in Volume 2, Appendix C were developed as common management direction for national wildlife refuges throughout the Alaska Region. It is the same for all Alaska refuges unless modified to meet specific management needs of a refuge. The primary sources of this management direction are the laws governing the National Wildlife Refuge System and the regulations, policies, and other national and regional guidance developed to implement the laws. Management of refuges in Alaska is governed by Federal laws (i.e., the National Wildlife Refuge System Administration Act of 1966 [Refuge Administration Act; 16 U.S.C. 668dd] and the Alaska National Interest Lands Conservation Act of 1980 [ANILCA]), by regulations implementing these laws, by intergovernmental treaties, by U.S. Fish and Wildlife Service (Service) policy, and by principles of sound resource management. These factors establish standards for resource management or limit the range of potential activities that may be allowed on refuges. When the management direction or details of the direction are specific to or modified for application to the Kenai Refuge, it is so noted.

Under any of the action alternatives (Alternatives B–E, which represent a change from current management), management of the Refuge would comply with the direction described in Volume 2, Appendix C. As a result, the action alternatives share a set of common management policies and guidelines. This direction provides a common base upon which each of the alternatives are built and represents the typical level of management necessary to comply with existing law, regulation, and policy. If specific regulations or other guidance changes while this plan is in effect, management direction for the Refuge would be modified as necessary to comply with those changes.

2.4 Comparison of Previous and New Management Policies and Guidelines

Table 2-13 highlights the significant changes in management direction between Alternative A and new regional management direction associated with the action alternatives (Alternatives B–E). Management direction under Alternative A is taken from the 1985 Kenai National Wildlife Refuge Comprehensive Conservation Plan (USFWS 1985a) and Record of Decision (USFWS 1985b), as modified by subsequent step-down management plans. Direct comparison of the management direction identified for Alternative A and that proposed for the action alternatives (Alternatives B–E) is difficult because the organization of the tables and level of detail provided for various categories of actions are quite different. Table 2-13 displays the *major* differences between Alternative A and the action alternatives (Alternatives B–E).

Table 2-13. Comparison of Current and New Management Direction (Alternative A compared with Alternatives B – E)

Activities, Public Uses, Commercial Uses, & Facilities	Alternative A (Current Management Direction)	Alternatives B, C, D, and E (New Regional Management Direction)	Comments
Collecting Information on and Monitoring Ecosystem Components	N/A	Data gathering, monitoring and maintenance of a comprehensive database of selected ecosystem components (e.g., plants, animals, water, air, etc.) is allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Research and Management	N/A	Access and collection of data necessary for management decisions or to further science by the Service is allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Research and Management Facilities	N/A	Permanent or temporary structures or camps, including weirs, counting towers, and sonar counters may be allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Describing, Locating, and Mapping Habitats	N/A	Development of quantitative, written, and graphic descriptions of fish and wildlife habitat, including water, food, and shelter components, is allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Habitat Management (Mechanical Treatment)	Modification of habitats to increase target wildlife populations, which includes both enhancement and restoration activities, such as use of the tree cutter, is permitted in Intensive and Moderate management categories.	Activities such as cutting, crushing, or mowing of vegetation; water control structures; fencing; artificial nest structures may be allowed in Intensive and Moderate management categories.	The proposed change in direction has the potential to restrict management flexibility.

Activities, Public Uses, Commercial Uses, & Facilities	Alternative A (Current Management Direction)	Alternatives B, C, D, and E (New Regional Management Direction)	Comments
Habitat Management (Manual Treatment)	N/A	Use of hand tools to remove, reduce, or modify hazardous plant fuels or exotic plant species, or to modify habitats (e.g., remove beaver dams) may be allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Aquatic Habitat Modifications	N/A	Activities such as stream bank restoration, passage structures, fish barriers, or removal of obstacles that result in physical modification of aquatic habitats to maintain or restore native fish species may be allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Fire Management – Prescribed Fires	Fires burning under controlled conditions as a management tools for improvement of resource values (habitat improvement) are permitted in Intensive, Moderate and Traditional management categories. Such activities are restricted to protect life, or property, or significant resource values in Minimal and Wilderness management categories.	Fire ignited by management to meet specific objectives may be allowed in all management categories.	The proposed change in direction allows for more management flexibility.
Fire Management – Use of Wildland Fire	Use of wildland fire as a management tool allowed in all management categories except Intensive.	The planned use of naturally occurring fires to meet management objectives may be allowed in all management categories.	The proposed change in direction allows for more management flexibility.

Activities, Public Uses, Commercial Uses, & Facilities	Alternative A (Current Management Direction)	Alternatives B, C, D, and E (New Regional Management Direction)	Comments
Fire Management – Fire Suppression	Actions taken to suppress wildfire (human-caused or natural), such as building fire breaks are mandatory in the Intensive management categories. Such fires are permitted to burn in all other management categories unless human life or property or significant resource values are threatened.	Management actions intended to protect identified resources from a fire, extinguish a fire, or alter a fire's direction of spread is allowed in all management categories.	The proposed change in direction allows for more management flexibility.
Non-native and Pest Plant Control	N/A	Monitoring, extirpation, control, removal and/or relocation, and other management practices for pest and non-native species may be allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Water Quality and Quantity Management	N/A	Monitoring of water quality and quantity to identify baseline data and for management purposes, including installation of gauging stations, is allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Reintroduction of Species	Reintroduction of native species within their historic range is permitted in all management categories.	The reintroduction of native species to restore natural diversity of fish, wildlife, and habitats may be allowed in all management categories.	The proposed change in direction will maintain current management flexibility.

Activities, Public Uses, Commercial Uses, & Facilities	Alternative A (Current Management Direction)	Alternatives B, C, D, and E (New Regional Management Direction)	Comments
Fish and Wildlife Control	N/A	The control, relocation, sterilization, removal, or other management of native species, including predators, to maintain natural diversity of fish, wildlife, and habitats; to protect reintroduced, threatened, or endangered species; or to restore depleted native populations may be allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no change to current management.
Non-native Species Management	N/A	The removal or control of non-native species (including predators) may be allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Pest Management and Disease Prevention and Control	N/A	Relocation or removal of organisms that threaten human health or survival of native fish, wildlife, or plant species. Management practices directed at controlling pathogens that threaten fish, wildlife and people, such as rabies and parasite control, may be allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Fishery Restoration	N/A	Actions taken to restore fish access to spawning and rearing habitat, or actions taken to restore populations to historic levels, including harvest management, escapement goals, habitat restoration, stocking, egg incubation boxes, and lake fertilization, may be allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.

Activities, Public Uses, Commercial Uses, & Facilities	Alternative A (Current Management Direction)	Alternatives B, C, D, and E (New Regional Management Direction)	Comments
Fishery Restoration Facilities	N/A	Fisheries facilities, which may be permanent or temporary and may include hatcheries, fish ladders, fish passages, fish barriers, and associated structures, may be authorized in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Fishery Enhancement	Actions taken to increase fishery stocks above historic levels, including lake fertilization, stocking, building hatcheries and fish passages, and artificially incubating fish in streams is permitted in special situations with cooperative agreements, subject to compatibility with Refuge purposes in all management categories. Fisheries enhancement for commercial purposes in Wilderness is prohibited.	Activities applied to a fish stock to supplement numbers of harvestable fish to a level beyond what could be naturally produced based upon a determination or reasonable estimate of historic levels may be allowed in Intensive and Moderate management categories. Such activities are not allowed in Minimal and Wilderness management categories.	The proposed change in direction will restrict current management flexibility.
Fishery Enhancement Facilities	Fishery enhancement facilities may be permitted in special situations with cooperative agreements in all management categories, subject to compatibility with refuge purposes. Fisheries enhancement facilities for commercial purposes in Wilderness is prohibited.	May be permanent or temporary and may include hatcheries, egg incubation boxes, fish ladders, fish passages, fish barriers, and associated structures. May be authorized in Intensive and Moderate management categories. Such facilities are not allowed in Minimal and Wilderness management categories.	The proposed change in direction will restrict current management flexibility.

Activities, Public Uses, Commercial Uses, & Facilities	Alternative A (Current Management Direction)	Alternatives B, C, D, and E (New Regional Management Direction)	Comments
Native Fish Introductions	Native fish introductions within their historic range is permitted in all management categories.	Movement of native fish species within a drainage on the Refuge to areas where they have not historically existed may be allowed in all management categories.	The proposed change in direction will enhance current management flexibility.
Helicopters	All rotary-wing aircraft are permitted on a site-specific basis subject to reasonable regulation in all management categories.	All rotary-wing aircraft may be authorized in all management categories.	The proposed change in direction will maintain current management flexibility.
All Weather Roads	Designated, maintained corridors that provide access for motorized vehicles, including asphalt roads, gravel roads, and other maintained roads (may include signs, bridges, pull-outs, waysides, etc), may be provided in the Intensive management category only.	All weather roads and associated developments, including bridges, may be allowed in Intensive and Moderate management categories. Such facilities are not allowed in Minimal and Wilderness management categories.	The proposed change in direction provides for additional management flexibility.
Constructed Hiking Trails	Designated, maintained routes that are restricted to walking, including interpretive trails, long-distance trails, and campsite trails. New trails may be provided in all management categories except Wilderness; existing trails may be maintained in all management categories.	Constructed hiking trails, including bridges, boardwalks, trailheads, and related facilities, may be allowed in all management categories.	The proposed change in direction provides no change in management flexibility.
Designated Hiking Routes	N/A	Unimproved and unmaintained trails may be designated by signs, cairns, and/or on maps.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.

Activities, Public Uses, Commercial Uses, & Facilities	Alternative A (Current Management Direction)	Alternatives B, C, D, and E (New Regional Management Direction)	Comments
Visitor Contact Facilities	A variety of staffed or unstaffed structures where the public can learn about and obtain information on the Refuge and its resources may be provided at the Refuge headquarters and other sites in the Intensive management category only.	Staffed and unstaffed facilities that provide information about the Refuge and its resources to the public (including visitor centers, kiosks, and signs) may be allowed in all management categories except Wilderness, where they are generally not allowed.	The proposed change in direction provides for additional management flexibility.
Campgrounds	Permanent campgrounds that may include fire rings, shelters, picnic tables, water developments, and sanitary facilities may be provided in the Intensive management category only.	Developed sites accessible by highway vehicles may be allowed in Intensive and Moderate management categories. Such facilities are not allowed in Minimal and Wilderness management categories.	The proposed change in direction provides for additional management flexibility.
Hardened Campsites	N/A	Areas where people can camp that are accessible by vehicle or on foot but where the only facilities provided are for public health and safety and/or resource protection, including gravel pads for tents, hardened trails, and/or primitive toilets, are allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Administrative Field Sites	N/A	Permanent facilities used by Refuge staff or other authorized personnel for the administration of the Refuge, including administrative cabins and related structures and larger multi-facility administrative sites necessary to support ongoing field projects, research, and other management activities, may be allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.

Activities, Public Uses, Commercial Uses, & Facilities	Alternative A (Current Management Direction)	Alternatives B, C, D, and E (New Regional Management Direction)	Comments
Refuge Administrative Office Complex	N/A	Facilities necessary to house Refuge operations, outreach, and maintenance activities; and associated infrastructure, including staff offices, storage, maintenance, and other similar facilities, may be allowed in the Intensive management category only. Such facilities are not allowed in other management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Hazardous Materials Storage	N/A	Sites, including appropriate structures and equipment necessary for the storage and transfer of fuels and other hazardous materials used for administrative purposes, may be allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Residences	N/A	Residential housing for Refuge staff and their families, including single and multi-family dwellings, may be allowed in the Intensive management category. Such facilities are not allowed in other management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Bunkhouses	N/A	Quarters to house temporary and similar employees, volunteers, visitors, and other agency personnel may be allowed in the Intensive management category. Such facilities are not allowed in Minimal, Moderate, and Wilderness management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.

Activities, Public Uses, Commercial Uses, & Facilities	Alternative A (Current Management Direction)	Alternatives B, C, D, and E (New Regional Management Direction)	Comments
Radio Repeater Sites	N/A	Sites used to maintain radio communications equipment, including helispots for access, may be allowed in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Core Sampling	N/A	The use of helicopter transported motorized drill rig to extract subsurface rock samples, not including exploratory wells, may be authorized in all management categories except Wilderness.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Other Geophysical Studies	N/A	Helicopter-supported gravity and magnetic surveys and other minimal impact activities that do not require mechanized surface transportation may be authorized in all management categories except Wilderness.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Transporting	N/A	May be authorized in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Helicopter Air Taxis	N/A	May be authorized in all management categories except Wilderness.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Bus and Auto Tours	N/A	May be authorized in Intensive and Moderate management categories. Such activities are not applicable in Minimal and Wilderness management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.

Activities, Public Uses, Commercial Uses, & Facilities	Alternative A (Current Management Direction)	Alternatives B, C, D, and E (New Regional Management Direction)	Comments
Commercial Filming, Videotaping, and Audiotaping.	N/A	May be authorized in all management categories.	Though not specifically mentioned in the 1985 Plan, the proposed new regional direction provides no significant changes to current management.
Commercial Timber and Firewood Harvest	Removal of timber from the Refuge for commercial purposes is permitted on a site-specific basis, subject to reasonable regulation in Intensive and Moderate management categories. Such activities are not permitted in other management categories.	May be authorized in all management categories except Wilderness.	The proposed new regional direction provides for additional management flexibility by allowing for timber and firewood harvest in Minimal, Intensive, and Moderate management categories.
Small Hydroelectric Power Development	N/A	Hydroelectric generation by low-head or instream structures that do not change the flow of the river may be authorized in Intensive and Moderate management categories. Such facilities are not allowed in Minimal and Wilderness management categories.	The proposed new regional direction provides for management flexibility to allow certain environmentally friendly energy generating projects in Intensive and Moderate management categories.

2.5 References

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USFWS. 1988. Record of Decision Kenai National Wildlife Refuge Supplemental Environmental Impacts Statement for the Wilderness Proposal of the Final Kenai Comprehensive Conservation Plan/Environmental Impact Statement/Wilderness Review. Anchorage, Alaska. October 20, 1988.

USFWS. "Guide for Managing Cultural Resources on the Kenai National Wildlife Refuge." Anchorage, Alaska: U.S. Fish and Wildlife Service.

3. Affected Environment

This chapter describes the physical, biological, and socioeconomic components of the Refuge ecosystem. The chapter is divided into seven major sections: Geographic Setting, Physical Environment, Biological Environment, Human Environment, Wilderness Values, River Values, and Refuge Infrastructure and Administration. References cited in this chapter are listed in section 3.8.

3.1 Geographic Setting

3.1.1 Refuge History

Major legislation affecting land ownership in Alaska units of the National Wildlife Refuge System (System) includes the Alaska Homestead Settlement Act of May 14, l898, which extended the provisions of the Original Homestead Act of May 20, 1862, to Alaska; Soldier's Additional Homestead (an amendment to the Homestead Act); Trade and Manufacturing Site Act (May 14, 1898); Native Allotment Act (May 17, 1906); Alaska Statehood Act of l959; Alaska Native Claims Settlement Act (ANCSA); Public Law [PL] 92-203, (December 18, 1971); and the Alaska National Interest Lands Conservation Act (ANILCA) PL 96-487 (December 2, 1980).

The Kenai National Moose Range (Range) was established on December 16, 1941 by Executive Order (EO) 8979 to protect the natural feeding and breeding range of the giant moose. On May 22, 1964, Public Land Order (PLO) 3400 adjusted the boundary of the Range. This order revoked EO 8979 in part by reducing the Range in size to approximately 1,730,000 acres. The privately settled and developed areas within the Range were removed, along with a six-mile strip of land along the shore of Cook Inlet and the area of the Range lying in the Harding Icefield.

With the passage of ANILCA on December 21, l980, the name of the Range was changed to Kenai National Wildlife Refuge (Refuge, Kenai Refuge) and approximately 200,000 acres of land on the Kenai Peninsula (Peninsula) were added. Three designated Wilderness units within the boundary of the Refuge were also established: Andy Simons Unit; Canoe Lakes Unit (later renamed the Dave Spencer Unit), and Mystery Creek Unit.

The Refuge encompasses approximately 1,987,202 acres as of 2007. The difference in the size of the Refuge is due largely to improved calculation methods with more accurate source data and shifting boundaries due to legislation.

3.1.2 Agreements, Decisions, and Legislation

Several actions have altered the land ownership patterns and management of Kenai Refuge, including litigation over ownership of submerged lands, settlement of aboriginal claims with Native organizations, and legislatively directed land exchanges.

On March 20, 1970, the Ninth Circuit Court overturned a lower court decision that had entered a summary judgment to quiet title to the submerged land in Tustumena Lake to the State of Alaska. The Ninth Circuit Court found that the intent of EO 8979 was to reserve both land and water of Lake Tustumena within the boundary of the Kenai National Moose Range to the United States. The court found that the submerged land in Tustumena Lake belonged to the United States and was managed by the U.S. Fish and Wildlife Service (Service).

On January 2, 1976, section 12(b) of PL 94-204 (amendment to the ANCSA) ratified "Terms and Conditions for Land Consolidation and Management in the Cook Inlet Area" (Terms and Conditions) (December 10, 1975). The land agreement was between the Department of the Interior (DOI), the State of Alaska, and the Cook Inlet Region, Inc. (CIRI)), and it authorized the Secretary of Interior to convey 10,240 acres of surface land and 218,880 of subsurface interests within the Range (Kenai Refuge) to CIRI.

On August 17, 1979, the Salamatof Agreement (among DOI, Salamatof Native Association, Inc., and CIRI) terminated the eligibility review of Salamatof as a Native village under section 11(b)(1) of ANCSA. This agreement was ratified with ANILCA (section 1432 [a]), which ended the dispute between the United States and the Salamatof Native Association. In this agreement, Salamatof Native Association, Inc., received 16,535 acres of surface entitlement, and CIRI received subsurface entitlement within the Range (Kenai Refuge). The agreement directed that the surface estate of lands conveyed to Salamatof Native Association be removed from the Range (section 1432 [c]); however, the subsurface estate remained in the Range so the land could not be removed from the Range (U.S. Fish and Wildlife Service Solicitor's Opinion, May 13, 1993, Alaska Region).

On May 18, 1981, the Beaver Creek Settlement Agreement (between the DOI and CIRI) settled a dispute between the United States and CIRI. In this agreement, which modified the CIRI "Terms and Conditions," CIRI agreed to relinquish, exchange, and convey title or interests in 13,000 acres to the United States, and the United States conveyed 9,600 acres of subsurface estate and 7,954 acres of coal, oil, and gas to CIRI. This agreement also reduced the original "Terms and Conditions" surface selection at Tustumena Lake to 6,900 acres from 10,240 acres. The implementing legislation authorized the removal of lands from the Kenai Refuge. The agreement provides that if the

United States re-acquires such lands, they shall become part of the Kenai Refuge.

3.1.3 Existing Land Status

Six villages (ANCSA section 11[a]), one Native group (ANCSA section 14[h][2]), one Native city (ANCSA section 14[h][3]), one regional corporation, and one primary place of residence were allowed to select land within the Kenai Refuge boundary by the passage of ANCSA (Figure 3-1). All of the villages are located outside the Refuge boundary. Villages were limited to 69,120 acres in the Refuge, as it was established prior to the passage of ANCSA. Land that was added to the Refuge by ANILCA was limited only by the villages' entitlement.

The Native corporations that have had selections or conveyances within the Kenai Refuge are:

- CIRI (regional corporation)
- Kenai Native Association (Native city limited to 23,040 acres)
- Point Possession Incorporated (Native group)
- The Tyonek Native Corporation (village of Tyonek)
- Salamatof Native Association, Incorporated (village of Salamatof)
- Chickaloon Moose Creek Native Association (village of Chickaloon)
- Knikatnu, Incorporated (village of Knik)
- Ninilchik Native Association, Incorporated (village of Ninilchik)
- Seldovia Native Association (village of Seldovia)

Point Possession was allowed to select land in the Range after a regulation (43 CFR 2653.6[b][1]) for Native groups was waived by DOI (601 Departmental Manual 3, January 7,1983).

All lands conveyed under ANCSA within pre-ANCSA national wildlife refuges are subject to section 22(g) of ANCSA. Under section 22(g), refuge lands conveyed under ANCSA remain subject to the laws and regulations governing use and development of the Refuge. Section 22(g) also reserves the right of first refusal to the United States if the lands are sold. BLM issued a Decision on May 23, 2007, rejecting the remaining village selections within Kenai Refuge. Point Possession and the Kenai Native Association no longer have land within the Kenai Refuge.

The land status of Kenai Refuge has undergone dramatic changes during the past decade due to the settlement of the *Exxon Valdez* oil spill and other legislation. Refuge lands selected by individual Natives Alaskans, Alaska Native corporations, and the State of Alaska continue to be adjudicated by the Bureau of Land Management. As of 2007, there were 10 private patents totaling 525 acres and five Native

Allotments totaling 385 acres within the Refuge boundary. Included in the 10 private patents is a 234-acre parcel of land that was deeded to a private company by Point Possession, Incorporated. These lands are subject to ANCSA 22(g). Of those five Native allotments, one has been conveyed and four remain to be adjudicated. ANCSA Native corporations have been conveyed 46,041 acres (Tyonek and Salamatof) of surface land. CIRI has been conveyed 187,647 acres of coal, oil, and gas, and 16,106 acres of subsurface estate, and currently has selected an additional 26,241 acres of coal, oil, and gas. This entitlement provides CIRI the opportunity to explore for, develop, and transport these resources in, on, or, from the Refuge, subject to reasonable regulations. The State of Alaska has been conveyed 1,362 acres and has selected an additional 12,293 acres of which 11,814 acres are invalid selections within the boundary of Kenai Refuge.[1]

On October 21, 1998, an amendment to ANCSA (section 432 of PL 105-276 [43 U.S.C 1629g]) allowed for certain Alaskan Native Vietnam veterans to have a renewed opportunity to apply for Native allotments. This law was passed in response to the concern that some Native Vietnam veterans may have missed their opportunity to apply for an allotment because of their military service. Qualified veterans were defined specifically, but the amendment essentially included those who served for at least six months between January 1, 1969, and December 31, 1971. The veterans also had to meet the qualifications set forth in the original Native Allotment Act. On December 21, 2000, section 302(2) of PL 106-559 allowed the heirs of those killed in action or those who died as a result of their wounds to apply for an allotment as a representative of an eligible deceased veteran. Currently, there is one Alaska Veteran allotment that has been filed on Kenai Refuge and not yet adjudicated.

3.1.4 Land Acquisition and Habitat Protection History

The Service has undergone a significant land acquisition program within Kenai Refuge. Compared to other units of the National Wildlife Refuge System in Alaska, the Kenai Refuge has fewer privately owned small parcels within its boundaries—primarily because the Refuge was established prior to most development or land tenure activities. There are, however, large parcels of land owned by Native groups and corporations that were conveyed pursuant to ANCSA. When funding is available and willing sellers of high-quality habitat are identified, the Service attempts to negotiate habitat protection actions to minimize habitat degradation, fragmentation, and permanent human intrusion within Refuge boundaries. A land protection plan for the Kenai Refuge was completed in 1994 to provide some direction to habitat-protection priorities.

[1] The Service determined these acreages by use of a geographic information system (GIS.

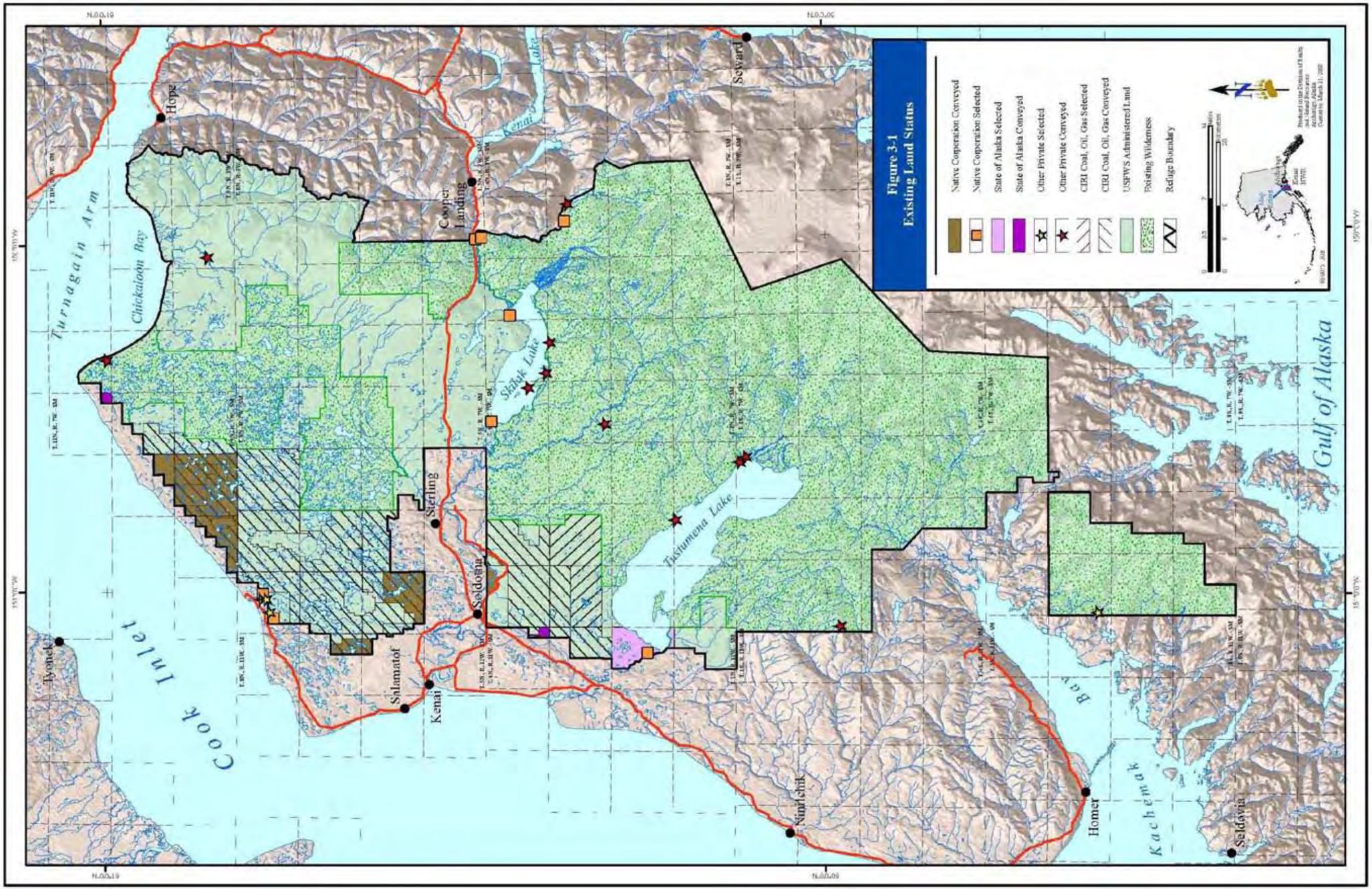


Figure 3-1. Existing Land Status

While the Kenai Refuge was only minimally affected by the 1989 *Exxon Valdez* Oil Spill (EVOS), the entire Refuge south of and including the Kenai River drainage was affected, at least in part, due to the large number of salmon and other species that spend at least a portion of their life cycles on the Refuge. Consequently, both the EVOS restitution (criminal) and restoration (civil) funds have been available for use in habitat protection efforts. In addition to the EVOS funds, minimal land-acquisition money has been available through Congressional appropriations of the Land and Water Conservation Fund (Conservation Fund). Using these funding sources, the Service has purchased nearly 9,000 acres of privately owned land from Native associations and individuals for approximately $11 million.

The major purchases came from three Native groups. In 1998, the Service paid KNA $4,443,000 for 3,254 acres of land and prioritized selections within the Refuge. These lands were located along the Kenai River just below the outlet of Skilak Lake and along the Moose River. Of the lands acquired, 592 acres below Skilak Lake were added to the Refuge as designated Wilderness. The remaining acreage was added to the Refuge's Traditional Management category. The legislated land deal also included an equal-value exchange in the Beaver Creek area, in which the Refuge received 100 acres for 280 acres of lesser-quality habitat; and 15,430 acres of KNA land was removed from the Refuge, along with the ANCSA 22(g) covenants that restricted development on those properties.

From 1996 through 1999, the Service purchased, for more than $2.7 million, about 1,377 acres from Salamatof Native Association, all along the Kenai River in the Moose Range Meadows area. The acquisitions included riverfront lots used for public fishing access and a large tract of undeveloped wetlands. This property was included in the Refuge's Intensive management category, although only a small portion has been developed with facilities for public fishing access.

In 2002, the Service purchased 4,247 acres from Point Possession, Inc., through the Conservation Fund for $3.3 million. These lands are located at the extreme northwestern corner of the Kenai Peninsula and include the site where, it is said, Captain Cook first set foot in Alaska in 1778 and where he claimed Alaska for the King of England. All of this property became designated Wilderness when it was re-acquired.

A small-parcel acquisition program, accomplished concurrently with the large-parcel acquisitions described previously, continues. The Service has completed acquisition of just a handful of small parcels, with other parcels being negotiated at the time of publication of this Comprehensive Conservation Plan (Plan). The acquisition of these small parcels is critical to habitat protection because the parcels are generally located at strategic points (i.e., at the mouths of rivers, heads of bays, and along important wildlife habitat migration routes). The protection of these crucial lands will complement the millions of dollars spent on large-parcel acquisition for the conservation of wildlife.

Along with easements reserved to the United States in ANCSA conveyances pursuant to section 17(b), the United States has two other significant easements along the Kenai River near the city of Soldotna. The terms and conditions negotiated with Salamatof Native Association provided for 25-foot-wide public access easements along both banks of the river in the lands conveyed to Salamatof. These allow public access for recreation purposes along the river. Because of excessive use, primarily during the sockeye salmon run in July and August, the Refuge has issued regulations that close those public access easements from July 1 through August 15 each year; the remainder of the year, the easements are open for public access. The easements do not allow wheeled conveyances, other than wheelchairs, or motorized use. They also do not allow camping, fire construction, etc., on the easement area or trespass from the easement onto private lands.

The second easement along the river is a nondevelopment easement received from Salamatof in exchange for sand and gravel used in the Moose Range Meadows subdivision. It protects from any development or alteration of vegetation an area ranging generally from 25–100 feet above normal high water of the river. Landowners may apply for a permit from the Refuge for installation of temporary compatible uses of their land within the nondevelopment easement area but may not construct permanent structures in the easement.

Land exchanges within Kenai Refuge have not greatly altered the ownership landscape. Only one small exchange with KNA (noted previously) has been completed in the Refuge. In addition to the small exchange already completed, one additional exchange is currently proposed that could transfer several thousand acres between the United States and ANCSA corporations. In all land exchanges, there must be a clear benefit to the Refuge and to the general public. While many exchanges are proposed, the process requires extensive evaluation to determine public interest, to ensure fair valuation to each party, to notify Congress, and to exchange title between the parties. Land exchanges remain valid land management tools but are far less numerous than land purchases because of cost and complexity.

3.2 Physical Environment

Kenai National Wildlife Refuge (Refuge, Kenai Refuge) lies on the western Kenai Peninsula (Peninsula). The 10,039-square-mile (26,000-square-kilometer) Peninsula is part of the southcentral ecosystem, one of ten ecosystems recognized in Alaska by the U.S. Fish and Wildlife Service (Service).

The Peninsula is connected to mainland Alaska by a 10-mile (16-kilometer) wide isthmus and is flanked by Prince William Sound to the east, Cook Inlet to the north and west, and the Gulf of Alaska to the south (59°05'–61°05' N and 152°00'–148°00' W). It is characterized by rolling lowlands (less than 492 feet [150 meters]) and gently sloping

benchlands (492–3,281 feet [150–1,000 meters) in the west; the Kenai Mountains (less than 5,249 feet [1,600 meters]) from northeast to southwest; and the Harding Icefield in the southeast.

3.2.1 Climate

The climate of southcentral Alaska is subarctic with a maritime influence. On the Kenai Peninsula, temperatures at many locations rarely rise to more than 80 degrees Fahrenheit (26 degrees centigrade) in the summer or drop to less than 0 degrees Fahrenheit (–18 degrees centigrade) in the winter. The average annual temperature at the Kenai airport is 33.9 degrees Fahrenheit (1 degree centigrade). Extended periods of temperatures less than 0 degrees Fahrenheit (–18 degrees centigrade) are rare.

The frost-free growing season varies from 71–129 days, depending on the location. The effects of this brief growing period are partially offset by long days (as much as 19 hours of daylight) in the summer.

Wind velocities rarely exceed 44 miles per hour (38 knots) and average about 10 miles per hour (6 knots) at lower elevations. The Kenai Mountains create a strong rain shadow on the western Kenai Lowlands. Thus, Sterling receives about 17 inches (43 centimeters) of total precipitation per year and the Kenai airport receives 19 inches (48 centimeters). On the east side of the mountains, however, Seward receives 68 inches (172 centimeters) and Whittier 198 inches (502 centimeters).

3.2.2 Landforms

The eastern one-third of the Refuge lies within the Kenai Mountains, which range in elevation from 3,000–6,600 feet (900–1,800 meters). The mountains are heavily glaciated, and many of the high valleys are buried beneath the vast Harding Icefield, which covers approximately 720 square miles (1,865 square kilometers) at elevations of 4,000–5,300 feet (1,200–1,600 meters).

The remaining two-thirds of the Refuge lie in the Kenai Lowlands, which is part of the Cook Inlet–Susitna Lowlands. These lowlands consist of ground moraine and stagnant ice terrain with low ridges, hills, and muskeg. Relief ranges from 50–250 feet (15–76 meters), and most of the land is less than 500 feet (150 meters) above mean sea level. This area contains thousands of lakes. The lowlands are within the Cook Inlet Sedimentary Basin, which contains extensive oil and gas beneath the Refuge and Cook Inlet.

3.2.3 Geology

Two geologic terranes are found on the Refuge: the Chugach–Prince William terrane is exposed in the Kenai Mountains; the Alaska Peninsular terrane is exposed in the lower Peninsula west of Seldovia and underlies the Kenai lowland and Cook Inlet basin. The two terranes

are separated by the Border Ranges Fault System, which runs from Kodiak through Seldovia Bay, under the Homer Spit, beneath the Skilak Benchlands, across Turnagain Arm, and eastward through the Chugach Mountains.

The Mesozoic rock of the Chugach–Prince William terrane is mostly greywacke, a marine sandstone derived from igneous rock, with lesser amounts of basalt, radiolarian chert, and limestone. All of these rock types are mixed together in a tectonic mélange that was formed during the Cretaceous period when the rocks were scraped off the subducting Pacific tectonic plate. These rocks are best exposed along the south side of Kachemak Bay.

Lying on top of the two terranes is a thick lens of younger Tertiary sedimentary rocks deposited in the Cook Inlet geosyncline, the structural basin that underlies the modern Cook Inlet. The Tertiary rocks, collectively known as the Kenai Group, consist of siltstone, fine sandstone, shale with some oil- and gas-bearing sandstones and conglomerate, and locally abundant coal beds. Thick, unconsolidated glacial moraines and outwash cover the Tertiary strata in all areas except in cut banks and sea bluffs along Cook Inlet. The Border Ranges Fault System has been inactive since the late Cretaceous period, which ended 65 million years ago.

Lowland portions of the Peninsula are mantled by glacial deposits that vary in texture and are capped by silt loam derived from post-glacial windblown loess. Although some of the loam soils can be productive, most are considered submarginal for agriculture. Sloped areas are vulnerable to erosion, especially if the vegetation cover is removed. Extensive peatlands (muskegs) fill old glacial lakebeds and typically have accumulations of peat 13–23 feet (4–7 meters) thick.

3.2.4 Oil and Gas Occurrences and Potential

Oil and gas activities have occurred on the Refuge since 1957. The majority of exploration and development work occurred between 1959 and the mid-1960s. The height of the activity occurred during 1960 through 1962, when seismic surveying, exploratory drilling, pipeline and power line construction, and other development on the Swanson River Oil and Gas Unit occurred simultaneously. Also during the early 1960s, Anchorage Natural Gas Company built a gas pipeline across the Refuge to Anchorage. This required an access road, river crossings, two airstrips, and construction camps (Hanley et al. 1981).

Presently, there are 13,252 acres of active oil and gas leases on the Refuge that were granted under the Mineral Leasing Act of 1920. The three oil and gas units on the Refuge are the Swanson River and Soldotna Creek Unit, the Beaver Creek Oil and Gas Unit, and the Birch Hill Oil and Gas Unit (Figure 3-2). Within these units, there are 20 Federal oil and gas leases. Marathon Oil Company and the subsurface

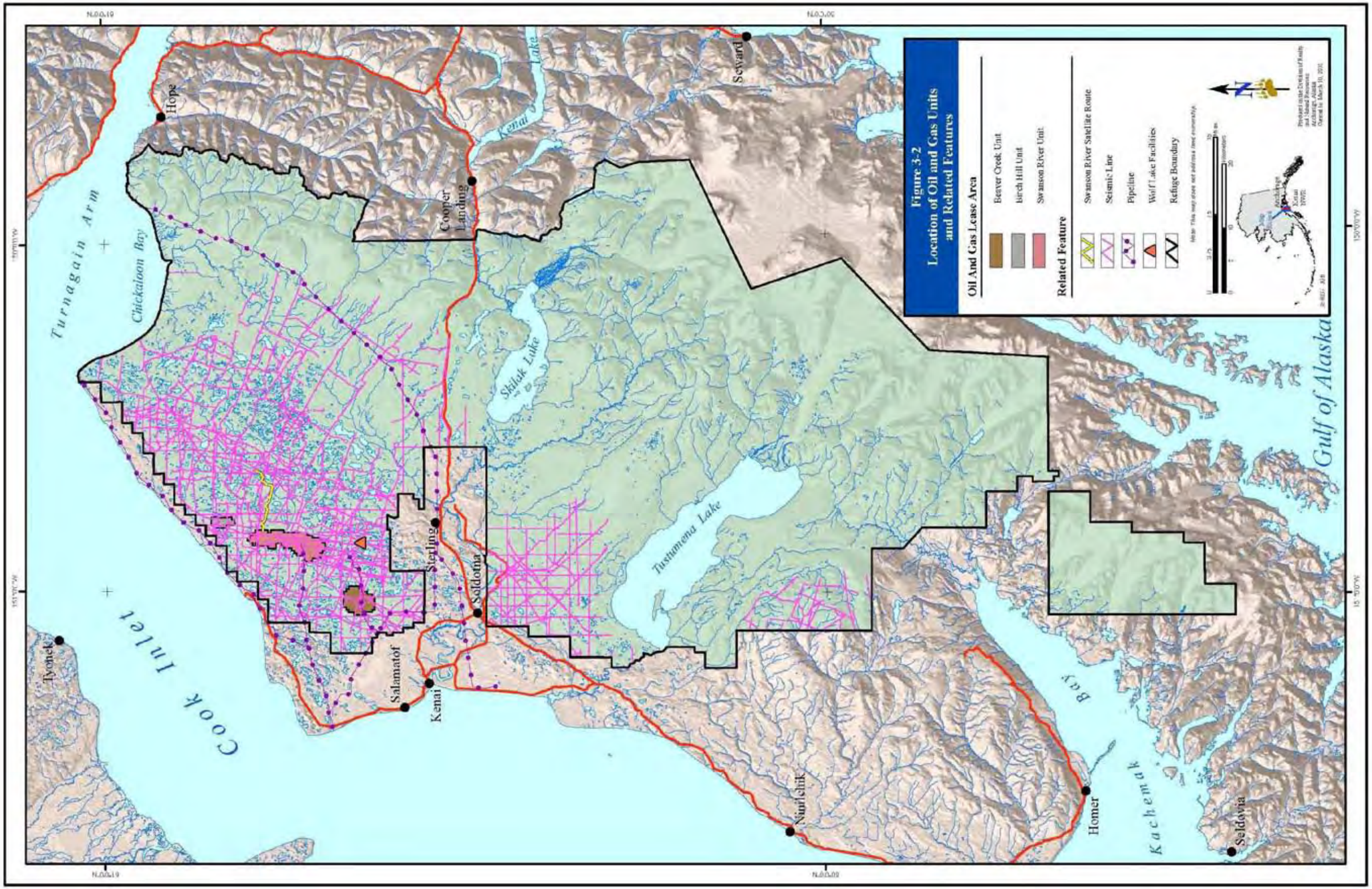


Figure 3-2. Location of Oil and Gas Units and Related Features

owner, Cook Inlet Region, Inc. (CIRI), developed the Wolf Lake Project and plan to develop the East Swanson River Satellite Project. These two areas are not included in a Federal oil and gas lease area.

3.2.4.1 Swanson River and Soldotna Creek Unit

The first substantial commercial oil discovery in Alaska occurred in 1957 within what is now the Swanson River Oil and Gas Unit. It is located 12 miles north of Sterling and occupies 7,880 acres of the Refuge (AKDNR 2003). The southern part of the unit is the Soldotna Creek Unit, and the northern part is the Swanson River Oil and Gas Unit. For simplicity, both units are referred to as the Swanson River Oil and Gas Unit as a whole. There have been four unit operators since 1957: Chevron USA (1957–1986), Atlantic Richfield Corporation Alaska, Inc. (1986–1992), Union Oil Company of California (Unocal) (1992 to 2005), and UOCC (a wholly owned indirect subsidiary of Chevron Corporation) from 2005 to present.

Numerous support facilities have been built within the field, including:

- 43 miles of roads
- 65 well pads
- 62 acres of building and storage areas
- 5 residential houses
- An office and maintenance shop building
- A large compressor plant
- 12 acres of gravel and sand pits
- A 4-acre solid waste disposal site
- A pipeline complex from each well to 7 tank settings
- 7 flaring stacks
- An 8-inch crude and a 16-inch gas pipeline across the Refuge from the unit to the coastal town of Nikiski 20 miles (30 kilometers) to the west
- 2 steel girder bridges over the Swanson River
- 2 power lines crossing the river
- A power line complex throughout the field (in addition to the main feeder line coming from Nikiski within the underground pipeline corridor)

A total of 140 wells have been drilled in the Swanson River Oil and Gas Unit. In the late 1960s, oil production peaked at approximately 40,000 barrels of oil per day from approximately 60 wells. Currently, the Swanson River Oil and Gas Unit production is approximately 700 barrels of crude oil per day from an average of 20 producing oil wells, and 2,049 thousand cubic feet of gas per day from an average of eight producing gas wells. As of July 2007, a cumulative 229,355,639 barrels of crude oil and 30,206,388 mcf (one mcf equals 1,000 cubic feet) of natural gas have been produced from this unit (AOGCC 2007). Twenty-

eight wells have been shut in for various reasons and might be used in the future. Sixty-four wells have been permanently plugged. Three service wells are used for injection of water, gas, or waste disposal (AOGCC 2004b). Because oil reservoirs are nearly depleted, the current operator is increasing natural gas production and storage within the existing unit.

3.2.4.2 Beaver Creek Unit

Development of the Beaver Creek Oil and Gas Unit began in 1967. The first three wells drilled did not yield commercial crude oil but did encounter commercial quantities of natural gas. Two wells drilled in the 1970s struck oil in commercial quantities. There are only two oil-producing wells in this unit today. The crude is transported (one or two trips daily) via tanker truck to the Tesoro Refinery in Nikiski.

The Beaver Creek Oil and Gas Unit began a program to produce natural gas in early 1982. Gathering lines and a 3.5-mile (5.6-kilometer) trunk line were constructed to an existing gas line to the southwest. Production began in November 1982, carrying Beaver Creek gas into the existing pipeline system and then to the Anchorage basin. This was the first natural gas produced at Beaver Creek for commercial sale.

The field is located eight miles north of Soldotna and occupies 4,960 acres of the Refuge (AKDNR 2003). Marathon Oil Company has been the only operator of the unit, which includes the following:

- 5 miles of roads
- 7 pads with 11 active wells (2 oil and 9 gas)
- An office and maintenance shop building
- A small gravel pit (now inactive)
- A 2-acre solid waste disposal site
- A 1,000-barrel crude storage tank and a 5,000-barrel crude storage tank
- A gas-dehydration unit
- Numerous thermo packs used to heat gas and separate out water
- A gas lift compressor
- 5 miles of 12-inch gas transport line, numerous in-field gas gathering lines (6 and 8 inch), and oil gathering lines (4 and 6 inch)
- A flare stack-gas pressure relief
- 2 steel support bridges crossing Beaver Creek
- 2 Caterpillar natural gas-fired electrical generators (230 kilowatt and 235 kilowatt)
- A 2,000-gallon aboveground diesel fuel storage tank

Seventeen wells have been drilled in the Beaver Creek Oil and Gas Unit. Current production is approximately 11,833 mcf of natural gas and 176 barrels of crude oil per day from an average of nine producing wells. As of July 2007, a cumulative 191,830,933 mcf of natural gas and 5,902,583 barrels of crude oil have been produced from this unit. Four wells have been permanently plugged, and one well is a disposal well. Two new gas wells were brought on line during 2004 (AOGCC 2007).

3.2.4.3 Birch Hill Unit

The Birch Hill Oil and Gas Unit is located two miles north of the Swanson River Oil and Gas Unit and occupies 1,240 acres of the Refuge (AKDNR 2003). Atlantic Richfield Company (DOI 1981) drilled one exploratory well in this unit in June 1965. The well did not find commercial crude oil but did encounter natural gas. The July 2007 AOGCC report shows that 65,331 mcf of natural gas was cumulatively produced from this well before operation was suspended in 1988. Chevron North American Exploration and Production is the current operator of the unit. Union Oil Company of California (Unocal) applied to the U.S. Fish and Wildlife Service (Service) for a right-of-way permit in 2001 to conduct exploration and production of natural gas wells in this unit; further development of this unit, however, is temporarily on hold.

3.2.4.4 Wolf Lake Facilities

A right-of-way permit was issued to Marathon Oil Company in 2000 authorizing the construction, operation, and maintenance of a natural gas pipeline and production facilities on the Refuge near Wolf Lake. Construction took place during the winter of 2000–2001. Two wells are located on the pad and have cumulatively produced 822,038 mcf of natural gas (AOGCC 2007).

The following facilities are authorized under the permit:

- A buried, 23,426-foot natural gas pipeline corridor between the Wolf Lake well pad and Pad 2 within the Beaver Creek Oil and Gas Unit. During construction of the pipeline and associated lines and utilities, the authorized width of the corridor was 50 feet. After completion of construction, the authorized width was reduced to six feet. The lines and utilities authorized to be buried along this route are an eight-inch-diameter primary product pipeline, a four-inch-diameter secondary product pipeline, two two-inch produced-water pipelines, communications lines, and electrical service lines.
- A buried, 4,885-foot natural gas pipeline corridor between Pad 2 and Pad 1A within the Beaver Creek Oil and Gas Unit. During construction of the pipeline and associated lines and utilities, the authorized width of the corridor was

30 feet. After completion of construction, the authorized width became six feet. The lines and utilities authorized to be buried along this route are an eight-inch product pipeline, two two-inch produced-water disposal pipelines, communications lines, and electrical service lines.

The Wolf Lake pad—an existing structure—is the location of well #2. The pad had to be expanded to allow re-opening and operation of well #1. Total area of the existing pad was 133,297 square feet, and it was expanded an additional 32,500 square feet. Production and treatment facilities on the Wolf Lake pad include well houses, several small gas-conditioning units, a manifold and pig launcher building, an instrumentation and control building, a 50-foot-high communications antenna, a generator building, a methanol building, and a produced-water building.

The well site is accessed via 2.2 miles of Finger Lakes Road (which extends westerly from milepost 9.8 of the Swanson River Road) and 0.64 miles of Wolf Lake Spur Road (which extends from the Finger Lakes Road to the Wolf Lake well pad).

3.2.4.5 East Swanson River Satellite Project

A right-of-way permit was issued to Marathon Oil in 2004 for development of the East Swanson River Satellite Natural Gas Exploration and Development Project (E-SRS Project). Although the E-SRS Project is located wholly within the Refuge and the Refuge owns the surface rights, CIRI owns the coal, oil, and gas interests. The E-SRS Project includes approximately eight miles of a 100-foot-wide right-of-way corridor from the Swanson River Oil and Gas Unit east to two exploratory locations. The E-SRS Project consists of the construction of a gravel access road, two drill pads, East Swanson Pad A (Pad ES-A) and East Swanson Pad B (Pad ES-B), exploratory wells at each drill pad, and a staging area for exploration and construction activities on an existing well pad within the Swanson River Oil and Gas Unit.

The E-SRS Project consists of the following three phases:

- Phase 1—Clearing and construction of a gravel access road from the Swanson River Field to Pad ES-A, construction of Pad ES-A, and exploratory drilling.

  Phase 1 reactivates a portion of an abandoned road (North Entrance) that ties in with an east-west running seismic trail (Trunk Segment), which will be the majority of the length of the gravel access road. Trunk Segment then ties in with a north-south seismic trail most of the distance to Pad ES-A. The Phase 1 route travels in sequence for approximately six miles. The area cleared in the 100-foot right-of-way corridor will not exceed a total of 80 feet, including 50 feet for exploration and road construction and an additional 30 feet for pipeline construction. The 30-foot

pipeline clearing will not occur until the well is drilled and tested to determine if it is a producing well. Phase 1 includes construction of Pad ES-A (300 feet by 400 feet). From Pad ES-A, directional-drilling techniques for exploratory wells may be used.

- Phase 2—Clearing and construction of gravel access road from Pad ES-A to Pad ES-B, construction of Pad ES-B, and exploratory drilling.

  Within two years of initiating exploratory drilling and testing at Pad ES-A, Marathon Oil will determine whether to construct an additional two miles of gravel road (with the same clearing restrictions as in Phase 1) and whether to construct Pad ES-B (385 feet by 485 feet). Pad ES-B will be accessed via a route (South Krein Segment) extending from northeast of Pad ES-A and sited on uplands between Krein and Sunrise lakes. From Pad ES-B, directional-drilling techniques for exploratory wells may be used.

- Phase 3—Installation of a buried pipeline and utility system, and production facilities.

  Discoveries of commercially viable quantities of natural gas at either Pad ES-A or Pad ES-B may result in the placement and installation of production facilities and a buried pipeline and utility system adjacent to the Phase 1 and Phase 2 gravel access roads. Each satellite development may include installation of a 4–10-inch pipeline, which may tie into the existing pipeline infrastructure at the Swanson River Field. Production facilities at each pad may include a heater-separator building, a glycol dehydrator building, a methanol building, a well house building, a natural gas–fueled generator building, and an electrical and control building. All facilities—including gravel roads, pads, pipelines and utility lines—would be located and designed for removal when natural gas reserves are depleted.

Because Marathon Oil has its own right-of-way permit for this project, the company can start at anytime. The permit does have a stipulation stating that no vegetative clearing will occur from May 1 through August 1 to protect nesting birds unless authorized in writing by the Refuge manager.

3.2.4.6 Cook Inlet Region, Inc., Exploratory Drilling

In 1980, CIRI received part of its entitlement to more than 204,954 acres of subsurface lands on the Refuge. Much of this conveyed area was explored during the next five winters with a portable helicopter-borne seismic system that does not require roads, trails, or removal of vegetation. Exploratory wells have been drilled near Wolf Lake (ARCO/CIRI 1 in 1983, ARCO/CIRI 2 in 1985); Funny River Road

(ARCO/CIRI in 1984); Galena 1 (in 1991) and Bufflehead (in 1995). These wells have been plugged and abandoned (AOGCC 2004b).

3.2.4.7 Gas Storage

In the Swanson River Oil and Gas Unit, four underground gas-storage wells have been approved by Alaska Oil and Gas Conservation Commission (AOGCC) and permitted by the Bureau of Land Management (BLM). The first well was developed in 2001, followed by two wells in 2002 and a fourth well in 2004. Currently, the field operator is storing gas that is produced from the unit and from off site. Cumulative gas injection into storage pools has been 9,189,430 mcf, and gas production from the storage pools has been 6,692,492 mcf (AOGCC 2007).

3.2.4.8 Compatibility Determination

A compatibility determination was completed by U.S. Fish and Wildlife Service (Service) for oil and gas exploration and development on the Refuge in 1999; in 2005, another compatibility determination was completed for natural gas storage in the Swanson River Oil and Gas Unit. Various laws and agreements limit the scope of this compatibility determination. Uses that are granted by law or that are included as part of a legal property right are not subject to the compatibility requirement. On the Refuge, this exception applies to oil and gas exploration and development activities within the Swanson River, Beaver Creek, and Birch Hill units; and where subsurface ownership and associated rights have been granted for coal, oil, and gas under provisions of the Alaska Native Claims Settlement Act (ANCSA) of 1971 and associated settlement agreements (186,383 acres conveyed; remaining entitlement equals 18,571 acres).

Legal property rights allowing some form of oil and gas exploration and development currently encumber approximately 199,635 acres of Refuge lands. As many as 18,571 additional subsurface acres (for coal, oil, and gas) can be conveyed to CIRI without being subject to a Service compatibility determination. The Wilderness Act and the Alaska National Interest Lands Conservation Act (ANILCA) preclude approximately 1,315,809 acres of Refuge from oil and gas exploration. Therefore, the compatibility determination only applies to the remaining 472,630 acres of the Refuge that have not been specifically opened or closed to oil and gas exploration and development by law and other legally binding agreements. Some of this remaining area has also had restrictions on oil and gas activities as result of the 1985 Comprehensive Conservation Plan (USFWS 1985) and Service policy; however, these management directions do not preclude an effective compatibility review.

The result of the compatibility determination is that oil and gas exploration and development is not compatible with the purposes of the Refuge. The effects of these activities on the Refuge have not

contributed to Refuge purposes, nor have the effects been neutral. Measurable—and often significant—impacts to wildlife and wildlife habitats have resulted from the activities. Oil and gas related activities are often intrusive and long lasting. Long-term evaluation of past and existing oil and gas activities provide reasonable projections of future activities and resulting impacts. Habitat alteration and loss, chronic contaminant problems, and disturbance to wildlife, wild areas, and Refuge users clearly interfere with the purposes of the Refuge.

3.2.5 Environmental Contaminants

Kenai Refuge was the first national wildlife refuge in Alaska to have completed a Contaminants Assessment Process (CAP). The purpose of the CAP is to document existing and potential contamination issues affecting national wildlife refuges by assessing known or suspected contaminant sources, contaminated areas, contaminant-transport pathways, and areas vulnerable to spills and/or contamination. Results from the CAP were summarized in the *Kenai National Wildlife Refuge Contaminant Assessment* (Parson 2001); much of the following text is excerpted from that document.

3.2.5.1 Contamination from Activities Associated with the Oil and Gas Industry

Frates (1999) and Parson (2001) documented the history of contamination from spills and leaks associated with the oil and gas industry. On the Swanson River Oil and Gas Unit, there were 292 reported spills from 1957 through 1999, averaging almost 7 spills per year and including the following contaminants:

- 35 gallons of antifreeze
- 65 gallons of methanol
- 85 gallons of hydraulic fluid
- 100 gallons of solvents
- 452 gallons of diesel fuel
- 2,213 gallons of triethylene glycol
- 24,169 gallons of crude oil
- 238,749 gallons of produced water
- Unknown quantities of xylene

On the Beaver Creek Oil and Gas Unit, there were 42 reported spills from 1988 to 1998, averaging 4 spills per year, including the following contaminants:

- 2 gallons of Percolite®
- 3 gallons of hydraulic oil
- 3 gallons of vehicle motor oil
- 31 gallons of methanol
- 163 gallons of triethylene glycol

- 400 gallons of diesel fuel
- 3,000 gallons of crude oil
- 5,078 gallons of produced water

Parson (2001) cautions that these reported spills may underestimate the extent of inadvertent contamination in the oil and gas fields. Drilling muds and reserve pits, injection wells, explosions, fires, use of transformers containing polychlorinated biphenyl (PCBs), use of mercury manometers, and seismic exploration activities are examples of some historic events and past (and current) practices that may have caused some unnoticed contamination issues on the Refuge. The most poignant example of a contamination event that went undiscovered for several years was the explosion of a compressor plant in the Swanson River Oil and Gas Unit. Although the explosion occurred in January 1972, it was not apparent that PCBs (specifically, Aroclor 1248) had been released until a baseline contaminants survey was completed 14 years later. The subsequent remediation lasted several years and is estimated to have cost more than $40 million.

3.2.5.2 Atmospheric Deposition

Environmental contaminants from local and distant sources are subject to short- and long-range transport. Arctic and subarctic environments are especially vulnerable to the long-range air and water transport of environmental contaminants because once chemicals reach colder climates, less volatilization occurs. Some environmental contaminants of particular concern within the Arctic are persistent organic pollutants such as PCBs; dioxins; dichlorodiphenyltrichloroethane (DDT); hexachlorocyclohexane (HCH); chlordane; toxaphene; mirex; dieldrin; heavy metals such as cadmium, mercury, lead, and polycyclic aromatic hydrocarbons (PAHs); and radionuclides.

There is some evidence that wildlife on the Refuge may be exposed to contaminants from off-site sources. PCBs (including Aroclor 1254 and/or 1260) have been detected in low concentrations in snowshoe hares, shrews, clams, slimy sculpins, rainbow trout and Arctic char on the Refuge (Ecology and Environment 1986). To date, there is no documentation that these aroclors were used on the Refuge. Parson (2001) suggested that the most likely source of these aroclors is atmospheric deposition; however, at this time, we have no direct measures of atmospheric deposition on the Refuge.

3.2.5.3 Biologically Transported Contaminants

Anadromous fish and migratory birds are possible biotic sources of contaminants. Because these species are highly mobile, they could be exposed to contaminants outside of the Refuge boundaries. When these species return to the Refuge, they may be vectors for contaminants and may impose contaminant-related risks to other Refuge resources and humans. For example, Ewald et al. (1998) documented the biotransport of contaminants, specifically DDT and PCBs, by a population of sockeye

salmon in Copper River, Alaska. These salmon accumulated relatively low levels of contaminants during their ocean life stage and transported contaminants to their freshwater spawning areas. Other studies have since shown that contaminant burdens carried by returning sockeye salmon can affect resident fish species such as arctic grayling (*Thymallus arcticus*) (Mu et al. 2004) and rainbow trout (*Oncorhynchus mykiss)* (Gregory-Eaves et al. 2007).

Similarly, migratory birds may be exposed to an array of potentially toxic chemicals on their wintering grounds in the contiguous 48 states and in other countries; these chemicals may include those that are banned or no longer used in the United States. During the spring migration, birds may transport these contaminants to their breeding grounds in Alaska. This migratory transport of contaminants provides a potential exposure pathway to other organisms that would otherwise not likely be exposed to these chemicals. However, we currently have no direct measures of biologically transported contaminants to the Refuge.

3.2.5.4 Aromatic Hydrocarbons from Boat Traffic

Data collected by the Kenai Watershed Forum and the Alaska Department of Environmental Conservation (DEC) suggest that contaminants from motorboat traffic on the lower Kenai River occasionally exceed the maximum concentration considered safe for fish and aquatic life (10 parts per billion). Total aromatic hydrocarbons (benzene, toluene, ethylbenzene, m-xylene, p-xylene, and o-xylene) exceeded 10 parts per billion in the lower Kenai River in each of three summer samplings in 2002. The majority of the hydrocarbon contamination observed in grab samples came from unburned, refined gasoline, with the most likely source being outboard motors. Based on boat traffic (which can exceed 400 boats per day on the Kenai River below Soldotna), percentage of two-stroke motors in use, and estimates of daily fuel consumption, 400–500 gallons per day of raw fuel may be entering the river from motorboats each summer. However, outside the Refuge, degradation of water quality anywhere in the Kenai River has the potential to negatively affect salmon returning to Refuge streams.

3.2.5.5 Other Point and Nonpoint Contaminant Sources Outside the Refuge

Three significant point sources of contaminants are just outside the Refuge boundaries in Nikiski: Agrium Kenai Nitrogen Operations, Kenai Pipeline Company, and the Tesoro Alaska Kenai Refinery. In 2002, these sources released more than 1.8 million pounds of contaminants on-site into the air and water (EPA 2002). The Agrium facility, which announced closure in September 2007, primarily produced anhydrous ammonia and urea for fertilizer. Total ammonia

production capacity at Kenai was 1.25 million gross (0.67 million net) tons over its lifetime.

The Tesoro Corporation pumps crude oil from the Swanson River and Soldotna Creek production units and from the Middle Ground Shoals production unit (an offshore field in Cook Inlet) to the Tesoro refinery. The Tesoro Alaska Kenai Refinery was opened in 1969 to process crude from Kenai Peninsula and Cook Inlet oil fields, and capacity is now 72,000 barrels per day. This refinery produces distillates (e.g., jet fuel, diesel fuel, and heating oil), gasoline, liquefied petroleum gas, heavy oils and bunker fuels, and liquid asphalt. The facility's primary product is jet fuel because of high demand at Ted Stevens International Airport, which is located about 70 miles away in Anchorage; a 40,000-barrel-per-day pipeline links the refinery with the airport. The impacts of short- and long-range dispersal of these contaminants on resources on the Refuge over the lifespan of the existing facilities are currently unknown.

Similarly, few data on runoff from impervious surfaces exist. Numerous storm water drains from the cities of Sterling, Soldotna, and Kenai discharge directly or indirectly (through tributaries) into the lower Kenai River. A two-year water quality study on the Kenai River found that river water samples taken from two storm drains at river mile (RM) 17.7 and RM 21.8 had a surface sheen, elevated fecal coliform, and total petroleum hydrocarbon (TPH) concentrations of 1,300 and 2,600 milligrams per liter (mg/L), respectively (Litchfield and Kyle 1992). The storm drain at RM 17.7 drains several streets in the vicinity of Marydale Drive. The storm drain at RM 21.8 drains part of the Sterling Highway and several streets. Although these urbanized areas are primarily downstream of the Refuge, contaminants entering the Kenai River from storm drains may affect trust species that inhabit or use the river.

3.2.6 Water Resources

The Kenai River, the largest river system on the Peninsula, drains about 2,148 square miles (5,563 square kilometers). Approximately 54 percent of the watershed is on the Refuge, 37 percent on the Chugach National Forest, and the remainder on private lands. Ten major tributaries feed the Kenai River system: Beaver Creek, Slikok River, Soldotna Creek, Funny River, Moose River, Killey River, Skilak River, Russian River, Cooper Creek, and Juneau Creek. Other Refuge river and stream systems flowing westward into Cook Inlet include Kasilof River (which drains Tustumena Lake), Deep Creek, and the Swanson, Fox, Ninilchik, and Chickaloon rivers.

There are thousands of lakes on the Kenai Peninsula—nearly all of them are on the Refuge. The largest are two glacial lakes, Tustumena Lake (73,000 acres or 29,500 hectares) and Skilak Lake (25,000 acres or

10,110 hectares). More than 4,600 smaller lakes dot the Refuge, mostly in the Moose, Swanson, and Chickaloon river drainages.

Most lakes are frozen from November to May; streams freeze later and thaw earlier. Summer water temperatures rarely exceed 68 degrees Fahrenheit (20 degrees centigrade). The high-flow period for glacial streams is in summer during the maximum glacier melt. Variations in stream flows tend to be gradual because of the moderating effects of ice melt, spring seepage, and low rates of precipitation. Streams originating from glaciers carry finely suspended silt that gives them a milky appearance and reduces light penetration. Runoff waters, however, are usually clear except during heavy runoff. In some areas, they are stained by organic tannins leached from partially decomposed vegetation. The dissolved mineral content of both runoff and glacial waters is generally low. Most lakes and streams are neutral to slightly acidic, and oxygen content is usually high during summer. Oxygen becomes depleted in some lakes during the winter when they are covered with ice and snow. Most lake bottoms and stream beds are composed of various sized gravels. Streams and lakes vary greatly in depth, flow characteristics, configuration, and the amount of aquatic vegetation and detritus contained.

The combination of cold water, reduced light, and low mineral content limits the productivity of waters on the Refuge. These characteristics are partially offset by high oxygen content, lack of pollution, and wide diversity in the physical characteristics of aquatic habitats. Such conditions are favorable to the early life stages of anadromous fish, which move to richer ocean waters to attain most of their growth.

3.2.7 Air Resources

Air quality has become an increasing concern in recent years. Air quality issues and concerns are discussed in several of the annual narratives in which Refuge personnel specifically note that during clear, cold weather, a brown haze is often seen over Cook Inlet and the northern lowlands of the Refuge. Known sources of significant air pollutants include the Swanson River and Beaver Creek oil and gas fields, Nikiski industrial complex (Tesoro refinery, Agrium), motorized traffic (snowmachines, automobiles, aircraft, motorboats, ATVs), smog from Anchorage, fires, and volcanoes. The Refuge does not have air-quality or visibility-impairment data.

The Refuge is designated as a Class I I air quality area under the Clean Air Act because it was established prior to 1977. The 1990 Clean Air Act amendments clarified that Class II “floor” area boundaries, which include national wildlife refuges and wilderness areas having more than 10,000 acres, are to conform to boundary changes in the underlying park or wilderness area. Policy in the Refuge Manual (dated 28 June 1994, 563 FW 2, Air Quality Protection) states that information on air quality and air quality–related values (AQRVs) of a Class II area

are important for comprehensive management of these Refuge resources (USFWS Service Manual). Although the United States Environmental Protection Agency (EPA) or delegated State authority is not required to notify the Federal land manager of proposed projects that may affect Class II areas, the EPA (or State) is required to evaluate whether such projects may cause the exceeding of the National Atmospheric Air Quality Standards (NAAQS) or prevention of significant deterioration Class II increments in these areas. Wilderness areas that are Class II air-quality areas receive additional protection from the Wilderness Act, which requires the Service to minimize the effect of human use or influence on natural ecological processes and to preserve untrammeled natural conditions within Wilderness.

3.2.8 Concerns Regarding the Physical Environment

3.2.8.1 Climate Change

Annual temperatures on the Kenai Peninsula have warmed several degrees following the warming of North Pacific sea-surface temperatures in 1977. Much of this annual increase is due to warmer winters, with December and January having warmed by nine and seven degrees Fahrenheit, respectively. Human beings have enjoyed the warmer winters and the resulting lower fuel consumption, but the most important biological changes have taken place with warmer summers. Summers began to warm most noticeably with the drought of 1968–1969, with a resultant increased rate of evapotranspiration. Similarly, the annual water balance declined from 5.8 inches per year to 2.7 inches per year after 1968 (Kenai airport data). The annual water balance represents the water available for plant and animal growth, stream flow, and groundwater recharge; and its decline by almost 50 percent is no doubt responsible for the landscape-scale changes described subsequently.

The following changes on the Kenai landscape appear to be related to an increasingly warmer and dryer climate:

- Spruce Bark Beetles—The Kenai Peninsula was the epicenter of a spruce bark beetle outbreak that lasted over a decade and caused high mortality of Sitka, Lutz, and white spruce on four million acres in southcentral Alaska. In the past, the pronounced El Nino-La Nina cycle of 4–6 years of warm and cold summers helped start and stop bark beetle outbreaks. However, a run of warm summers since 1987 set the stage for an outbreak of unprecedented scale—suggesting that with a future warmer climate, fire and beetle kill may be more closely associated than in the past (Berg et al. 2006). Because many forests on the Refuge are monospecific white spruce stands, there are now hundreds of square miles of standing dead spruce forest.
- A Drying Landscape—With warmer summers, more water is transpired from vegetation and evaporated from the soil

and waterbodies; consequently, closed-basin lake levels have declined by as much as a meter (approximately three feet) and ponds are drying up. Many ponds shown on the 1950 maps and aerial photos are now grassy pans with various degrees of spruce and hardwood invasion (Klein et al. 2005).

- Vegetative Changes in Peatlands—Peat soil cores show that wetlands that were pure *Sphagnum* fens for thousands of years have been heavily invaded by ericaceous shrubs and dwarf birch in recent decades. The drying of wetlands probably started at the end of the Little Ice Age in the 1850s, as shown by the ages of first-time black spruce forests that are spreading over the peatlands. The drying appears to have intensified since the 1970s, with warmer summers and greater evapotranspiration.
- Retreating Glaciers—Many of the Kenai glaciers began retreating in the 1850s, but their retreat has greatly accelerated in recent years. The rapid retreat of Portage, Skilak, and Grewingk glaciers in the last 20–30 years is especially striking. The Harding Icefield lost about 70 vertical feet (21 meters) between 1950 and the 1990s (Adageirsdottir et al. 1998) and has shrunk five percent in area (Rice 1987).
- Rising Tree Line—Tree line rise has averaged one meter per year in the Kenai Mountains during the past five decades (Dial et al. 2007). Normally, mountain hemlock forms a distinct zone above white spruce at tree line, but white spruce seedlings are now growing several hundred meters above the hemlock tree line. Furthermore, the growth form of mountain hemlock is changing from ground-hugging *krummholz* to normal upright trees, indicating a general amelioration of the climate at tree line.

3.2.8.2 Noise Pollution

Motorized vehicle noise is increasing on the Refuge because of increased aircraft overflights, highway traffic, and snowmachine use (Figure 3-3). Motorized traffic will no doubt increase as the human population grows (currently the population is increasing 2.2 percent per year on the Kenai Peninsula) and probably will grow at an even faster rate because the rising standard of living in Alaska provides more disposable income to purchase motorized equipment, and the equipment itself is advancing rapidly in power and mobility.

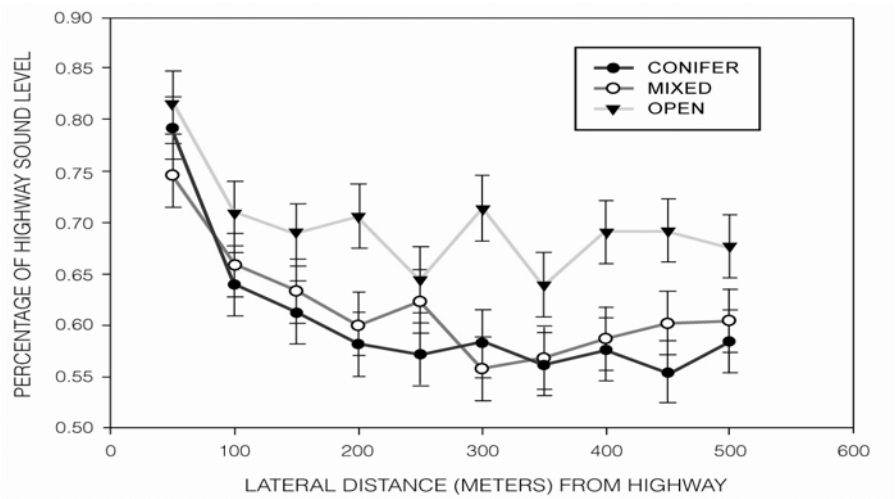
Sound levels are typically measured in decibels (dBs). The sensitivity of the human ear to sounds of different frequencies is denoted by dB. The threshold of hearing is 0 dB, normal conversation occurs at about 60 dB, and the threshold of hearing damage is approximately 120 dB. Because decibels are on a logarithmic scale, people generally associate a 10-dBa increase with a doubling of sound level.

Vehicle noise was measured on and adjacent to the Sterling Highway in July 2004, a period of peak vehicle traffic. Highway noise averaged 72 dB (standard error = 0.26, n = 180) immediately on the highway, about the equivalent of typical construction equipment, although values as high as 120 dB were recorded for short periods. Where the Sterling Highway passes through forested areas, most vehicle-generated noise was reduced to background levels in the first 328–656 feet (100–200 meters) from the highway. However, vehicles continued to be heard above background noise levels more than 1,640 feet (500 meters) from the highway where the highway passed through open areas (primarily muskegs).

The Refuge is still a relatively quiet respite from more urbanized areas. Ambient sound levels were measured at five-kilometer intervals across the Refuge during the last three weeks in June in 2004 and 2006. Measurements represent five-minute integrated averages during early morning hours (5:00–10:00 a.m.) in the absence of rain and high winds. The mean sound level, averaged from 257 sites across two million acres, was 45.1 dB (standard error = 0.68). This value is similar to background noise levels (3–40 dB) typically measured in wilderness (EPA 1974). For example, the National Park Service reported ambient noise levels of 31.5 to 41.5 dB on the Merced Wild and Scenic River (NPS 2000).

However, during sound sampling across the Refuge, values ranged from 32 to 95 dB. To put this in perspective, a value as high as 95 dB (typical of fixed-wing aircraft) indicates a 32-fold increase in noise over ambient sound. Motor vehicles traveling on the Sterling Highway represent an eightfold increase in noise over typical background sound levels. Our data strongly suggest that while the current soundscape is representative of undeveloped lands, noise pollution can be problematic at some sites on the Refuge—at least some of the time—for humans and wildlife.

Figure 3-3. Attenuation of noise (dB) generated by motor vehicle traffic on Sterling Highway in different cover types



3.2.8.3 Oil and Gas Units Industrial Footprint

The National Research Council documented numerous cumulative environmental effects of commercial oil and gas activities on Alaska's North Slope during the time that the Beaver Creek and Swanson River Oil and Gas Units have been in operation (NRC 2003). Although operations in the high Arctic are encountering environmental problems unique to that system (e.g., permafrost), the Swanson River and Beaver Creek oil and gas units have had—and continue to have—measurable negative effects on wildlife populations and habitats in the leased area. Approximately 1,129 acres (or 15 percent) of the two leased areas has been developed. Much of this habitat loss has been linear, resulting in a fragmented landscape.

In addition to the existing infrastructure within the leased areas, exploration elsewhere on the Refuge has been conducted by using dozers to cut seismic trails, helicopters to transport portable drills, and vibroesis machines on constructed roads and pads. Over 1,800 miles of seismic lines are known to exist on the Refuge. Many of the seismic lines that were bulldozed in the early 1950s and 1960s have not completely regenerated and have resulted in additional lost natural habitat. They also serve as access routes for illegal ATVs, which can cause additional habitat damage, erosion, illegal harvest, and wildlife disturbance. Although less damaging seismic technologies have been employed in recent years, collateral damage from exploration is problematic. The 3-D seismic exploration in the winter of 1997–1998 (which used heliportable drilling units rather than cat trains) resulted in multiple spill problems with fuel and hydraulic fluid; blowouts from drill holes; and littering with flagging, wires, paper, and non-detonated explosives.

Disturbed soils associated with oil and gas activities have proven to be fertile grounds for the introduction of exotic flora. Thirty-three exotic plant species have been documented in oil and gas fields on the Refuge associated with drilling pads, roads, buildings, and seismic lines. Reed canary grass (*Phalaris arundinacea*) and white sweetclover (*Melilotus alba*) are considered the most invasive of these species, frequently found along roadside ditches and on well pads, respectively.

Lastly, many contaminant spills in the Swanson River and Beaver Creek oil and gas units went undetected for extended periods of time. A well-supported contaminant assessment and monitoring program within the oil and gas fields probably would have detected some of these problems earlier, which would have ultimately saved in remediation costs. The $40 million effort to remediate the 14-year old compressor explosion in the Swanson River Oil and Gas Unit highlights the importance of systematic contaminant surveys.

The Refuge could greatly benefit from comprehensive studies of baseline contaminant levels in soil, sediment, water, and biota. Baseline data would be helpful in assessing the impacts from potential

contaminant sources on and near the Refuge. For example, baseline sampling in areas that are likely to see new activities and an increase in existing activities (such as oil and gas development) may aid in management decisions and assessing impacts due to future spills and contamination events. These data also could be used to establish the contaminant contribution from off-Refuge sources, including atmospheric and biotic transport mechanisms.

Several potentially contaminated areas exist on the Refuge. Some of these areas are documented contaminant sites where cleanup activities have occurred; however, it may be beneficial to conduct additional sampling at these areas to determine if residual contamination is an issue. Other potentially contaminated areas have yet to be examined for contaminants.

Parson (2001) recommended the following areas and species for future inspection and/or sampling:

1. A contaminant assessment and monitoring program is recommended for Swanson River Field and Beaver Creek Field. Due to the history of undiscovered contamination events (and known contamination events awaiting remediation), sampling and ongoing monitoring at locations throughout these fields may reveal other contamination issues. Some sampling areas may include the following:
   - PCB excavation, incineration and disposal sites at the Swanson River Field
   - Locations where fires and explosions have occurred
   - Former locations of PCB-containing transformers at the Swanson River Field
   - Former locations of mercury manometers at the Swanson River Field
   - Locations where pesticides such as 2,4-D and 2,4,5-T were used (dioxin contamination could be an issue)
2. Former Army recreation camp at Skilak Lake
3. Naptowne radio relay site
4. Surprise Creek mining location (note: this has since been sampled)
5. Cooper Creek watershed and the Kenai River downstream from where mining occurred on Cooper Creek
6. Anadromous, migratory, and resident species to determine baseline contaminant concentrations and determine if biotic transport of contaminants is a concern

3.3 Biological Environment

3.3.1 Ecosystems

Flora and fauna on Kenai National Wildlife Refuge (Refuge, Kenai Refuge) are unusually diverse for this latitude because of the juxtaposition of two biomes on the Kenai Peninsula: the northern fringe of the Sitka spruce-dominated coastal rainforest on the eastern side of the Kenai Mountains and the westernmost reach of boreal forest in North America on the western side of the Kenai Mountains. The forests on the Refuge are dominated by white and black spruce with an admixture of aspen and birch. Extensive peatlands are interspersed among spruce in the Kenai Lowlands on the northern part of the Refuge. Lichen-dominated tundra replaces hemlock and subalpine shrub above tree line in the Kenai Mountains and Caribou Hills. The Refuge has documented 1,086 species of flora and fauna: 151 birds, 20 fish, 30 mammals, 164 arthropods, 484 vascular plants, 97 fungi, 35 lichens, 14 liverworts, 90 mosses, and 1 other invertebrate (Volume 2, Appendix F). Eighteen formations have been classified on the Refuge under the National Vegetation Classification System.

3.3.2 Landscape Types

Eighteen landscape types were classified on the Refuge, including 12 terrestrial vegetation classes, four aquatic classes, and two abiotic classes (rock and ice) (Table 3-1and Figure 3-4).

Table 3-1. The 18 Landscape Types on the Kenai National Wildlife Refuge

Landscape Type	Percentage	Acres
Hardwood	5.274	99,910
Mixed hardwood-softwood	18.359	347,803
White spruce	9.683	183,439
Black spruce	15.344	290,690
Mountain hemlock	1.613	30,564
Wetland	2.649	50,177
Herbaceous/grass	3.08	58,344
Shrub (alder)	4.315	81,752
Shrub (nonalder)	0.363	6,884
Alpine tundra	6.888	130,491
Alpine shrub	5.413	102,549
Streams (nonanadromous)	0.089	1,693
Streams (anadromous)	0.2	3,798
Lake (rearing)	5.895	111,684
Lake (non-rearing)	1.956	37,063
Estuarine	0.703	13,314
Rock	9.18	173,905
Ice	8.996	170,421

3.3.2.1 White Spruce

White spruce (*Picea glauca*) represents almost 10 percent of the Refuge (or 19 percent of the forests on the Refuge). This vegetation type is dominated by white spruce and Lutz spruce, a hybrid between Sitka (*Picea sitchensis*) and white spruce, with occasional scattered paper birch or aspen in the overstory canopy. It occurs mostly in the Kenai Mountains and uplands of the Caribou Hills and Tustumena Benchlands. Since the 1985 Comprehensive Conservation Plan was completed, spruce bark beetles have killed most mature white and Lutz spruce south of Tustumena Lake, leaving standing and fallen snags with bluejoint grass *(Calamagrostis canadensis)* in the understory. As a result of beetle-induced mortality, 50 percent of the white spruce forest is estimated to be in the early stages of regeneration. Less than five percent of white spruce is old growth (less than 150 years old), suggesting that remnant stands are a rare habitat on the landscape. Other vascular flora that occur frequently in this landscape type on the Refuge include bluejoint grass *(Calamagrostis canadensis)*, field horsetail *(Equisetum caldera)*, false toadflax *(Geocaulon lividum),* twinflower *(Linnaea borealis),* pink pyrola *(Pyrola asarifolia),* wintergreen *(Pyrola secunda),* prickly rose *(Rosa acicularis),* arctic raspberry *(Rubus arcticus),* strawberryleaf raspberry *(Rubus pedatus),* marsh fern *(Thelypteris dryopteris),* starflower *(Trientalis europaea),* and longonberry *(Vaccinium vitis-idaea)*.

3.3.2.2 Black Spruce

Black spruce (*Picea mariana*) occupies 15 percent of the Refuge (or 30 percent of forests on the Refuge). This landscape type is dominated by black spruce, much of which is in the Kenai Lowlands north of the Sterling Highway. Wildfire is frequent, with a mean fire return interval of more than 80 years. Large fires in 1947 and 1969 established the age-class distribution in this forest. More than 45 percent of black spruce forests are in the 41- to 60-year class, with five percent estimated to be less than 40 years old. Following fire, black spruce is often converted to early successional hardwood browse, providing high quality, abundant moose browse for as long as 35 years post-fire. Vascular flora that occur frequently in this landscape type on the Refuge include dwarf birch *(Betula nana),* paper birch *(Betula neoalaskana),* bluejoint grass *(Calamagrostis canadensis),* crowberry *(Empetrum nigrum),* field horsetail *(Equisetum caldera),* false toadflax *(Geocaulon lividum),* narrow-leaf labrador tea *(Ledum palustre),* twinflower *(Linnaea borealis),* trembling aspen (*Populus tremuloides),* bog labrador tea (*Rhododendron groenlandicum),* prickly rose (*Rosa acicularis),* arctic blackberry (*Rubus arcticus),* cloudberry (*Rubus chamaemorus),* and lingonberry (*Vaccinium vitis-idaea)*.

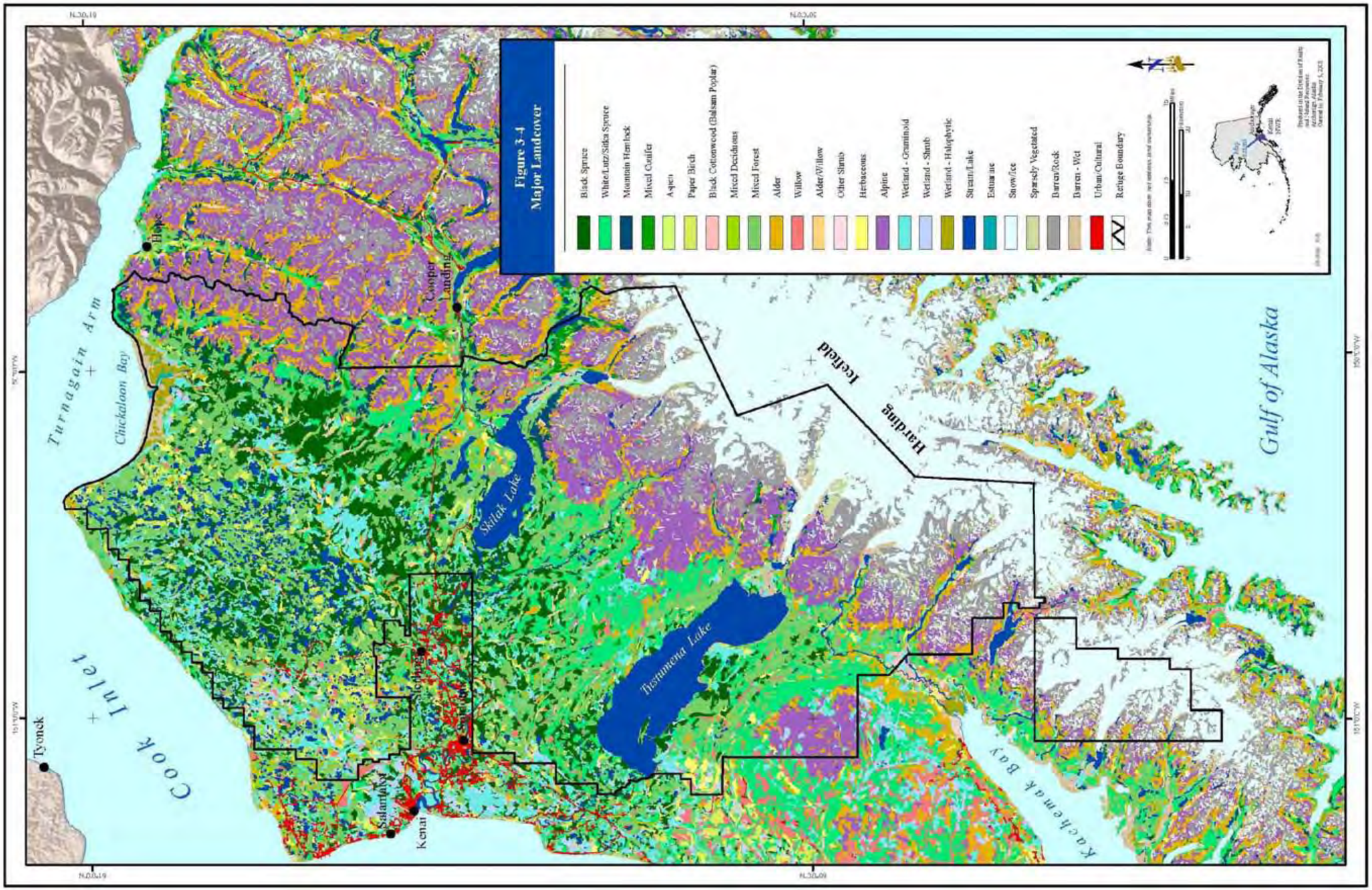


Figure 3-4. Major Landcover

3.3.2.3 Hemlock

Mountain hemlock (*Tsuga mertensiana*) occupies less than two percent of the Refuge (or three percent of forests on the Refuge). It generally grows in a high-elevation band between white and Lutz spruce and alpine shrub-tundra. Hemlock at the highest elevation in this ecotone may show a growth form called "krummholz," literally "crooked wood." In this community, tree species that normally grow upright are stunted and tend to grow parallel to the ground because of the extreme environmental stress. In contrast, small stands of mature hemlock also exist in the Kenai Lowlands. Hemlock may be a major determinant of marten distribution on the Refuge.

Almost all (98 percent) of the hemlocks on the Refuge is estimated to be more than 80 years old, so they represents an important source for old-growth forest. Other vascular flora that occur frequently in this landscape type on the Refuge include bluejoint grass *(Calamagrostis canadensis),* black crowberry (*Empetrum nigrum),*false toadflax (*Geocaulon lividum),*twinflower (*Linnaea borealis),* club moss (*Lycopodium alpinum),* Menziesia (*Menziesia ferruginea),*strawberryleaf raspberry (*Rubus pedatus),* northern oak fern (*Thelypteris dryopteris),* starflower (*Trientalis europaea),*oval-leaf blueberry (*Vaccinium ovalifolium),* and lingonberry (*Vaccinium vitis-idaea)*.

3.3.2.4 Hardwood

This vegetation type occupies 5 percent of the Refuge (or 10 percent of the forests on the Refuge). This type is characterized primarily by paper birch (*Betula neoalaskana*) and, to a lesser extent, quaking aspen (*Populus tremuloides*) and balsam poplar (*P. balsamifera*). Although this forest type is fairly well distributed across all age classes, more than 50 percent is estimated to be less than 60 years old. Early successional and intermediate-stage hardwood, which constitute about 40 percent of the Refuge, are important habitat for moose and snowshoe hares. Other vascular flora that occur frequently in this landscape type on the Refuge include bluejoint grass *(Calamagrostis canadensis)*, Sitka alder (*Alnus crispa* subsp. *Sinuate)*, black crowberry (*Empetrum nigrum)*, false toadflax (*Geocaulon lividum),* twinflower (*Linnaea borealis),* club moss (*Lycopdium alpinum),*black spruce (*Picea mariana),* wintergreen (*Pyrola secunda),* prickly rose (*Rosa acicularis),* clasping twisted stalk (*Streptopus amplexifolius),* northern oak fern (*Thelypteris dryopteris),* starflower (*Trientalis europaea),* lingonberry (*Vaccinium vitis-idaea),*and highbush cranberry (*Viburnum edule).*

3.3.2.5 Mixed Hardwood-Softwood

This vegetation type occupies 18 percent of the Refuge (or 36 percent of all forests on the Refuge). Several alliances (Alaska Vegetation Classification level 4) make up this forest type; the most common are spruce–paper birch–balsam poplar, quaking aspen–spruce, and spruce–paper birch. Mixed hardwood-softwood forests are mostly mature, with 70 percent of this type estimated to be more than 120 years old. This vegetation type may be a transitional stage from hardwood to softwood. Other vascular flora that occur frequently in this landscape type on the Refuge include bluejoint grass *(Calamagrostis canadensis)*, false toadflax (G*eocaulon lividum),* twinflower (*Linnaea borealis),* club moss (*Lycopdium dubium),* prickly rose (*Rosa acicularis),* northern oak fern (*Thelypteris dryopteris),* starflower (*Trientalis europaea),* lingonberry (*Vaccinium vitis-idaea),* and highbush cranberry (*Viburnum edule)*.

3.3.2.6 Subalpine Shrub

This vegetation type occupies five percent of the Refuge and is dominated by alder thickets in the ecotone between forest (generally mountain hemlock or white spruce) and alpine tundra. An important area for brown bear denning, it provides cover while brown bears feed in adjacent habitats. Barclay's willow (*Salix barclayi)*, diamond-leaf willow (*S. pulchra)*, under-green willow (*S. commutate)*, Richardson's willow (*S. richardsonii)*, gray-leaf willow (*S. glauca)*, and arctic willow (*S. arctica)* are common willows in these thickets. Boreal sagebrush (*Artemisia arctica),*black crowberry (*Empetrum nigrum),*lingonberry (*Vaccinium vitis-idaea),* narcissus-flowered anemone (*Anemone narcissiflora),* cloudberry (*Rubus chamaemorus),* starflower (*Trientalis europaea),*alpine blueberry *(Vaccinium uliginosum),* and monkshood (*Aconitum delphinifolium)* occur frequently in this vegetation type.

3.3.2.7 Lowland Shrub

This vegetation type occupies five percent of the Refuge and is dominated by permanent shrub communities, primarily willow (*Salix spp.)* and alder (particularly *Alnus crispa* subsp. *sinuata*, *A. incana* subsp. *tenuifolia)*. These communities are typically on sites disturbed frequently by water, wind, or sliding snow. Other vascular flora that occur frequently in this landscape type on the Refuge include boreal sagebrush (*Artemisia arctica),* black crowberry (*Empetrum nigrum),* moss campion (*Silene acaulis),* bog Labrador tea (*Rhododendron groenlandicum),* yellow rattle (*Rhinanthus minor),*salmonberry (*Rubus spectablis),* Canada burnet (*Sanguisorba Canadensis),* snow saxifrage (*Saxifraga nivalis),* Alaska spiraea (*Spiraea steveni),* and northern oak fern (*Thelypteris dryopteris).*

3.3.2.8 Alpine Shrub–Lichen Tundra

This vegetation type covers about seven percent of the Refuge in the Kenai Mountains. About 87 percent of this type is composed of dwarf shrub and lichen tundra, and 13 percent is tall shrub (alder and willow) thickets usually associated with tundra. This is critical habitat for several species, including caribou, Dall sheep, and ptarmigan. Other vascular flora that occur frequently in this landscape type on the Refuge include black crowberry (*Empetrum nigrum),* alpine azalea (*Loiseleuria procumbens),* lingonberry (*Vaccinium vitis-idaea),* bog blueberry (*Vaccinium uliginosum),* alpine bistort *(Polygonum viviparum),* bog labrador tea (*Rhododendron groenlandicum),* wooly lousewort (*Pedicularis kanei),* partridgefoot (*Luetkea pectinata),* Nootka lupine (*Lupinus nootkatensis),* netleaf willow (*Salix reticulate),* dwarf blueberry (*Vaccinium caespitosum),* star gentian (*Swertia perennis),* Canada burnet (*Sanguisorba Canadensis),* boreal sagebrush (*Artemisia arctica),* alpine speedwell (*Veronica wormskjoldii),* rough fescue (*Festuca altaica),* and spruce-fir buttercup (*Ranunculus eschscholtzii).*

3.3.2.9 Wetlands (Fens and Peatlands)

Sphagnum moss-dominated fens and peatland are defined by periodic saturation or coverage of the soil by water. Only three percent of Refuge lands are wetlands, but they are valuable wildlife habitat, contributing to populations of 96 vertebrate species. Due to a warmer and drier climate, black spruce seedlings and shrubs (*Vaccinium spp.*, *Betula nana*) have encroached on these wetlands in the past half century (Klein 2004).

3.3.2.10 Herbaceous and Grass

This habitat type is a composite of naturally occurring patches of bluejoint grass *(Calamagrostis canadensis)* and mostly linear features associated with human disturbance such as seismic lines, right-of-ways, pipeline corridors, and roadsides. It currently represents three percent of the Refuge but will likely increase in the future as bluejoint replaces stands of beetle-killed spruce. Although bluejoint is native, it can be highly invasive and suppress stand regeneration for many decades (Berg 2005).

3.3.3 Special Terrestrial Habitats

3.3.3.1 Riparian Habitats

Habitats of this type contain various terrestrial plant communities distinguished by their association with lakes, ponds, and streams. Riparian habitat makes up only five percent of the Refuge but is perhaps the most valuable wildlife habitat. It is essential to 36 species of birds (26 percent of the species that breed on the Refuge) and is used by every other species occurring on the Refuge). These birds depend on mature cottonwood (*P. balsamifera* subsp. *trichocarpa*) or quaking

aspen trees for nest sites. About 400 bald eagles are present every winter along the Kenai River, above and below Skilak Lake, and in the Fox River Valley.

3.3.3.2 Estuary

A 1,700-acre (6,900-hectare) mud flat and tidal marsh has been created at the mouth of the Chickaloon River by tidal action from Turnagain Arm. This area is a major waterfowl and shorebird staging area used by as many as 25,000 birds a day during fall migrations and by lesser numbers in the spring. Among the species using the estuary are whistling and trumpeter swans, lesser and cackling Canada geese, white-fronted geese, snow geese, sandhill cranes, northern pintail, mallard, green-winged teal, and other dabbling ducks. Some 78 bird species and 15 mammalian species have been recorded using the estuary in some manner. Fifty-one species of birds are believed to nest in the area, and 11 species of mammals probably use the area for rearing young. As many as 5,000 lesser Canada geese at a time may use the Chickaloon estuary in late September and early October on their southward migration (Quimby 1972). The estuary is also used as an area for resting and feeding harbor seals and Cook Inlet beluga whales; the former is currently considered a depleted population under the Marine Mammal Protection Act and is a candidate species for listing under the Endangered Species Act (NMFS 2005).

3.3.3.3 Cliffs

Cliff habitats are scarce on the Refuge, occurring only in the central and southern mountainous areas. It is believed that perhaps 10 pairs of peregrine falcons nest on Refuge cliffs. This is also important habitat for mountain goats.

3.3.3.4 Islands in Lakes

Islands are a scarce but important habitat type on the Refuge. They support a variety of other waterfowl, such as nesting trumpeter swans, common loons, and seabird colonies; and provide predation-free calving areas for moose.

3.3.3.5 Gravel and Rock (Outwash Plains, River Floodplains, Alpine Rock)

This landscape type occupies nine percent of the Refuge. Mountainous, rock-dominated habitats comprise most of this type, although alluvial outwash plains are also included. This type supports few plants and sparse wildlife populations. Representative vascular plant species include mountain-avens (*Dryas drummondii), D. octopetala*, boreal sagebrush (*Artemisia arctica),* black crowberry (*Empetrum nigrum),* bog blueberry (*Vaccinium uliginosum),* timber oatgrass (*Danthonia intermedia),* spotted saxifrage (*Saxifraga bronchialis),* moss campion (*Silene acaulis),* alpine azalea (*Loiseleuria procumbens),*alpine bistort (*Polygonum viviparum),* narcissa anemone *(Anemone narcissiflora),*

and cordate-leaved saxifrage (*Saxifraga punctata).* Alaska willow (*Salix alaxensis)* and Sitka willow (S*alix sitchensis*) are common along river bars; least willow *(Salix rotundifolia)* is common on alpine rock. This habitat type may increase soon if the rate of glacial retreat exceeds the rate of shrub succession.

3.3.3.6 Snow, Ice, and Glaciers

These habitats are harsh, cold, and barren, covering nine percent of the Refuge. The Refuge has at least 14 major glaciers that feed off the 694.98-square-mile (1,800-square-kilometer) Harding Icefield. Outlet glaciers on the Harding Icefield within the main portion of the Refuge include Skilak, Killey, Indian, Tustumena, Truuli, Chernof, Dinglestadt, and Kachemak. Nuka, Dixon, Portlock, Grewingk, Wosnesenski, and part of Doroshin glaciers are in the southern unit.

Iceworms *(Mesenchytraeus solifugus*) are the primarily inhabitant of glaciers, feeding on interstitial green algae (*Chlamydomonas nivalis*). Snow fleas (*Hypogastrura nivicola*), tiny spiders, microscopic nematodes, and tardigrades are also part of the glacial community. Although only used occasionally by vertebrate species such as mountain goats, caribou, and snow buntings, this landscape type is critical to water regulation and has immense importance for river-dependent wildlife such as salmon, bears, and eagles. For example, Edmondson et al. (2003) recently showed that euphotic zone depths in Skilak Lake declined throughout much of the 1990s from increased glacier melting and its attendant silt loading and inorganic turbidity. A significant reduction in the body mass of sockeye salmon fry was attributed to these changes in the euphotic zone.

3.3.3.7 Nunataks and Other Unglaciated Areas

The Kenai Peninsula (Peninsula) experienced at least two and as many as five major glaciations during the Pleistocene Epoch (Karlstrom 1964), which began about 1.8 million years ago and ended 10,000 years ago. All of the Kenai Peninsula has been glaciated at one time or another, with the possible exception of nunatak peaks projecting above the Harding Icefield and the Grewingk–Yalik Icefield south of Kachemak Bay.

The last major glaciation, known as the Wisconsin or Naptowne (local name) glaciation, brought icesheets from across Cook Inlet to as far east as Swanson River Road and Kasilof and out of the Portage, Skilak, and Tustumena valleys and Kachemak Bay. A chain of narrow glacial lakes separated the western and eastern ice sheets at most points, and their remnant lakebeds now floor the muskegs running from northeast of Sterling, through Kasilof, and south to Anchor Point. The Caribou Hills formed an unglaciated island at this time, although the hills were glaciated at least once earlier in the Pleistocene. Like the nunataks, the Caribou Hills are a possible repository of relict flora and ice-age fossil and DNA material from animal species that lived there during the full

glacial maximum. Several small lakes in the Caribou Hills (northwest of the Boxcar Hills) may contain a pollen record of the vegetation during the last full glacial maximum, and they deserve study with lake sediment cores.

Forty-six vascular plant species were collected from three nuntaks inventoried in July 2007. Although no new records were identified for the Refuge, several were considered rare (e.g., Alaska rockjasmine Douglasia alaskana,) and two dandelions (Taraxacum officinale ssp. ceratophorum, and Taraxacum phymatocarpum) (Kenai National Wildlife Refuge, unpubl. data).

3.3.4 Lakes and Streams

Aquatic habitats are particularly fragile in this subarctic region. Their productivity depends on maintenance of high water quality, proper water temperature, clean stream gravels, and the nutrient-exchange cycles driven by anadromous fish runs. The welfare of the fish populations is—at least theoretically—dependent on maintenance of a broad spectrum of genetic traits in the populations. The escapement of sufficient spawning stocks is also vital. Refuge waters have been categorized into four habitat classes for planning and management purposes: (1) anadromous fish streams; (2) resident fish streams; (3) anadromous fish lakes; and, (4) resident fish lakes (Figure 3-5).

3.3.4.1 Anadromous Fish Streams

These are running water courses connected to the ocean and capable of sustaining anadromous fish populations. They also support resident fish populations. There are approximately 430 miles (692 kilometers) of anadromous fish streams on the Refuge.

3.3.4.2 Resident Fish Streams

These are running waters with no anadromous fish because of barriers to migration or other factors. Most of these waters are capable of supporting resident fish species. There are about 1,073 miles (1,727 kilometers) of resident fish streams on the Refuge.

3.3.4.3 Anadromous Lakes

These are standing bodies of water connected to the ocean by outlet streams that are large and unimpeded enough to allow passage of migrating anadromous fish. Water flows from these lakes throughout the year—even under winter ice cover. About 250 of the Refuge's 4,622 cold water lakes, covering 113,000 acres or 45,729.47 hectares (69 percent of the total lake surface) fall into this habitat class. Most of these lakes support both anadromous and resident fish.

3.3.4.4 Resident Lakes

These are standing bodies of water not connected to the ocean by an outlet through which migrating anadromous fish can pass. There are 4,372 resident fish lakes on the Refuge, covering 52,000 acres or 221,043 hectares (31 percent of the total lake surface area).

This class is used by fish species that can complete their entire life cycle in landlocked freshwater systems. These waters naturally support at least nine species, of which Arctic char and kokanee salmon are of particular interest to anglers.

Most lakes within the Refuge are resident fish lakes. The ability of a resident fish lake to support a recreational fishery depends on whether or not there are tributary streams and gravel-bottomed lakes suitable for trout and char spawning. Because they do not contain salmon, and in many cases cannot sustain any sort of recreational fishery, resident fish lakes are considered the least valuable type of aquatic habitat. Some of these lakes, however, provide good trout and char fishing on a seasonal basis and are important habitat for birds and mammals. Many could sustain excellent fisheries if exclusively managed for that purpose.

3.3.5 Natural Disturbance Processes

3.3.5.1 Spruce Bark Beetles and Other Insects

The spruce bark beetle is the dominant agent of disturbance in white, Lutz, and Sitka spruce forests of the Kenai Peninsula (Figure 3-6). Beetles selectively attack mature spruce trees (more than six inches diameter at breast height) because large, slow-growing trees are less able to resist the establishment of adult female beetles in the phloem. Dendrochronology studies have shown evidence of regional bark beetle outbreaks in the 1760s, 1780s, 1810s, 1850s, 1870–1880, 1910s, and 1970s. Bark beetles are always active somewhere on the Peninsula at low levels; on average, any stand can expect to experience some degree of bark beetle mortality every 52 years (Berg et al. 2006). However, the outbreak of the last 15 years has been of unprecedented size and intensity. Beetles infected four million acres of forested land in southcentral Alaska, of which more than 800,000 acres on the Kenai Peninsula experienced 80–90 percent spruce mortality.

Increasing temperatures and drought stress because of global warming are likely increasing the rate of spruce bark beetle outbreaks on the Peninsula (Berg et al. 2006). The Kenai outbreaks of the 1970s and 1990s followed runs of unusually warm summers (1967–1969, 1987–1997, respectively). Starting in 1987, summer temperatures remained above average for 11 years, unprecedented in length and intensity during the past 250 years.

A variety of other forest insect pests reside on the Kenai Peninsula, such as the engraver beetle *Ips* and various defoliators, but they have not affected significant acreages, according to the U.S. Forest Service annual surveys. The introduced amber-marked birch leafminer (*Profenusa thomsoni*), responsible for thousands of acres of damage in the Anchorage area, was detected along the Sterling Highway as far west as Soldotna in 2006. Recently, aspen leaf-miner moth (*Phyllocnistis populiella*), a native lepidopteran, has started to affect trees on the Peninsula.

The diversity of arthropods on the Refuge is poorly documented. No records exist for centipedes, Pauropods, or Proturans, all of which should be present on the Refuge. Seven species of arachnids have been recorded. Of the estimated 1,000–1,500 insect species likely to occur on the Refuge (D. Collet, personal communication), 164 species have been documented.

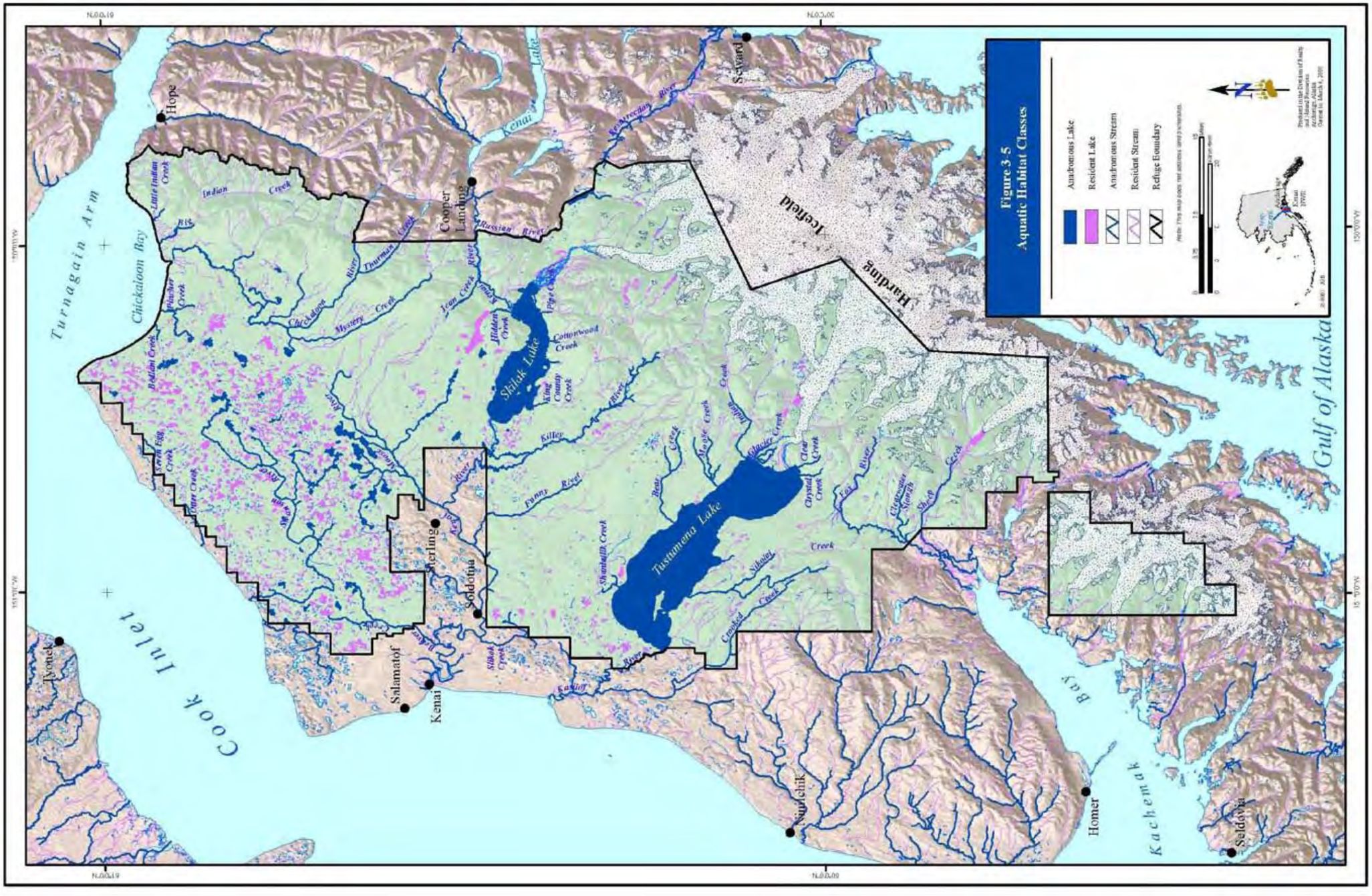


Figure 3-5. Aquatic Habitat Classes

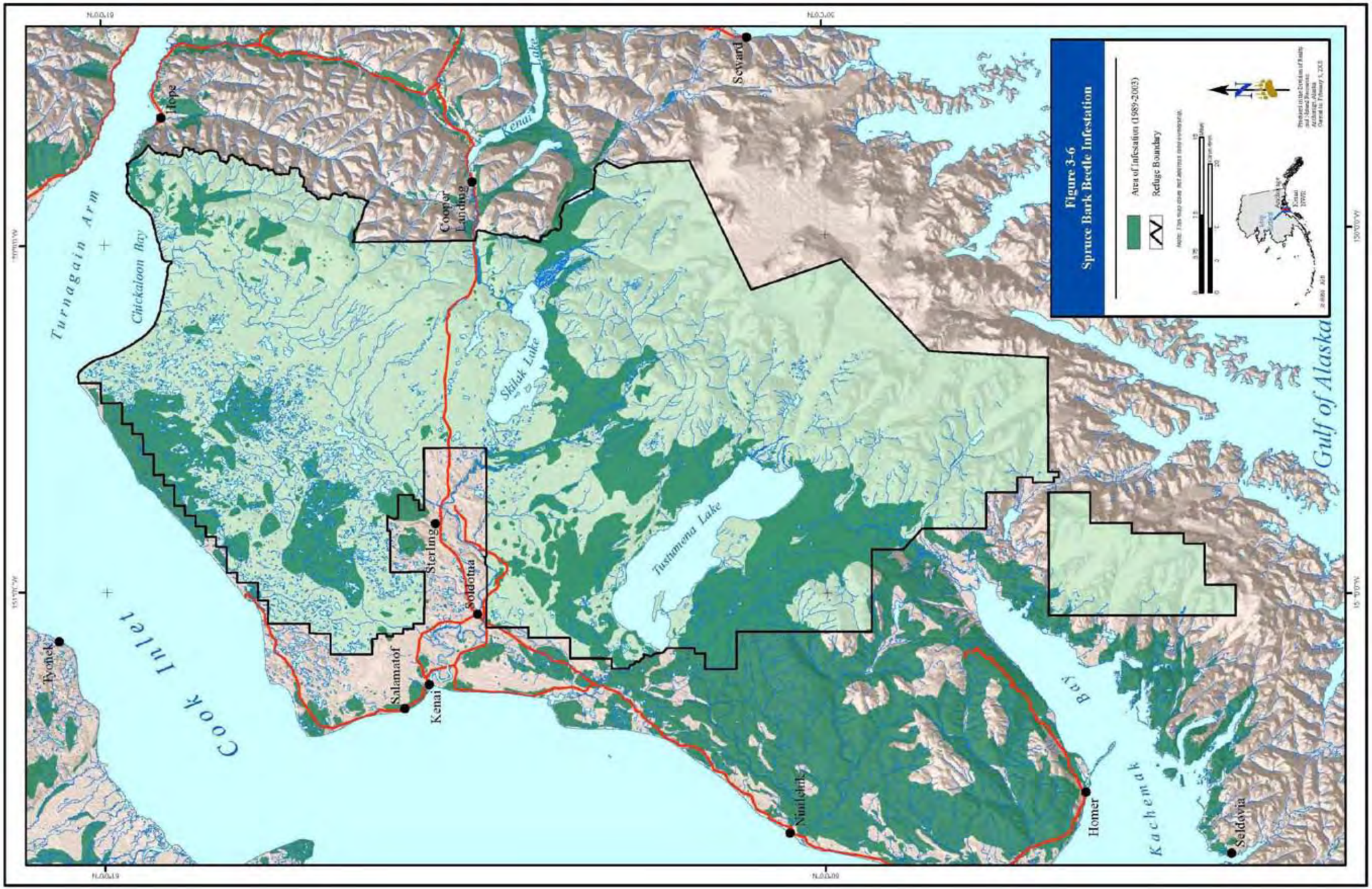


Figure 3-6. Spruce Bark Beetle Infestation

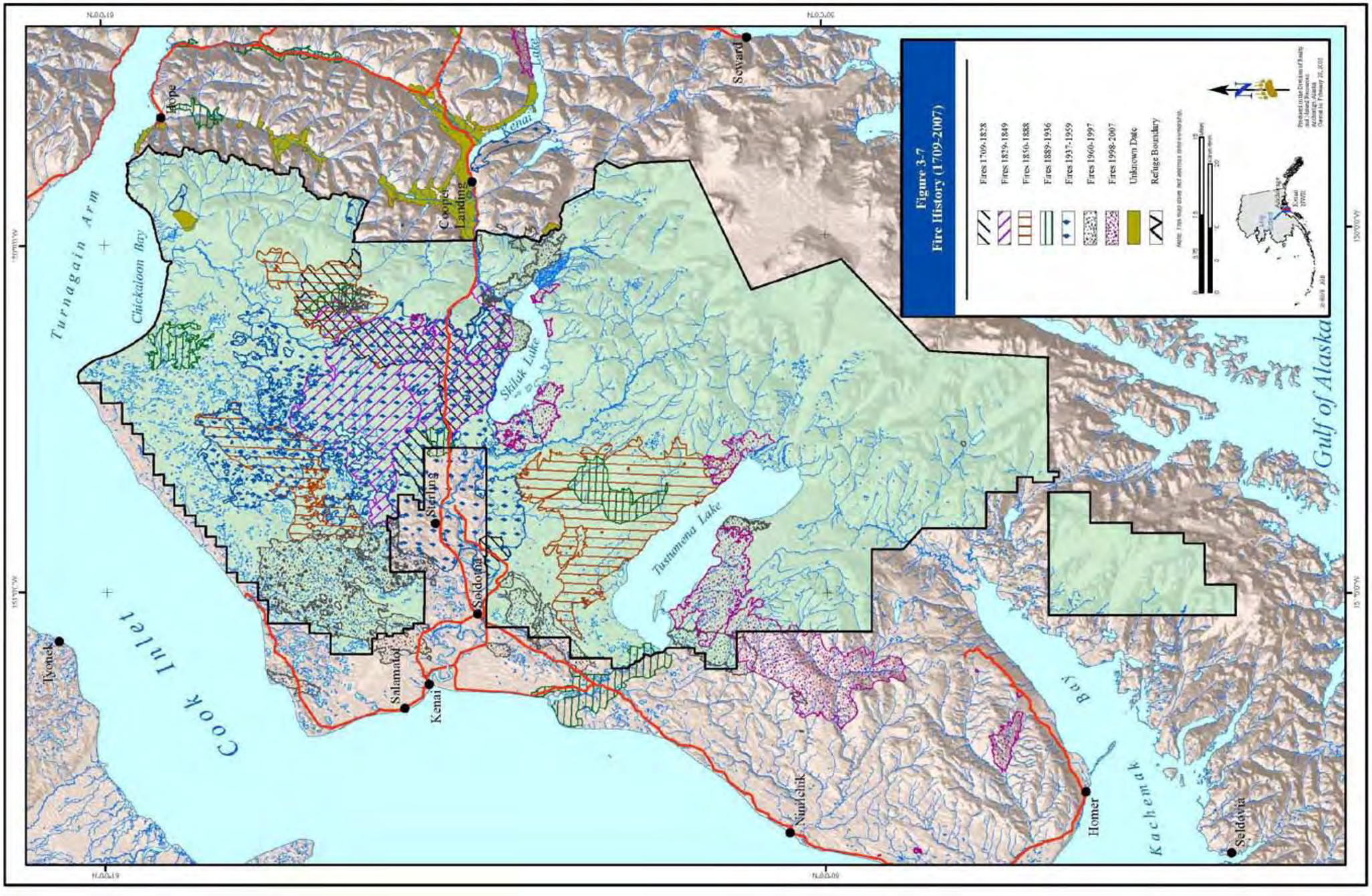


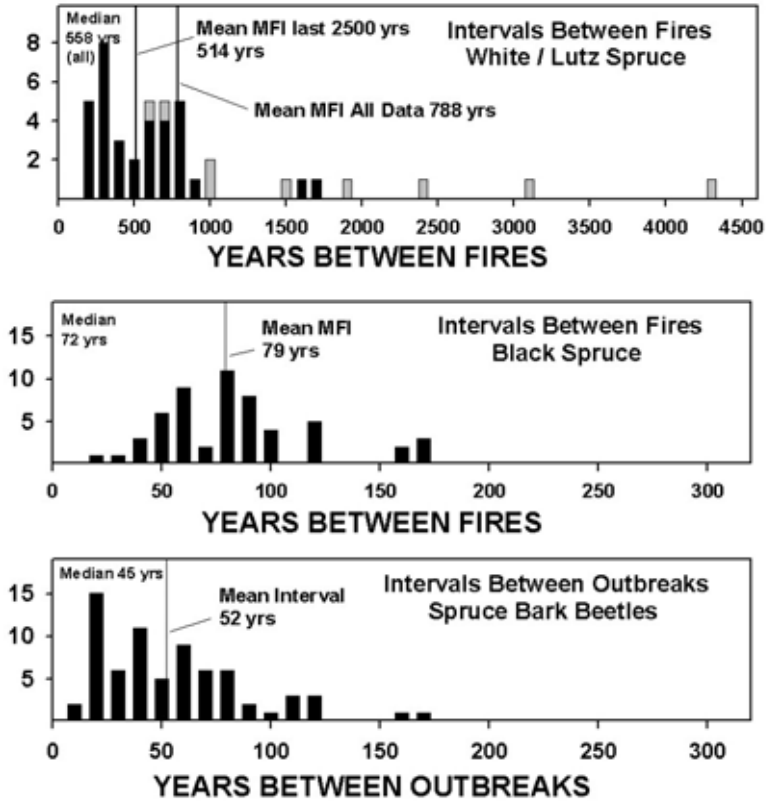
Figure 3-7. Fire History (1709-2007)

3.3.5.2 Fires

Many fires have occurred on the Refuge in the past 100 years. Major fires of unknown origin took place in 1871, 1883, 1891, and 1910 (Lutz 1960) (Figure 3-7). In 1947 and 1969, two large human-caused fires burned 310,000 acres (125,000 hectares) and 86,000 acres (35,000 hectares), respectively. These fires resulted in replacement of mature spruce forests by a mosaic of young forest in various stages of succession. The 1969 fire was a severe, mineral-soil–exposing fire that produced lush thickets of birch browse, which has now grown to a young birch forest. Post-fire hardwood browse provides excellent winter food for moose and hares and for predators that eat moose and hares such as lynx, wolves, and coyotes.

Two distinct fire cycles occur on the Kenai landscape. Lowland black spruce forests increase in flammability with age and have a mean fire return interval of 79 years (DeVolder 1999) (Figure 3-8). Much of the acreage of the large fires described previously, some of which were human ignited, was mature black spruce forest.

Figure 3-8. Historical return intervals between wildfires and spruce bark beetle outbreaks on the Kenai Peninsula



White, Lutz, and Sitka spruce forests burn on a much longer time interval; in the virtually monospecific stands of Lutz spruce on the

southern Kenai Peninsula, the mean fire return interval is approximately 514 years, as determined from radiocarbon-dated soil charcoal, and the mean time since burning is about 600 years (Berg and Anderson 2006). In the Swanson River Road area, a lake-sediment charcoal study at Paradox Lake estimated the mean fire return interval to be about 200 years, perhaps due to the presence of more black spruce in the valley bottoms. On the south side of Kachemak Bay, there is no charcoal evidence that the old-growth Sitka spruce forests have ever burned in the 2,200 years that Sitka spruce has been in the area. On the Refuge, there is no old-growth spruce forest north of Kachemak Bay, even though some of the spruce forests have not burned for at least 1,500 years. It appears that spruce bark beetles recycle these forests much more frequently than does fire. It is rare to find spruce trees more than 300 years old, although these species typically live 500 to 600 years in southern British Columbia.

The presence of thousands of acres of beetle-killed spruce forest on the Kenai Peninsula has raised the specter of catastrophic wildfire. However, Berg and Anderson (2006) used 121 radiocarbon-dated soil charcoal samples to reconstruct the regional fire history of the last 2,500 years and found no relation between fire activity and past spruce–bark beetle outbreaks. One fire occurred for every 10 spruce–bark beetle outbreaks in these forests. Nevertheless, a run of warm summers since 1987 has created a spruce–bark beetle outbreak of unprecedented scale, and at least three major fires with high rates of spread in recently beetle-killed timber have occurred. This suggests that, with a future warmer climate and increasing human use of the landscape, fire and beetle kill may be well more closely associated than in the past (Berg and Anderson 2006).

Furthermore, the long-term colonization of the peatlands by black spruce will provide continuity of fuels across previously wet muskegs that served as firebreaks in fires such as the one in 1947. The expanded fuel bed and drier summers will create conditions for larger and more severe fires in the lowland black spruce forests and will put more fire on the flanks of the upland white and Lutz spruce stands.

3.3.5.3 Avalanches

Avalanches are most common in winters with heavy snowfall and temperatures that vary between freezing and thawing. Avalanches were not specifically identified as a major impact on wildlife until 2001 when approximately 150 caribou were killed by a major slide near Alpine Lake. Since this discovery, at least three other avalanches have occurred, in which some 52 caribou have been killed. Although these avalanches all occurred in the mountains between Skilak and Killey rivers, avalanches likely occur throughout the Kenai Mountains and may affect other species that use mountain habitat—brown and black bears, mountain goats, Dall sheep, wolves, wolverine, and moose. For example, an avalanche killed a radio-collared brown bear sow and her cubs near Skilak Glacier in 1998. Avalanches are also a natural means of

habitat change. In many parts of the Kenai Mountains, large areas of even-aged forests occur with small fans of shrub or herbaceous vegetation, suggesting a recent avalanche.

3.3.5.4 Windstorms

The Kenai Peninsula occasionally experiences local windstorms, typically from northeasterly winds coming though mountain valleys from Prince William Sound. These winds can knock down forest stands of as much as several hundred acres and have blown down beetle-killed spruce trees on large areas of the southern Peninsula in recent years. There is no history of hurricane-scale regional windstorms on the Kenai Peninsula.

3.3.5.5 Flooding

Autumn is the period of highest precipitation on the Kenai Peninsula; in some years, there have been dramatic floods and mudflows. The Kenai River flood of 1995 destroyed homes on the floodplain, and the southern peninsula floods of 2002 washed out bridges and isolated communities. Kenai River flooding can be exacerbated by the release of glacially-dammed lakes in the Snow River drainage above Kenai Lake when the lakes become swollen with heavy fall rains. Mudflows occasionally occur with water-saturated soils along steep bluffs, especially along Kachemak Bay—again, typically in the fall.

3.3.5.6 Earthquakes and Volcanoes

Earthquakes of magnitude more than 8.0 on the Richter scale such as the 1964 earthquake (magnitude 9.2) are estimated to occur on average every 800 years, although the interval can be considerably shorter. These are subduction-zone earthquakes, where the Pacific plate is moving to the northwest under the Kenai Peninsula. The zone of rupture of such earthquakes is typically quite large. The rupture of the 1964 earthquake, for example, extended from the epicenter at the top of Prince William Sound down past Kodiak, covering about 110,000 square miles (284,898 square kilometers).

Four historically active volcanoes—Mounts Spurr (1953 and 1992), Redoubt (1989–1990), Augustine (1986), and Katmai (1912)—are across Cook Inlet from Kenai, in order from the southwest to the northwest and all windward of the Refuge. These and other volcanoes of the Alaska Range and the Aleutian Islands, some extinct and others perhaps only temporarily quiescent (e.g., Mount Iliamna), are responsible for widespread deposits of volcanic ash on the Kenai Peninsula.

Explosive eruptions that destroy vegetation and deposit volcanic rocks and ash over wide areas create conditions that promote increased rates of surface runoff during rainstorms, dramatically increase the availability of loose debris that can be eroded and transported into river valleys, and typically result in persistent airborne “ashy” conditions due to wind and human activities. The

destruction of vegetation, combined with deposition of ash on hill slopes, reduces the amount of water that normally soaks into the ground or is transpired by plants. The increased overland flow of water erodes rock debris from hill slopes and carries it into river valleys, where sediment can accumulate and change the normal hydrology of river valleys. The net effect of such changes to watersheds is that post-eruption stream velocities and peak discharges during rainstorms are temporarily much higher than during pre-eruption conditions.

3.3.5.7 Receding Glaciers and Icefields

The Harding Icefield, covering some 695 square miles (1,800 square kilometers), is the largest icefield completely contained within the boundaries of the United States. Slightly less than half the icefield lies within the boundary of the Refuge. The remaining portion of the field falls within Kenai Fjords National Park. Although most of the 38 outlet glaciers on the Harding Icefield are land-terminating glaciers, seven are tidewater glaciers.

The Harding Icefield has been thinning and shrinking since the Little Ice Age, which ended in the 1850s. Comparisons between measurements made in the mid-1990s and maps from the 1950's indicate that the volume of the icefield has decreased by approximately 34 cubic kilometers, which corresponds to an average decrease in thickness of 70 feet (21 meters) (Adageirsdottir et al. 1998; Meier et al. 2003). Rice (1987) showed that the surface area of the Harding Icefield as decreased by five percent over a similar time interval. Monitoring of mass-balance changes continues at the Wolverine Glacier, one of three benchmark glaciers monitored by the U.S. Geological Survey.

3.3.6 Concerns Regarding Habitat

The distribution and quality of fish and wildlife habitats on the Refuge have always varied in response to natural disturbances, particularly wildfire and spruce bark beetle as dominant agents of change.

3.3.6.1 Habitat Changes Since 1985

Since 1985, wildfires have burned more than 130,000 acres, and spruce bark beetles have infected nearly 400,000 acres on the Refuge. Overall on the Refuge, forests have continued to age, with a seven percent increase in forest stands 41–70 years old and a concomitant decrease in forests 20–40 years old. Mature (71–200 years) and old-growth forests (more than 200 years) have increased in acreage eight percent since 1985, although the full toll of the most recent spruce–bark beetle outbreak is yet to be realized. Concern has been expressed by the public about declining moose habitat in Game Management Unit 15A, but this variation in habitat conditions is consistent with a mean fire return interval of 80 years. The last extensive wildfire in Game Management Unit (GMU) 15A occurred in 1969 when 86,000 acres

north of the Sterling Highway burned. This fire converted much of what was mature black spruce to hardwood forest and helped create the habitat conditions to sustain high moose populations in Game Management Unit 15A for years after the fire.

This type of variation in habitat is well within the known wildfire (80 years in black spruce, 600–800 years in white, Lutz, and Sitka spruce) and spruce bark beetle cycles (50 years). However, rates of spruce bark beetle outbreak (and perhaps fire) appear to be increasing because of global climate change. Over 1,000 lightning strikes in 2005 on the Kenai Peninsula, an area of the State in which lightning ignitions were once considered unusual, suggest that conditions may be changing (Morton et al. 2006). Similarly, in the past 60 years, black spruce forests have encroached into peatlands as the peninsula has gotten warmer and drier (Klein 2004). Forests have encroached into alpine tundra as the tree line has risen in apparent response to warmer temperatures. Glaciers have continued to recede, declining three percent in surface area on the Refuge as bare rock and gravel have concomitantly increased since 1985.

Habitat changes in response to either global climate change or deliberate alteration of natural processes (such as wildfire suppression) are of more concern than those that occur from natural variation over time. Over the long-term, we can expect profound habitat changes that will result in wildlife species shifting their distribution northward and to higher elevations (Parmesan 2006, Parmesan and Yohe 2003). Local extirpations of some populations may result, just as range expansions of others will occur. Similarly, as new rate trajectories are estimated for these agents of change, the Refuge will have to decide whether to manage with these changes (i.e., adapt) or against these changes (i.e., mitigate). The former approach manages the system towards a new climate change-induced equilibrium; the latter abates the impact by trying to maintain the current condition in the face of climate change. Some restoration ecologists have suggested that it only makes sense to manage toward future conditions rather than historic conditions (Choi 2007, Harris et al. 2006).

3.3.6.2 Rising Tree Line (Krummholz)

In the Kenai Mountains, a zone of mountain hemlock occurs above spruce tree line. *Krummholz* is German for "twisted wood," which refers to the horizontal growth of trees at wind-swept alpine tree line sites. Krummholz trees are often found hunkered down in swales and hollows where the snow is deeper and lasts longer than on the open tundra slopes. The twisted horizontal growth occurs when the normally upright tree tip or leader is blasted by wind-driven ice crystals during the winter. Krummholz is very slow-growing and can be very old; krummholz trunks north of the Skyline Trail have been tree-ring dated to the 1500s, even though these trunks are only five or six inches in diameter.

Kenai mountain hemlocks do not appear to be growing as krummholz in recent years. Hemlock seedlings now grow straight up at tree line and have probably been doing so for much of the 20th century, judging from the upright saplings growing amidst the krummholz ancients. Furthermore, we now see old krummholz trees turning upright and producing normal vertical trunks. Trunks may hug the ground for as much as eight or ten feet and then sweep upward into the vertical mode.

Whatever the climatic cause, tree line will be higher for the next generation of trees on the Kenai Peninsula. Indeed, it appears that white spruce has essentially leap-frogged over the narrow mountain hemlock zone—krummholz and all—and is starting to grow above the hemlock zone. A dramatic example of this rapid advance occurs in the headwaters of Mystery Creek. The mountain hemlock krummholz zone is well-developed on the northeastern flank of the mountain at 1,968–2,524 feet (650–800 meters) elevation; at least 300 feet (100 meters) above the top of the hemlock krummholz, abundant white spruce seedlings (as much as three feet [one meter] tall) and lesser numbers of hemlock seedlings have been found.

Tree line probably began to rise about 150 years ago with the end of the Little Ice Age. In the 1850s, Kenai Peninsula mountain glaciers began to pull back, and shrubs and black spruce forest began to invade the extensive sphagnum moss peatlands on the Kenai Lowlands. Winters on the Peninsula have been dramatically milder since 1977, when North Pacific sea surface temperatures warmed, following the half-century cycle of the Pacific Decadal Oscillation (PDO). Most of the seedlings that we see above tree line were probably established in the post-1977 warm period.

3.3.6.3 Drying Wetlands, Shrinking Lake Surface Area

The Refuge's 1985 Comprehensive Conservation Plan quantified streams and lakes used by resident and anadromous salmonids in terms of stream lengths and lake surface area. There is no evidence to suggest that stream lengths or the surface areas of open-basin lakes (those which would be used by anadromous fish) have changed significantly. However, analysis of aerial photographs taken in 1950 and 1996 suggest there has been a significant decline in the surface area of closed-basin lakes (Klein 2004, Klein et al. 2005). In one example, Sunken Island Lake decreased in surface area by more than 11 percent from 1950 through 1996. This evaporation is being driven by a major shift in the water balance on the Kenai Refuge, presumably in response to a warming climate.

3.3.6.4 Lowland Hemlock

Mountain hemlock is normally a high-elevation species that forms a visually distinct belt above white spruce tree line in the mountains. On the Kenai Lowland, there are several outlier populations of mountain

hemlock growing in mature white spruce forest. The largest stand is 1,200 acres (485 hectares) north of Scaup Lake; smaller stands exist on the north side of the Swanson River oilfield (Discovery Well area) and a mile south of Funny River Road on the horse trail. Reportedly, a small grove is situated off Echo Lake Road. Some trees cored at Scaup Lake dated to the 1500s and likely are among the oldest living trees on the Refuge. These stands are probably a product of long-distance dispersal of seeds from the mountains. They are not attacked by spruce bark beetles, are reproducing well, and probably represent the best possibility for future old-growth forest on the Refuge.

3.3.6.5 Old-Growth Forest

Less than 3 percent (approximately 48,000 acres [19,424 hectares]) of the Refuge is represented by old-growth forests (i.e., more than 200 years old). Although this habitat has increased slightly in acreage since 1985 because of forest maturation, this may become a rare age class as the full effects of the 15-year spruce–bark beetle outbreak are realized. Spruce bark beetles usually tend to infect mature white, Lutz, and Sitka spruce, and many of the stands on the southern part of the Refuge have experienced 80–90 percent mortality. The relative contribution of mountain hemlock to old-growth forests on the Refuge will likely increase in the future as beetle-killed white, Lutz, and Sitka spruce trees are blown down or fall over. The ecological value of old-growth forest on the Kenai Peninsula is not well understood.

3.3.6.6 Exotic, Invasive, and Injurious Flora

Over 90 exotic plant species have been recorded on the Kenai Peninsula (Densmore et al. 2001, DeVelice 2004, Duffy 2003), representing over 60 percent of the known exotic vascular plants in Alaska (Rejmanek and Randall 1994). Although relatively still pristine, Kenai Refuge hosts more than 300,000 annual visitors, is one of only two refuges in Alaska on the highway system, and has been the site of commercial oil and gas activities since the early 1960s. With 56 square miles of anthropogenic footprint, exotic flora are well established on certain areas of the Refuge. Most of the 62 exotic species documented are associated with roads, trails, seismic lines, utility right-of-ways, oil and gas infrastructure, campgrounds, and cabins. Several of the species are relatively invasive, including scotchbroom (*Cytisus scoparius*), white sweetclover (*Melilotus alba*), bird's vetch (*Viccia cracca*), and reed canary grass (*Phalaris arundinacea*). Only three species of exotic vascular plants have been found on the Refuge, and these have been recorded on less than four percent of the Refuge. These species include Bigleaf lupine (*Lupinus polyphyllus),* Rough Meadowgrass *(Poa trivialis),* and common dandelion (*Taraxacum officinale).* Exotic, invasive, and injurious flora will almost certainly continue to spread on the Refuge as more land is developed inside and outside the Refuge, as fire is more aggressively managed because of the expanding urban

interface (Hunter et al. 2006), and as global warming moderates the subarctic climate on the Kenai Peninsula (Dukes and Mooney 1999).

Exotic aquatic flora may become a potential problem in the future. Limited sampling of the macrophyte communities in Vogel, Johnson, and Longmere lakes (all lakes with high visitation, two of which receive floatplane traffic) suggest that exotic aquatic flora have not yet been introduced to the Kenai Peninsula. However, unintentional transportation on trailered boats, deliberate introduction by humans, escape of ornamental varieties from water gardens, and escape from the aquarium trade are known transport routes for introducing and spreading invasive aquatic plants (Pfauth and Sytsma 2005). In Alaska, transport of plant fragments on floatplanes flying between waterbodies in urban population centers and those in more remote locations within the State is a likely mechanism of aquatic plant introduction. Floatplane and trailered boat traffic between Alaska and waterbodies elsewhere in Canada and the contiguous U.S. are also likely sources of new infestations (Pfauth and Sytsma 2005).

The most likely source for the introduction of exotic aquatic plants to the Kenai Peninsula is Lake Hood in Anchorage. Lake Hood is a shallow basin that has been used as a floatplane base for many years and, in fact, is a central hub for floatplane traffic within the State of Alaska. Numerous small structures and docks line the shores of the lake and function as permanent bases for floatplanes. Lake waters support abundant aquatic macrophyte growth that gets entangled on aircraft floats and rudders. Although field sampling by Pfauth and Sytsma in 2005 suggests that Lake Hood is still free of non-native aquatics, it clearly represents one of the most likely places for the establishment of an incipient population of exotic macrophytes due to its heavy floatplane traffic and proximity to the aquarium trade in Anchorage (Helfrich et al. 2003).

3.3.6.7 Damage and Disturbance Due to Legal and Illegal Use of Snowmachines and Off-Road Motorized Vehicles

Snowmachine use has been and is currently permitted in lowland forests on 1.25 million acres (63 percent) of the Refuge. All alpine areas, with the exception of the Caribou Hills, have been closed to snowmachine use since 1986. According to the 1985 Comprehensive Conservation Plan, “A single exception, the Caribou Hills, would remain open until the already heavy snowmachine use reached a level where it is adversely affecting wildlife or becomes incompatible with Refuge purposes or future management decisions” (USFWS 1985). Additionally, the headquarters area, Skilak Lake Wildlife Recreation Area, and parts of the Swanson River Canoe System are closed to snowmachine use.

In the past 20 years, snowmachine use has noticeably increased because of growing human populations on the Kenai Peninsula, increasing

numbers of winter recreation cabins on State lands adjacent to the Refuge, and increased winter access via logging roads (resulting from salvage operations for spruce bark beetle–killed trees). The Refuge continues to permit snowmachines on authorized areas from December 1 through April 30, but only when snow depth is sufficient to protect underlying vegetation and terrain. This regulation, however, is difficult to enforce. In areas south and west of Caribou Hills that are outside the Refuge boundaries, more than 16 major snowmachine trails (over 130 miles) are maintained by private organizations. Additionally, hundreds of miles of seismic lines are accessible, in varying degrees, to snowmachines. There is concern that authorized use in Caribou Hills may be exceeding levels compatible with wildlife and that unauthorized use in other alpine areas is increasing.

The effects of snowmachine use on wildlife vary with species, size, individuals, snow conditions, and wildlife habituation to snowmachines at different levels of use. Because of this, effects of snowmachines on wildlife are difficult to generalize. Several studies have been conducted that show the direct impact of repeated snowmachine use on wildlife behavior and levels of physiological stress (Aune 1981, Dorrance et al. 1975, Freddy et al. 1986, Moen et al. 1982, Neumann and Merriam 1972, Powell 2004, Rudd and Irwin 1985, Simpson 1987, Tyler 1991, Voyageurs National Park 1996). Many of the studies showed behavioral effects on the same species that occur on the Refuge. These studies and others on different species (e.g., deer) indicate that snowmachine activity does affect a wide variety of animals. They confirm that exposure of wildlife to snowmachine use results in behavior alteration, habitat avoidance, and energy expenditures at critical times when animals are under extreme stress due to winter deprivations. Of most concern on the Refuge is disturbance to wintering moose populations and potential disturbance to denning black and brown bears. Also, while the Caribou Hills is known as an area important to caribou historically, animals that were re-introduced into the Refuge (some specifically in Caribou Hills) in the 1960s and 1980s have avoided the area. While there is no concrete evidence that caribou avoid the Caribou Hills now because of the current levels of snowmachine use, snowmachines may contribute to making the area unsuitable for their use (Powell 2004).

To assess the potential magnitude of snowmachine traffic, Refuge staff deployed off-road vehicle counters at five sites in winter 2005: three major trail heads south of the Kasilof River (Centennial, Clam Gulch, and Falls Creek Road) and two sites on Tinkle Trails, which is one of the known major entry points onto the Refuge in the Caribou Hills area. These counters detect the electromagnetic signature of passing snowmachines. Sensors were operated for a 25-day period over four different weekends.

As expected, snowmachine traffic was higher on weekends than on weekdays; the mean detection rate was 13.7 snowmachines per day on weekends in contrast to 3.7 per weekday. On average, a snowmachine or a group of snowmachines passed every 42 minutes on weekdays and every 25 minutes on weekends. Most snowmachine traffic on these trails occurred between 9:00 a.m. and 8:00 p.m., generally coinciding with the hours of daylight at that time of year.

The Refuge has always been closed to access by all-terrain vehicles (ATVs). In recent years, however, the illegal use of ATVs on the Refuge has been identified as a growing problem. Damage to wetlands by ATVs is very evident on lands adjacent to the Refuge, especially along the Cook Inlet coast north of Nikiski and near Caribou Lake. Illegal ATV use has been documented in Chickaloon Flats. ATVs traveling through Refuge wetlands and bogs leave trails for others to follow. Subsequent ATV traffic widens and deepens the muddy tracks, destroys more vegetation, and impairs water flow and water quality.

3.3.7 Wildlife

3.3.7.1 Threatened and Endangered Species

There are no Federally listed threatened or endangered species known to breed or overwinter on the Refuge.

The Kittlitz's murrelet (*Brachyramphus brevirostris*), a candidate species for listing, likely nests on the southern unit of the Refuge. Three records of Kittlitz's murrelet nesting on lands adjacent to the Refuge south of Kachemak Bay exist (Piatt et al. 1999). There are also some concentrated feeding areas on Kachemak Bay just below the mountainous alpine habitat on the Refuge that match habitat where previous nests were discovered (Angler et al. 1998). This is very similar to the characteristics described from the two other nests found nearby (Day et al. 1983).

The Cook Inlet population of the beluga whale (*Delphinapterus leucas*) is also a candidate species for listing. The Cook Inlet beluga whale stock may once have numbered as many as 1,300 animals but declined dramatically during the last decade. Aerial surveys indicate a decline of 47 percent from 1994 through 1998. In response to this significant decline, the National Marine Fisheries Service designated the Cook Inlet stock of beluga whales as depleted under the Marine Mammal Protection Act (MMPA) on May 31, 2000 (65 FR 34590). Subsequent surveys have resulted in abundance estimates from 313 to 435 with no clear trend. Harvests from this stock have been severely restricted since 1999, but the population has not shown significant response (NMFS 2005).

In Turnagain Arm, beluga whales follow the eulachon run early in the spring, starting in April or early May and lasting into June. Beluga whale use of upper Turnagain Arm decreases in the summer and then

increases in August and throughout the fall, coincidental with the coho salmon run (NMFS 2005). The Chickaloon Bay area appears to be used throughout the year, and belugas have been observed in several rivers of the Refuge, including the Chickaloon, Kenai, and Kasilof rivers.

3.3.7.2 Species of Special Concern

"Species of Special Concern" is an administrative listing established in May 1993 and amended in October 1998 by the commissioner of the Alaska Department of Fish and Game (ADF&G). A Species of Special Concern is any species or subspecies of fish or wildlife or population of mammal or bird native to Alaska that has entered a long-term decline in abundance or is vulnerable to a significant decline because of low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance (ADF&G 2007). Several species identified by the State can be found on the Refuge, two of which are unique to either Cook Inlet or the Kenai Peninsula:

- American peregrine falcon *(Falco peregrinus anatum)*
- Steller's eider *(Polysticta stelleri)*
- Olive-sided flycatcher *(Contopus cooperi)*
- Gray-cheeked thrush *(Catharus minimus)*
- Townsend's warbler *(Dendroica townsendi)*
- Blackpoll warbler *(Dendroica striata)*
- Brown bear *(Ursus arctos horribilis),* Kenai Peninsula population
- Harbor seal *(Phoca vitulina)*
- Beluga whale *(Delphinapterus leucas),* Cook Inlet population

ADF&G should be contacted about designations of species of special concern, how these designations are made, how they relate to other designations, and what management measures may be employed.

In addition, several local populations of fish and wildlife species have been identified by Refuge staff as species of special interest, including the following:

- Red fox (*Vulpes vulpus kenaiensis*); very rare; potential candidate for local extirpation; candidate for restoration efforts
- Marten (*Martes americana*); very low densities on the western portion of the Peninsula; candidate for restoration efforts
- Northern goshawk (*Accipiter gentilis*); regionally and locally rare
- Wolverine (*Gulo gulo luscus*); declining harvest and population estimates; apparent decline

- Dwarf longnose sucker (*Catostomus catostomus*); possible endemic subspecies
- Arctic char (*Salvelinus alpinus taranetzi*); possible endemic subspecies
- Marbled murrelet (*Brachyramphus marmoratus*); unknown nesting occurrence

Draba mustard (*Draba stenopetala*), Alaska rock-jasmine (*Douglasia alaskana),* Pale poppy (*Papaver alboroseum),* Yellow moosedung moss (*Splachnum luteum),* and Menzies' burnet (*Sanguisorba menziesii*) are uncommon plants that have been collected adjacent to the Refuge.

3.3.7.3 Wildlife

Birds

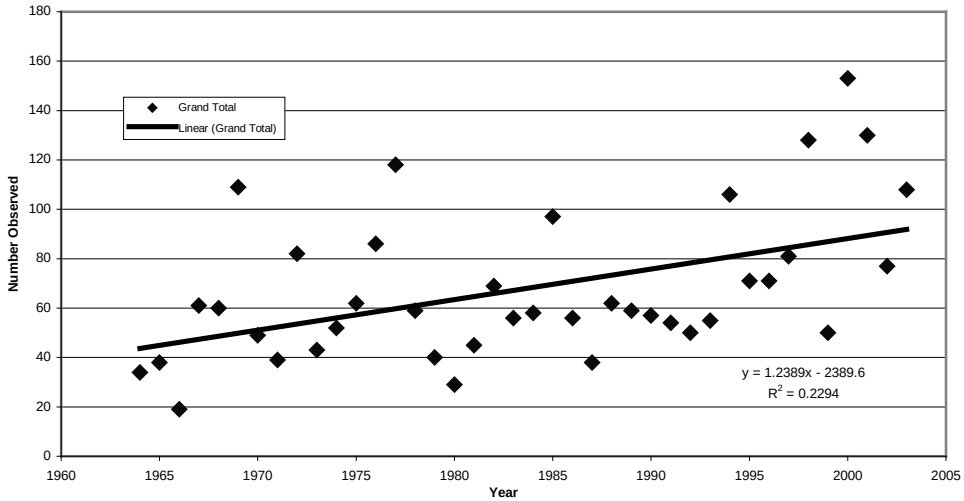
The Refuge provides a mosaic of habitat types and contributes to a very diverse avian population. Habitats where birds are found range from unvegetated rock outcroppings in the middle of the Harding Icefield at almost 6,000 feet elevation to estuarine wetlands along Chickaloon Bay at sea level. Of 192 bird species recorded on or just adjacent to the Refuge, 113 are known to breed in the area.

Waterfowl

Of 27 waterfowl species found on the Refuge, 16 are known to breed here. A focused study of bird use on Chickaloon Flats produced detailed numbers of seasonal use by waterfowl in 1970 and 1971 (Quimby 1972). A similarly focused study of bird use of the Kenai Lowlands was conducted in 1980–1981 (Rosenberg 1986).

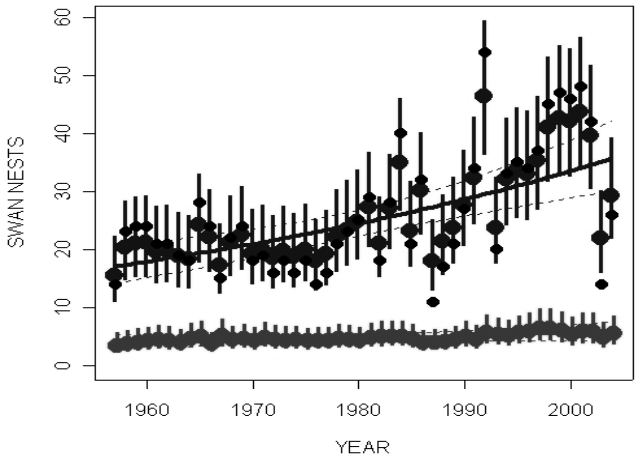
The only consistent long-term waterfowl data set for the Refuge is from three east–west transects (48 miles total in length) that are part of the Aerial Waterfowl Breeding Ground Population Survey (Conant and Groves 2003). These transects have been flown annually by U.S. Fish and Wildlife Division of Migratory Bird Management since 1964. In addition to Canada geese, the most common dabblers have been mallards, northern pintails, and American widgeon. All three species of scoters, both species of goldeneyes, and scaup (mostly greater) are frequently observed diving ducks. Data suggest that total numbers of breeding waterfowl have increased since the onset of the survey (Figure 3-9).

Figure 3-9. Aerial waterfowl counts and trend on three transects on the Kenai National Wildlife Refuge since 1964 (USFWS Division of Migratory Bird Management data)



The trumpeter swan is one of the most prominent waterfowl species on the Refuge and has received the most attention, based on historic research. Surveys conducted since 1957 indicate that the number of nesting pairs on the Refuge has significantly increased in the last 20 years to over 40 pairs (Figure 3-10).

Figure 3-10. The number of swan nests inside (blue) and outside (red) the boundaries of the Kenai National Wildlife Refuge since 1957 (Kenai National Wildlife Refuge unpublished data)



Marsh and Waterbirds

Five different species of waterbirds have been found on the Refuge. Three species of loons (common, red-throated, and Pacific) have been documented as breeding on the Refuge. They occur in low densities

throughout much of the Refuge and, in some cases, have been found to prefer slightly different habitats (Larned and Mills 2002; Rosenberg 1986). Red-necked grebes are commonly found on lakes throughout the Refuge, and horned grebes are found breeding very sporadically throughout the Refuge. Great blue heron is the only other marsh bird documented on the Refuge. Occasional sightings are reported throughout the Refuge semi-annually, but no nesting activity has been documented.

Shorebirds

The majority of shorebird populations using the Refuge are made up of migrants. Only 12 of the 24 recorded shorebird species are known to breed on the Refuge. Greater yellowlegs and sandhill cranes are the most obvious breeders, but the Refuge also supports good numbers of lesser yellowlegs; least, spotted, and solitary sandpipers; semi-palmated plovers; and Wilson's snipe. There are also small numbers of breeding wandering tattlers, Hudsonian godwits, short-billed dowitchers, and red-necked phalaropes.

Additionally, 10 species have been recorded at the Kenai River Flats, and many are likely common migrants at Chickaloon Flats. Species that probably migrate through there in small numbers but have not yet been recorded are bar-tailed godwit, red knot, sharp-tailed sandpiper, dunlin, killdeer, rock sandpiper, and marbled godwit. Aerial surveys have indicated that the Chickaloon Flats area is an important stopover area, and it appears to be the most important area on the Refuge for shorebird migration.

Marine Birds

Although the Refuge consists of mostly boreal forests and does not contain sea cliffs or any of the characteristic seabird nesting habitats, there is still some interesting use by marine birds. Nine marine bird species have been recorded on the Refuge, of which seven have been documented as breeding. Glaucous-winged gulls are the most prolific nesting marine bird on the Refuge. Small numbers can be found nesting around the Refuge near lakes and ponds that have appropriate nesting habitat. Larger, more concentrated nesting colonies are in the estuarine area of Chickaloon Flats and the rocky islets on the northeastern end of Skilak Lake.

The colony on Skilak Lake consists of an apparent hybrid of glaucous-winged and herring gulls. The Refuge has conducted counts of this colony periodically since 1981. Egg counts have increased from 1,219 in 1982 to 1,726 eggs in 2003. During that same interval, however, fledgling counts were fairly stable, ranging from 765 in 1982 to 736 in 2002.

Also present at the Skilak Lake colony is one of only two known inland nesting populations of double-crested cormorants in Alaska. Since the initial discovery of this colony, the total number of eggs laid has

increased from 23 in 1982 to 154 in 2004—with a peak count of 178 in 2000. Ten nearly-fledged chicks died in the nest in 2000. Although the carcasses were too deteriorated for confirmation, it was speculated that the cause of mortality could have been Newcastle's virus, which had been confirmed elsewhere in North America that year.

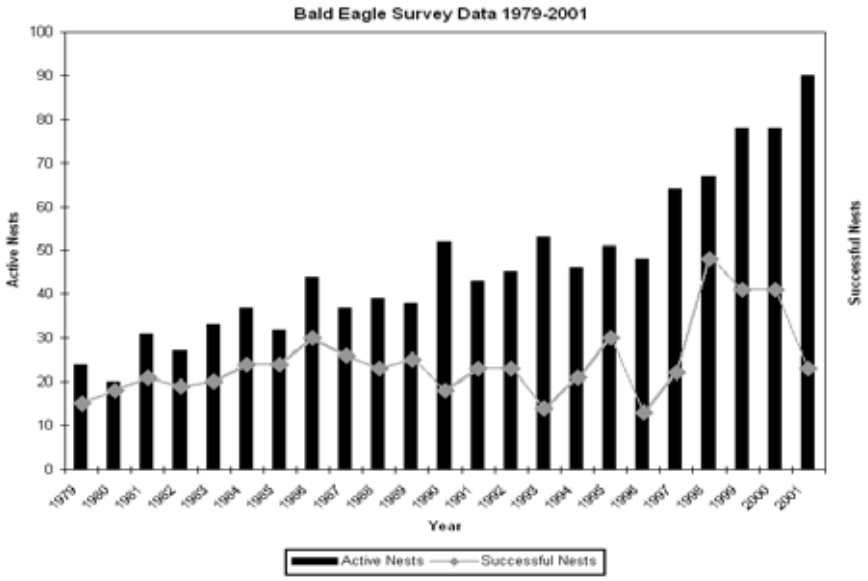
Fourteen other marine birds species have been recorded adjacent to the Refuge and most likely occur on the Refuge, but have yet to be recorded. Aleutian terns formerly nested in the pattern string bogs in the Kenai Lowlands; small breeding colonies were present in 1980 (Rosenberg 1986). No recent evidence indicates that these colonies still exist, and very few sightings occur near the mouth of the Kenai River where the previous nesting birds fed. Additionally, it is believed that marbled and Kittlitz's murrelets likely nest on the southern portion of the Refuge. There are three nesting records of Kittlitz's murrelet on lands adjacent to the Refuge south of Kachemak Bay (Piatt et al. 1999). There are also some concentrated feeding areas on Kachemak Bay just below the mountainous alpine habitat on the Refuge that matches habitat where previous nests were discovered (Angler et al. 1998). This is very similar to the characteristics described from the two other nests found nearby (Day et al. 1983).

Raptors

Eighteen species of raptors have been documented on the Refuge: two types of eagles, four types of falcons, five types of hawks, six types of owls, and the osprey. Fourteen of those species are known to breed on the Refuge.

The bald eagle is the only species that has been a focus of species-specific surveys to monitor populations. Surveys of nesting bald eagles have been conducted annually since 1957, and counts of wintering bald eagles have been conducted since 1983 (Figure 3-11). About 90 pairs of eagles are known to nest on the Refuge; however, because nest locations have been added to the survey as they have been encountered, it is difficult to determine whether the number of nesting eagles or simply the number of nest sites that are known has increased. The proportion of nests, where eaglets were successfully fledged, to all active nests (and the number of eaglets produced per nest) has declined since the late 1980s. The reasons for this change are not known.

Figure 3-11. Active and successful bald eagle nests on the Kenai Refuge since 1979



Gallinaceous Birds

Four native species of gallinaceous birds breed on the Refuge. There are also several species that are introduced or escaped that have been seen on and adjacent to the Refuge and may be breeding. This list includes ruffed grouse, ring-necked pheasant, chuckar, northern bobwhite, and California quail. With the exception of ruffed grouse, all other non-native birds are escaped or released by private individuals. Ruffed grouse, native to Alaska but not to the Kenai Peninsula, were deliberately introduced by Alaska Department of Fish and Game (Steen 1997).

Passerines and Other Avifauna

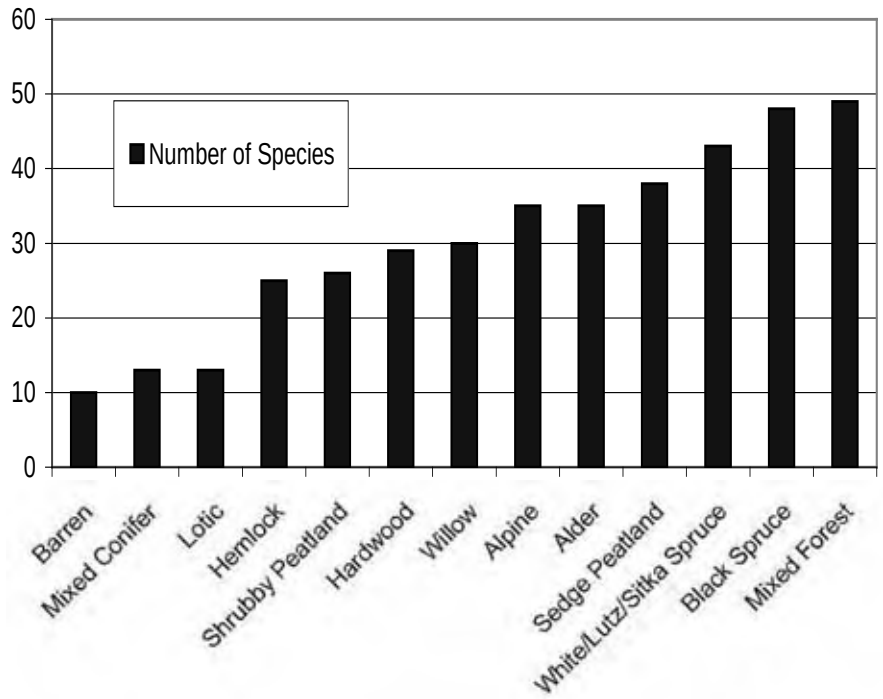
Sixty-three species of passerines have been recorded on the Refuge. This compilation includes doves, woodpeckers, nighthawks, kingfishers, corvids, and hummingbirds because they are more closely related to passerines than to any of the other categories of birds. Of those birds recorded on the Refuge, 54 have been documented as breeding or having bred on the Refuge. Passerines on the Refuge are largely migratory, with 37 of the 54 (69 percent) breeding species migrating outside of Alaska for the winter.

Avian species richness is greatest in forests on the Refuge, with about 30 species found in black spruce, white spruce, hardwood, and mixed spruce-hardwood forests (Figure 3-12). Common forest breeding birds include slate-colored junco, myrtle warbler, Swainson's thrush, boreal chickadee, orange-crowned warbler, ruby-crowned kinglet, gray jay, alder flycatcher, and American robin. Hemlock stands have lower species diversity than other forest types, probably because this habitat

type generally occurs in a relatively harsh environment at high elevations immediately below tree line.

Of the unforested habitats on the Refuge, the alpine shrub community has the highest degree of avifauna richness, with 25 species present. Golden-crowned sparrow, savannah sparrow, and Wilson's warbler are the most common species in alpine shrub. Fox sparrow, common redpoll, hermit thrush, American Robin, golden-crowned sparrow, orange-crowned warbler, and Wilson's warbler are the most common species in alder shrub. Other habitats provide relatively low species richness, but are critical for Lincoln sparrows (grass and herbaceous); American pipit (alpine tundra, rock); snow bunting (alpine tundra); gray-crowned rosy finch (rock); and white-tailed, willow, and rock ptarmigan (alpine tundra).

Figure 3-12. Avian species richness by vegetation type on the Kenai Refuge



Mammals

Large Carnivores

Black Bear—Black bears are estimated to number 3,000 on the Kenai Peninsula (Del Frate 2002). They are widely distributed in most forest habitats on the Refuge and also occur above tree line in the Kenai Mountains. A comprehensive study of black bear demographics in two major habitat types from 1982 through 1987 was conducted on the northern portion of the Refuge (Schwartz and Franzmann 1991).

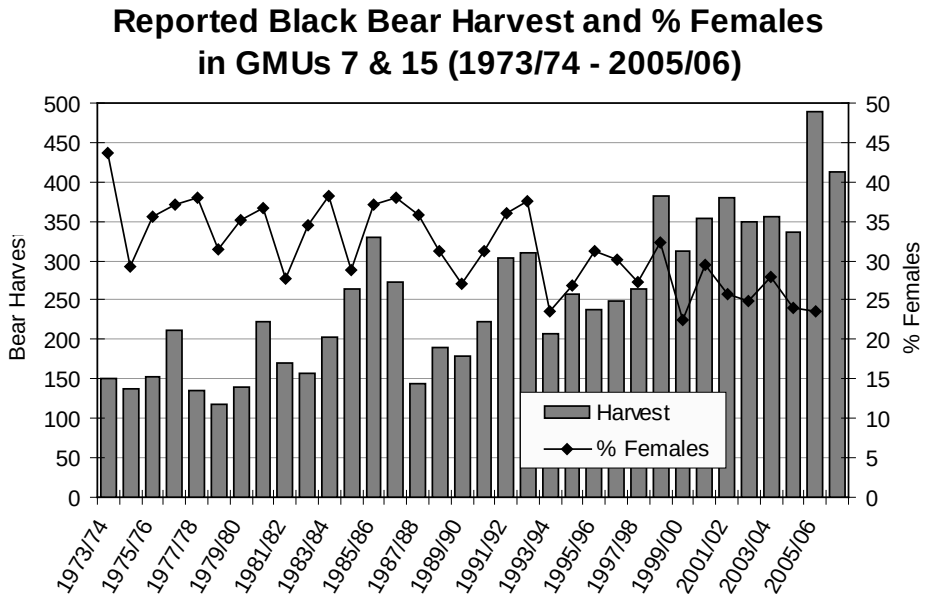
Although black bear densities were similar on the 1947 and 1969 burn habitats, averaging 152 and 204 bears per 1,000 square miles, respectively, more yearlings were present in the 1969 burn because of higher cub production and survival. Black bears in the 1969 burn consumed four times more moose calves per individual than in the 1947 burn. Hunting was found to be the primary source of mortality for all age classes except cubs. Cub-specific mortality appeared to be either from natural predation (black and brown bears) or unknown.

Mating season occurs mid-May through early July. Bears mature sexually between three and six years of age, and females produce their first litter at four to five years of age. Black bears are born in the den following a gestation period of seven months. Litter size is usually one to three, two being most common. Black bears average 200–300 pounds for adults, and males are larger than females. They are considerably lighter in spring upon emerging from their dens and much heavier in the fall.

Black bears are opportunistic and eat vegetation, berries, and animal matter. Moose calves make up an important food for Kenai Peninsula black bears in the spring. When salmon enter streams in summer, they become a prime source of food. Some black bears migrate from their traditional use areas to old-growth forest where they consume American devil's club (*Oplopanax horridus*). Additionally, the ripening berries of lowbush cranberry, blueberry, watermelon berry, currants (*Ribes* sp.), Pacific red elder, and raspberry become a major part of the diet.

Mortality of black bears is closely related to food supply; substantial change in recruitment may occur from year to year as food supplies fluctuate. Harvest data from Kenai Refuge-issued black bear baiting permits and ADF&G sealing records suggest that black bear populations have been stable or increased since the 1985 Comprehensive Conservation Plan. In particular, the proportion of females in the harvest has decreased in recent years despite a steady or increasing harvest, suggesting a healthy population (Figure 3-13).

Figure 3-13. Black bear harvest on the Kenai Peninsula since 1973 (ADF&G preliminary data)



Brown Bear—Brown bears occur in southeastern Alaska, on Kodiak Island, on the Kenai Peninsula, along the Alaska Peninsula, and in coastal areas. Brown bears are a species of continued interest and study on the Refuge because of the insular nature of their relatively small population (unknown but estimated at 100–300) and threats from human-caused mortality (IBBST 2001). The Peninsula is 9,000 square miles (23,310 square kilometers), but only about 3,397 square miles (8,800 square kilometers) are regularly used by brown bears (Jacobs 1989). The Peninsula is connected to the mainland by a 10-mile-wide (16 kilometer) strip of land, and movements of brown bears through this strip may be sufficiently restricted by human development and physiographic features to isolate the Kenai Peninsula bear population (IBBST 2001).

The following was excerpted from "A Conservation Assessment of the Kenai Peninsula Brown Bear" (IBBST 2001). Habitat use by brown bears usually varies seasonally in response to food availability (Jacobs 1989; Schoen 1990). Terrestrial meat (moose, caribou, rodents, etc.) and vegetation accounted for 76 percent and 24 percent, respectively, of the spring-to-summer diet for female brown bears from 1996 through 1998 (Hilderbrand et al. 1999). In the fall, salmon was the dominant food resource (60 percent), with terrestrial meat (21 percent) and vegetation (20 percent) accounting for the remainder. From 1996 through 1998, adult female brown bears consumed an estimated 541 kilograms of moose in the spring and summer and 1,003 kilograms of salmon in the summer and fall (Hilderbrand et al. 1999). Moose are an important food resource in the spring when bears may be short of energy and/or

protein from spring growth and lactation, or when they are replenishing lean mass lost while hibernating.

Jacobs (1989) determined annual home range size for male brown bears (949.6 square kilometers or 367 square miles) were more than twice as large on average as females (401.2 square kilometers or 155 square miles) on the Kenai Peninsula from 1984 through 1987. Home ranges tended to overlap human developments, which made bears more susceptible to human-bear conflicts. Indeed, most defense-of-life-or-property (DLP) incidents in the past four decades have occurred in urbanized areas or near roads (Figure 3-14). Suring et al. (1998) developed a cumulative-effects model evaluating the effects of human actions on Kenai Peninsula brown bear habitat quality. The model was applied to the Kenai portion of the Chugach National Forest, and it was found that human activities had reduced habitat effectiveness (defined as the interaction of habitat quality and human activities) by 70 percent in some areas.

Reducing bear-human interactions and DLP mortality are vital components of brown bear management on the Kenai Peninsula, particularly as DLPs have increased in the past decade (Figure 3-15). The age of a bear is strongly related to its chance of being killed in a DLP incident. From 1962 through 1998, 39 percent of mortalities were bears from birth to three years old, 16 percent were bears 5–10 years old, and 17 percent were older than 11 years); age was not known for 28 percent of all DLP mortalities (IBBST 2001). Females with offspring may be at greater risk of being killed in a DLP action than are lone bears because the public perception of a dangerous bear is greatest for a mother with cubs. Any loss of female bears has a negative effect on the sustainability of the Kenai brown bear population (IBBST 2001).

Currently, the brown bear population and its health on the Kenai Peninsula are not completely understood. The existing estimate of 250–300 brown bears was based on multiplying the area of suitable habitat (5,347 square miles or 13,848 square kilometers) by the assumed bear density from studies conducted elsewhere (Del Frate 1993). No quantifiable population estimate has been completed for the Kenai population of brown bears. Based on data that has been collected, "the estimated finite rate of population increase indicates neither an increase nor a decrease, whereas demographic information (survivorship data and the female age distribution) indicates the possibility that reproductive females have a low recruitment into the Kenai brown bear population" (IBBST 2001). This is an area that warrants continued research and monitoring.

The State of Alaska has formally declared the Kenai Peninsula population to be one of special concern, and a conservation strategy is currently being formulated through an Interagency Brown Bear Study Team (IBBST) comprised of biologists and researchers from the U.S.

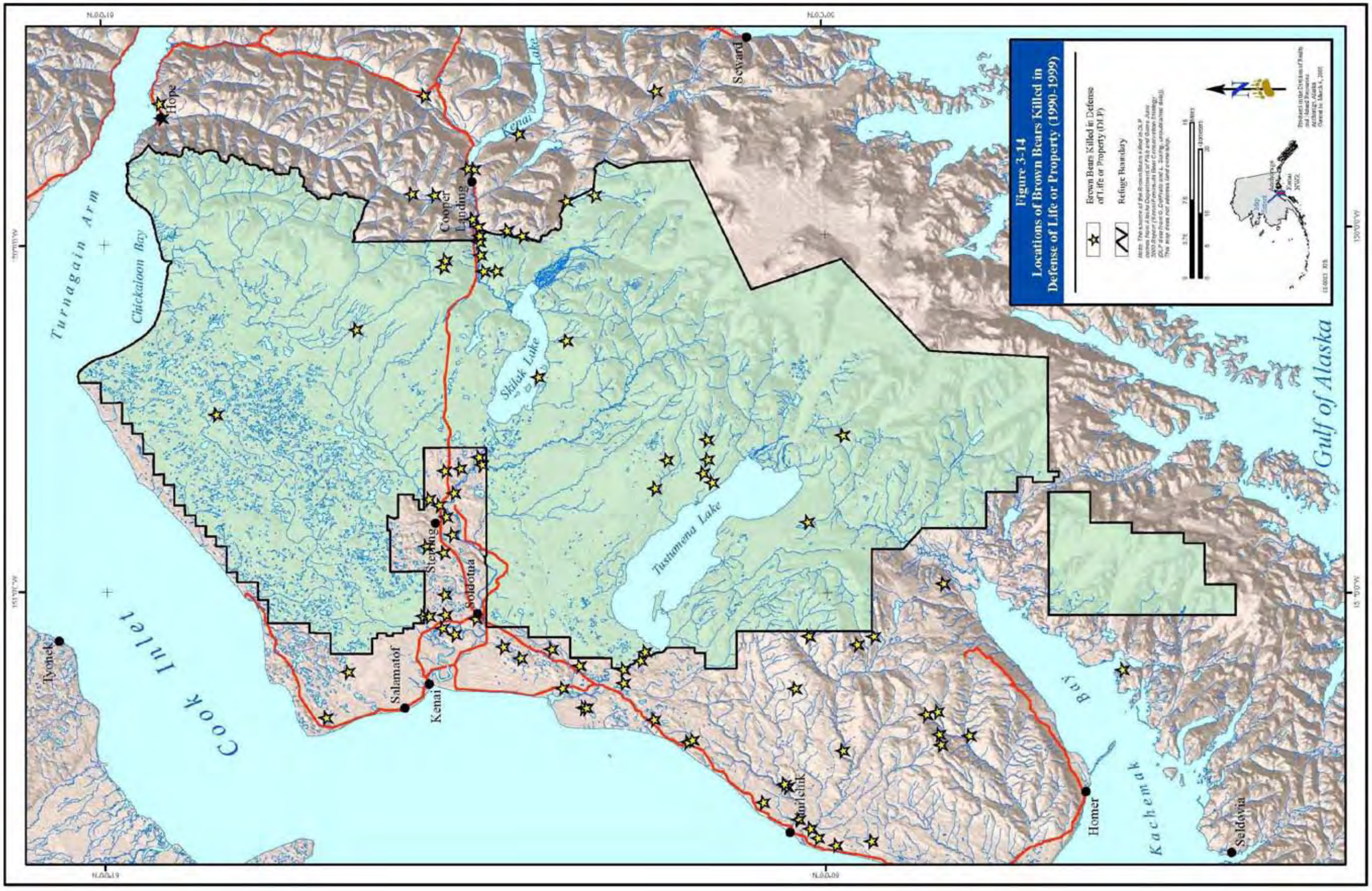
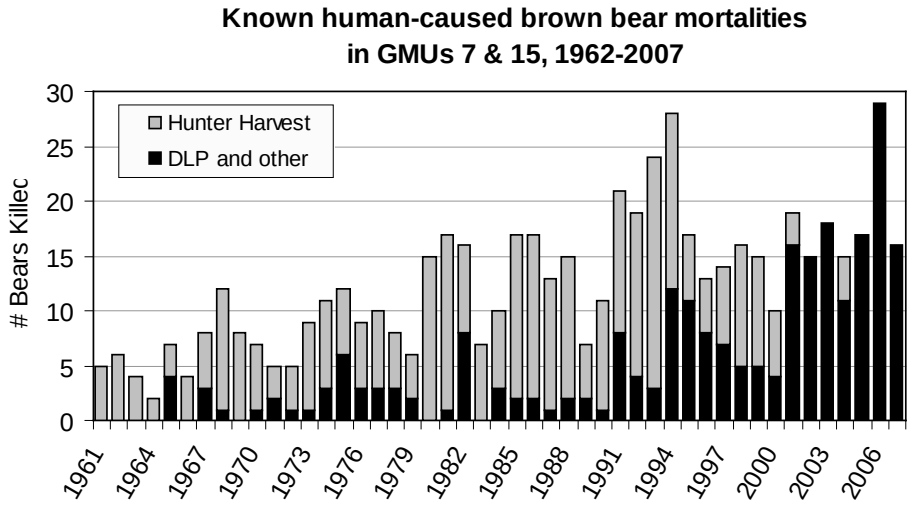


Figure 3-14. Locations of Brown Bears Killed in Defense of Life or Property (1990-1999)

Fish and Wildlife Service, the U.S. Department of Agriculture Forest Service, the National Park Service, and Alaska Department of Fish and Game. The Refuge provides the largest continuous, homogenous block of brown bear habitat on the Kenai Peninsula and is the only Federal land unit on the Peninsula specifically mandated by Congress to conserve bear populations and habitat in their natural diversity. In the future, as development and urbanization outside the Refuge boundaries continue to eliminate and decrease the quality of brown bear habitat elsewhere on the Peninsula, Refuge management decisions will become even more critical to conservation of Kenai Peninsula brown bears.

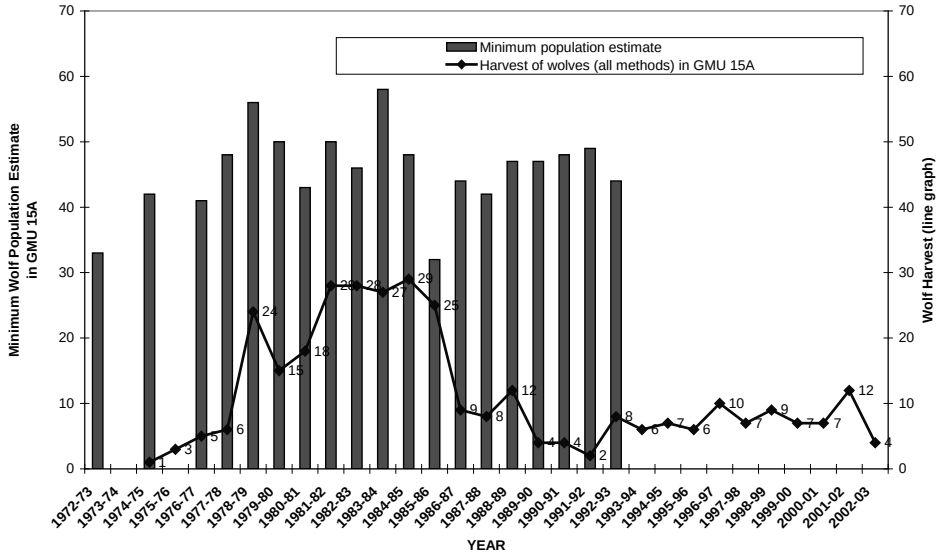
Figure 3-15. Mortality of brown bears due to hunting and defense-of-life-or-property on the Kenai Peninsula since 1973 (ADF&G data)



Gray Wolf—Wolves were exterminated by man on the Kenai Peninsula in about 1915, primarily by the use of poisons during the gold prospecting and mining period. Wolves remained absent from the Kenai Peninsula for about 50 years (except for a few rare sightings) until they naturally recolonized in the late 1960s. By the mid-1970s, most wolf habitat was again occupied by wolves.

Several studies (Jozwiak 1997; Peterson et al. 1984) have focused on wolf-moose relationships, the effects of harvest, pack size, and dispersal movements of wolves in the northern portion of the Kenai Refuge. In the 1970s, the population reached about 90 animals. From the 1980s to early 1990s, average wolf pack territory size in the northern half of the Refuge ranged from 69.5 to 328 square miles (180 to 850 square kilometers), and wolf density averaged about 13 wolves per 386 square miles (1,000 square kilometers). The Refuge likely supports an estimated 80–90 wolves in at least five to seven packs in GMU 15A (Figure 3-16).

Figure 3-16. Minimum wolf population estimate and reported harvest on the Kenai National Wildlife Refuge since 1972



The biting dog louse (*Trichodectes canis*) is an ectoparasite that can be transmitted through social contact between dogs, coyote, and wolves. Wolves in the early 1980s contracted this louse, probably from contact with free-ranging or feral dogs (Schwartz et al. 1983). The parasite causes itching, some loss of some guard hairs, and a reduction in the ability of the animals to stay warm in winter. The parasite spread quickly through the Kenai wolf population, and earlier attempts by Alaska Department of Fish and Game (ADF&G) and the U.S. Fish and Wildlife Service (Service) to eradicate the lice by treating wolf packs with medication was unsuccessful (Schwartz et al. 1983).

In 1988, a wolf management operational plan was signed between ADF&G and the Service. This operational plan proposed to jointly implement a wolf management strategy by both agencies on the northern portion of the Kenai Refuge in GMU 15A. The 1985 Kenai Refuge Comprehensive Conservation Plan (USFWS 1985) set an overall objective of maintaining 90 wolves (fall population estimate) on the Refuge, with a post-harvest population objective in GMU 15A of 25–35 wolves.

As ungulate densities fluctuate with successional changes in habitat on the Kenai Peninsula, wolves should be managed with this dynamic prey component in mind.

The most critical habitat requirements for wolves are the abundance of large ungulates, especially moose or caribou, and a minimum of human disturbance. Refuge-specific studies have found that wolves avoid the use of primary roads and highways and instead select secondary or gated roads (Thurber et al. 1994). Wolves also use habitat near oilfield roads 43 percent less than adjacent habitat with no road.

Because summer food availability appears to be important for early pup survival on the Kenai Refuge, the abundance of snowshoe hares, and perhaps beaver, could also be important to wolves. Human-caused mortality is the most significant factor influencing wolf numbers from year to year (Peterson et al. 1984). Wolf packs near road systems can be nearly or completely removed by human harvest under certain hunting and trapping conditions and intensities. Little information is known on wolf numbers in GMUs 15B, 15C, and 7.

Coyote—During the same period (1915–1965) wolves were absent from the Peninsula, coyotes in North America were extending their range northward. First recorded in Alaska during the Gold Rush in 1899 (Sherman 1981), coyotes spread to southcentral Alaska by the 1920s, following a decline in wolf abundance and a major increase in human activity. Coyotes were first documented on the Kenai Peninsula in 1926 (Thurber and Peterson 1991), and they were sufficiently abundant in the 1940s to become the focus of predator control by Federal agents.

Because of intense competition between coyotes and foxes, coyotes likely took over much of the habitat that was occupied by red foxes, particularly in the absence of wolves.

Once wolves recolonized the Kenai Peninsula, coyotes adapted and now maintain a sympatric association with wolves. Home ranges of coyotes overlap with wolf pack territories, although coyotes tend to use public roads, whereas wolves usually avoid roads (Thurber et al. 1992).

Smaller mammals such as snowshoe hares, porcupines, and red-backed voles make up the majority of a coyote's diet on the Kenai Peninsula. There is little evident overlap in food habits between coyotes and wolves because the latter rely primarily on moose. Because coyotes appear to be the most adaptable of the three canid species, they continue to survive well on the Kenai Peninsula, especially in areas of high human development that are avoided by wolves.

Red Fox—Red foxes are rare on the Refuge. The last known harvests of red foxes on the Kenai Peninsula occurred in 1969–1970 and 1978–1979 when 12 foxes were taken. No harvests have been reported on the Kenai Peninsula in the last 25 years. However, there have been unconfirmed sightings since 2002 of them near Kasilof, in the Caribou Hills, and as far east as Cooper Landing.

Red foxes were once apparently common on the Kenai Peninsula; the Dena'ina Indians regularly trapped them and occasionally ate them, noting they were especially good in the winter (Osgood 1937). Osgood (1901) reported that the Kenai foxes (*Vulpes vulpus kenaiensis*) were the largest fox known to North America. Red, cross, and black foxes were taken annually in limited numbers. By the early 1920s, foxes were apparently getting scarce. Culver (1923) noted that before the propagation of foxes was undertaken, "there was a good supply of wild

stock on the Kenai Peninsula" and "trappers were able to secure a fairly good catch each winter." Fox dens were raided by fur farmers who captured the adults and pups during the late spring and early summer for breeding stock. Culver (1923) attributed the catching of live foxes to the decline of red fox on the Peninsula.

Concurrently, coyotes were becoming numerous as wolves were also being eliminated from the Kenai Peninsula. Whether coyote-fox interactions have kept the red fox population depressed remains unknown. It is likely that the very small population of red foxes that persists today occurs in areas that coyotes do not continuously occupy. In the mid-1980s, the last reported red fox habitat was limited to alpine areas, especially those in the Caribou Hills where traditional red fox dens were known to exist (less than three or four known pairs), and between Skilak and Tustumena lakes. As long as the coyote population persists on the Refuge, it is unlikely that the red fox population will significantly increase.

Wolverine—Wolverine (*Gulo gulo luscus*) are uncommon on the Kenai Refuge. They are primarily restricted to the rugged subalpine and alpine habitats in the mountainous eastern region of the Refuge and appear to be rare on the western lowlands of the Refuge. Harvest records suggest that relatively high populations exist on the Tustumena benchlands and in the Fox River valley (ADF&G sealing records) (Figure 3-17).

Wolverine are solitary animals, coming together only for a brief mating season. Males have territories of as much as to 240 square miles (621.5 square kilometers) and travel as much as 40 miles per day in search of food; females maintain smaller territories of 50–100 square miles (129.5 to 259 square kilometers). Although wolverines are capable of taking large ungulates as live prey (Magoun 1985), most ungulate presence in the wolverine diet is from scavenging—with some evidence of a seasonal reliance on local rodent abundance (Banci 1987; Magoun 1985; Gardner 1985) and marmots.

Wolverine populations on parts of the Kenai Peninsula were estimated in 1995 and 2004. The most complete survey, conducted in 2004, estimated a population density of 3.0 wolverines per 1,000 square kilometers in the upper Turnagain Arm and Kenai Mountains (Golden et al. 2007b). A 1995 survey, using similar methodology but restricted to the northeast corner of the Refuge, estimated a density of 5.2 wolverines per 1,000 square kilometers (Golden 1996).

Wolverine harvest on the Kenai Peninsula has ranged from a high of 48 in 1971 to a low of 6 in 2003. Harvest has remained somewhat low, averaging 19 (range 6–34) per year from 1984 through 2004. Most harvest occurs in GMUs 7 and 15C. This decline in harvest mirrors a widespread decline in the reported wolverine harvest in southcentral Alaska since 1971 (Golden et al. 1993; Whitman 1987). It is unknown, however, if these changes in harvest reflect actual changes in wolverine populations or changes in trapper interest or effort.

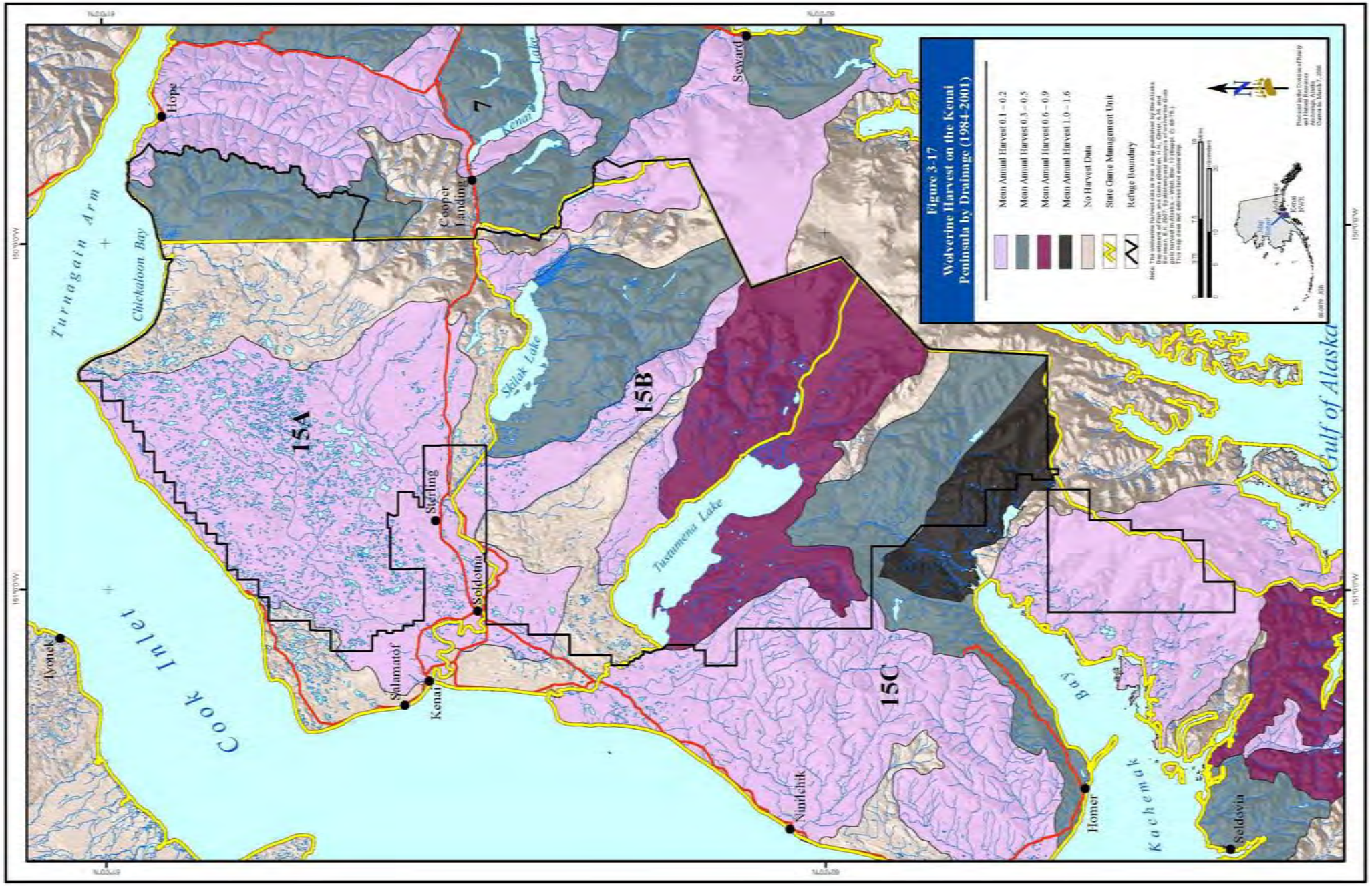


Figure 3-17. Wolverine Harvest on the Kenai Peninsula by Drainage (1984-2001)

The wolverine on the Kenai Peninsula was previously considered a unique subspecies (*Gulo luscus katschemakensis*). A recent study of mitochondrial DNA suggests that despite a single unique haplotype in the Kenai population, the "occurrence of common and widespread haplotypes on the Kenai Peninsula is not consistent with subspecies status for this population" (Tomasik and Cook 2005). However, Tomasik and Cook (2005) also point out that the Kenai Peninsula population may harbor a disproportionate amount of the North American mitochondrial diversity and, as such, warrants special conservation.

The wolverine's affinity for remote wilderness, rugged terrain, low densities, and large home-range sizes, coupled with its sensitivity to human disturbance, all contribute to the challenge of managing and conserving this solitary and secretive species (Ruggiero et al. 1994 cited in Tomasik and Cook 2005). Because wolverines have few natural predators, harvest by humans is believed to be the greatest factor influencing adult wolverine numbers (Hornocker and Hash 1981). Krebs et al. (2004) indicated that human-caused mortality was additive to natural mortality and that trapped populations of wolverine would decline in the absence of immigration from untrapped populations. However, as long as there was a source meta-population within a protected nearby refugium, harvested wolverine populations would likely persist. As with other low-density species, maintaining high annual survival of adult females is central to sustaining populations and harvest (Eberhardt 1990, Golden et al. 2007a).

Marten—Marten are uncommon on the Refuge, occur primarily in mountainous habitat on the Refuge's eastern side and, until recently, did not occupy forested low-elevation habitat on the Peninsula's western side.

Dense old-growth forests appear to provide the best marten habitat. In winter, marten activity appears to be highest in forest stands with greater than 30 percent canopy cover. Open areas are generally avoided and, when crossed, are traveled by a more direct route than are forested areas. Young marten are frequently born in hollow trees or logs or in cavities within piles of rocks. Late successional forests usually provide more denning holes in trees than do earlier successional stage forests. The major prey of marten is red-backed voles; however, there is also a seasonal reliance on mountain ash berries in autumn and winter (Bailey et al. 1991).

Marten are easily trapped and vulnerable to overexploitation (Magoun 1987; Strickland et al. 1982), and overharvest may be responsible for their disappearance and reduced density on the Kenai Refuge (Schumacher et al. 1989). Attempts to protect marten on the Kenai Peninsula became apparent as early as 1916 when marten seasons were closed throughout Alaska for five years (Culver 1923). Despite at least 21 years of marten closures from 1916 through 1960 (USFWS 1987), marten did not increase appreciably on the Peninsula. Trapper harvest

on the Kenai Refuge has been low. From 1988 through 2003, 1,103 marten were harvested in GMU 7; in contrast, only six were harvested on GMU 15 (ADF&G sealing records). However, 26 marten from GMU 15 have been sealed by ADF&G in just the past three years, suggesting that the distribution of marten may be expanding.

The only known breeding population of marten on the Refuge occurs on the eastern edge of the Refuge, starting from the eastern half of Skilak Lake, extending to the Kenai Mountains, and continuing to the Chugach National Forest boundary. Scattered marten sightings, however, are widespread across the Refuge—particularly since 2002. In 1989, marten tracks were confirmed on the Resurrection Pass Trail north of the Sterling Highway, not far from the known Kenai Lake population (S. Rickabaugh, personal communication). In 2002, Refuge staff caught a male marten west of Bufflehead Lake in the Swanson Oil Field. Marten have since been harvested on Fox Creek, the southern shoreline of Skilak Lake (Cottonwood Creek) and along the coast near the Gray Cliff subdivision in 2004 (ADF&G sealing records).

The current distribution of marten on the Kenai is roughly coincident with the occurrence of mountain hemlock. Site prerequisites for mountain hemlock may suggest other environmental factors that may be important to marten. Mountain hemlock grows in a subalpine boreal climate, and marten may be keying in to specific precipitation and temperature conditions that favor deep snow. A marten study in the eastern portion of the Kenai Refuge from 1986 through 1988 determined that marten occurred in areas with consistent deep snow and appeared to orient cold-season movements to higher elevations with deep snow. Suitable marten habitat on the Kenai Peninsula may be limited by winter thermal cover provided by snow (Schumacher et al. 1989).

Lynx—The lynx is the most northerly distributed wild felid. Lynx are similar to bobcat that occur in the contiguous United States, but they have longer legs and long tufts of fur on their ears. Broad, heavily furred paws help the 20– to 40-pound cats increase the snowshoe effect, which enables it to travel across deep snow. Mating occurs in March and April, and the kittens are born two months later under a natural shelter such as a windfall or root buttress. Kittens stay with their mother through their first winter. When food is scarce, lynx females will delay reproduction until prey becomes abundant.

Lynx inhabit spruce forests where hares are available. In the late 1980s to early 1990s, lynx showed a preference for 1947 burn areas and mature forest remnants in the 1947 burn; they avoided 1969 burn types and large mature forest areas (Staples 1995).

Lynx can be fairly abundant on the Refuge, but are subject to periodic cycles (of 8–13 years) of abundance and decline because of the cyclic abundance of snowshoe hares, their main prey. Recruitment into lynx populations is extremely low for three or four years after snowshoe

hare populations crash (Brand and Keith 1979) because of reduced productivity and high kitten mortality. During the 1973–1975 peak in snowshoe hare abundance on the Kenai Peninsula, nearly 250 lynx were taken from the Kenai Refuge. When snowshoe hare populations peaked again in 1983–1984, lynx numbers continued to remain low, despite abundant habitat and prey. Bailey et al. (1986b) determined that trapping mortality was additive to natural mortality and that the lynx population had been over-harvested on the Kenai Peninsula during the 1970s. Low lynx numbers and harvest in the mid-1980s, despite abundant habitat and prey, indicated a depressed lynx population.

Because of these concerns, lynx harvest was closed by ADF&G emergency order prior to the 1984–1985 trapping season to allow the lynx population to recover while snowshoe hare were still abundant. Kesterson (1988) found lynx numbers increased fourfold, after the trapping closure began. He also determined that the size of the home range of male and female lynx decreased as lynx densities increased. Analysis of a sample of 40 scats showed that lynx primarily consumed hares during the 1984–1987 winters, a period when snowshoe hares were relatively abundant.

Lynx densities increased in the mid- to late 1990s, and the trapping season opened in 1997. However, the snowshoe hare population did not peak as anticipated 10–11 years after the last peak in the cycle (1984–1985), and the hare cycle on the Kenai Peninsula appeared to be out of phase with cyclic snowshoe hare peaks reported elsewhere in North America (Hodges 1999).

Snowshoe hares remained the principal prey species of lynx throughout the low hare abundance years of the hare cycle, making up 64 percent and 38 percent, respectively, of the food items during the snow and snow-free period (Staples 1995). The availability of red squirrels in mature forest habitats and the diversity of forest stands on the Kenai Peninsula, which include a high proportion of mature forest stands and unburned remnant mature forest stands within the 1947 and 1969 burns, apparently provided enough alternate prey (such as voles, spruce grouse, and moose carcasses) to help lynx survive periods of lowered hare abundance (Staples 1995).

Results of the long-term monitoring study of lynx and snowshoe hares on the Kenai Refuge over the 18-year period (1983–2000) indicate that lynx are highly vulnerable to trapping (Bailey 2000). A minimum of 95 lynx that were monitored either died or were killed during one complete hare cycle and two periods of open and one of closed lynx seasons. Humans were responsible for most lynx deaths (80 percent), there were few natural mortalities (14 percent), and other predators were identified in only two lynx deaths. To maintain adequate numbers of lynx on Kenai Refuge, both snowshoe hare cycles and lynx harvest need to be monitored to ensure that lynx populations reach high enough

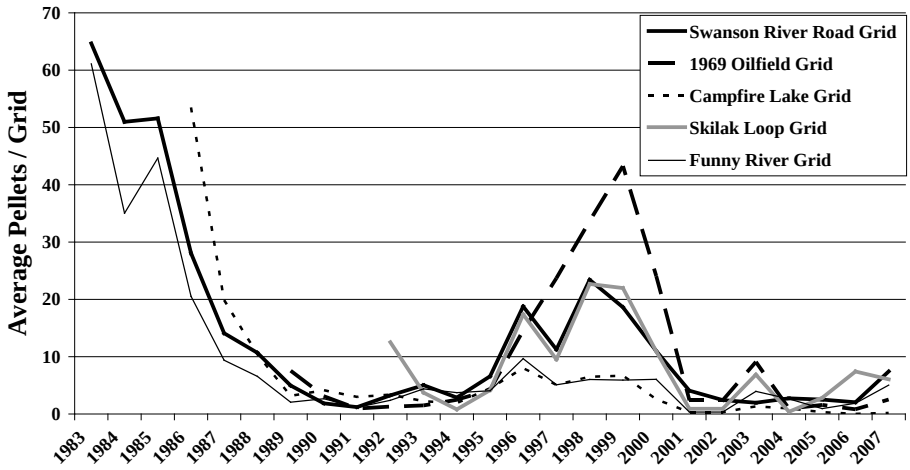
levels that adequate numbers are available after the hares decline to respond to the next hare population increase.

Snowshoe Hare — Snowshoe hares are the only leporid in the Alaska boreal forest (MacCracken et al. 1988). Snowshoe hare populations build and crash at 8- to 13-year intervals. These cyclic-like fluctuations in hare populations can be dramatic, with densities ranging from highs of 800–1200 hares per square mile to 50 per square miles (Keith 1974). During population highs, hares are a major food source for lynx but are also eaten by canids (the dog family), mustelids (the weasel family), and raptors (birds of prey) (Keith and Cary 1991). When hare populations are high, most older female lynx successfully rear kittens. Conversely, when hare numbers are low, few lynx reproduce. In the absence of hares, lynx switch to squirrels, grouse, and voles for food and, as observed on the Refuge, even feed off winter-killed moose carcasses to supplement their diet.

Because of the importance of snowshoe hare populations as a primary driver of predator-prey relationships in the northern boreal forest, the Refuge established five grids for sampling the number of hare pellets as a population index in mid-successional (1947 burn) and early successional (1969 burn) forest habitats. These grids are located near the Swanson River, Funny River, Campfire Lake, Skilak Lake, and Swanson Oil Field. Pellet counts have been sampled annually since they were established (1983–1992).

Fifteen years lapsed between peaks (1984 to 1998) in average adult snowshoe hare densities among study grids in the 1947 burn (Figure 3-18). Estimated average adult hare density in the 1947 burn during the 1998 peak—1.0 adult per 2.5 acres (1 hectare)—was only 60 percent of that estimated during the previous 1984 peak of 2.5 adults per 2.5 acres (1 hectare). In the 1969 burn, the lowest adult density was also in 1990 (0 adults per acre), but it increased rapidly to 3.6 adults per 2.5 acres (1 hectare) in 1999 or 3.6 times greater then the average adult density estimated in 1998 for the peak in the 1947 burn.

Figure 3-18. Snowshoe hare pellet counts on five monitoring grids since 1983



Ungulates

Moose—Moose are the primary ungulate species on the Refuge and commonly occur on the Kenai Lowlands as well as in the Kenai Mountains. During deep-snow winters, moose tend to move into mountain valleys and onto the Kenai Lowlands.

Since 1985, the moose population has increased on the Refuge from 5,000 to almost 6,000 animals. This increase, however, is not uniform in distribution. Moose populations have decreased in Game Management Unit (GMU) 15A, remained stable in GMU 15B, and increased in GMU 15C. These differences can be attributed to the habitat conditions in each unit. GMU 15B has seen very little change in habitat conditions; there have been no major or minor wildland fires. GMU 15C had large wildland fires (Windy Point and Crooked Creek) and widespread logging of beetle-killed spruce on the lower Kenai Peninsula. In contrast, forests within GMU 15A have continued to age since the 1969 burn and have experienced few fires (either wildland fires or prescribed burns) to produce moose browse.

Caribou—After being extirpated around 1912, caribou were reintroduced in the mid-1960s and again in the mid-1980s from the Nelchina herd. Since 1985, caribou have increased from less than 400 animals in two herds to 1,158 animals in four herds. The Kenai Mountain herd has stabilized at approximately 400 caribou for the past two decades. The Kenai Lowland herd has remained around 135–150 caribou since 1998, although domestic dog predation at the urban interface may be problematic. The Killey River herd (which was combined with the former Twin Lakes herd) numbered more than 700 in 2001 until an avalanche killed at least 143 animals—mostly cows. The Fox River herd peaked at about 100 animals in 1998; however, the last count made in October 2003 showed only 41 animals, perhaps because

of overgrazing and trampling of habitat. Two sightings in July 2004 of groups of caribou near Exit Glacier (Kenai Fjords National Park) suggest that caribou are continuing to expand into new areas of the Kenai Peninsula.

Dall Sheep—Aerial sheep surveys began on the Refuge in 1949. Records after statehood (ADF&G and Service files) show the Kenai Mountains sheep population steadily increased from 1949 to 1968 before sharply declining until 1977 and 1978, when the lowest counts were recorded. From records in the Refuge files, it appears that different count areas are surveyed in different years, making it difficult to determine population.

Only two complete censuses of sheep were done on the Kenai Peninsula. In 1968, estimates were 2,200–2,500 animals; while in 1992, population size reached only 1,508–1,774. There are 12 count areas on the Kenai Peninsula. Three count areas from Skilak Glacier to Fox River were designated in 1987 to assess trends of the sheep population. The count area from Killey Glacier to Tustumena Glacier continues to have the highest numbers of sheep.

Mountain Goats—Kenai Peninsula is divided into 35 count areas for mountain goats. The management objective of the Alaska Department of Fish and Game (ADF&G) for mountain goats is to monitor population trends, maintain a low proportion of nannies in the harvest, and restrict or liberalize hunting permits according to conservation assessments of minimum population size and population trends. No population estimates after 1999 were found, but data from ADF&G's annual survey and inventory reports suggest that the population may be declining. Severe winter weather, competition with Dall sheep, and overharvesting may be causing a decline.

Small Mammals

Vagrant shrew, masked shrew, dusky shrew, pygmy shrew, singing vole, tundra vole, northern red-backed vole, and northern bog lemming have been found on the Refuge. Bangs (1979) reported meadow voles (*Microtus pennsylvanicus*) on the Refuge, but he has since stated that they were misidentified tundra voles (E. Bangs 2005b, personal communication).

No records exist for many mammals that may inhabit the Kenai Refuge, including collared pika (*Ochotona collaris*), brown lemming (*Lemmus trimucronatus*), yellow-cheeked vole (*Microtus xanthognathus*), water shrew (*Sorex palustrus*), tundra shrew (*S. tundrensis*), tiny shrew (*S. yukonikus*), least weasel (*Mustela nivalis*), northern flying squirrel (*Glaucomys sabrinus*), meadow jumping mouse (*Zapus princeps*), and meadow vole (*Microtus pennsylvanicus.*)

Timberline areas produce the greatest species diversity, including the vagrant and masked shrew; singing, tundra, and red-backed vole; and northern bog lemming (Fuller 1981). Vagrant shrews and bog lemmings are usually absent from alpine tundra areas; however, both red-backed voles and masked shrews are common in all vegetated areas of the Refuge (Fuller 1981). Microtines such as red-backed voles and tundra voles are alternate prey of lynx (Kesterson 1988) and coyote (Todd et al. 1981, Thurber et al. 1992) in northern areas of the Kenai Refuge.

There have been two confirmed reports of degus (O*ctodon degu*) caught in suburban areas around Soldotna. The degu is a South American rodent that is often sold as a pet in the United States. It is unknown whether degus in these two cases were escaped from captivity or transported incidentally in cargo, nor is it known whether these were breeding individuals. However, the potential certainly exists for these to get established, as they are endemic to central Chile.

Other Mammal Species

Harbor Seals—The harbor seal (*Phoca vitulina*) has been identified as a "keystone" species in the Cook Inlet and Gulf of Alaska marine environment, and a top-level predator in the food chain. The western Gulf of Alaska–Cook Inlet population of harbor seals has declined significantly since 1976 (Pitcher 1990). At Tugidak Island near Kodiak, numbers have declined 90 percent from approximately 11,000 seals to 1,000.

Most harbor seals are associated closely with coastal waters, although occasional observations up to 50 miles (81 kilometers) offshore have been made. Harbor seals haul out of the water periodically to rest, give birth, and nurse their pups. Reefs, sand and gravel beaches, sand and mud bars, and glacial and sea ice are commonly used for hauling sites. Harbor seals are sometimes found at the mouth and lower portions of the Kenai River, usually on a seasonal basis (present in summer, absent in winter). Births of harbor seal pups are not restricted to a few major rookeries (as is the case for many species of pinnipeds) but occur at many hauling sites.

Two seasonal peaks in the numbers of harbor seals hauled out occur in Alaska—one during May–June associated with pupping, and the other during July–September associated with molting. Harbor seals do not appear to make long annual migrations like some species of marine mammals. However, considerable local movements occur. Tagging studies have shown that juveniles move up to 150 miles (242 kilometers) from their birthplace. A radio-tagged adult was discovered 120 miles (193 kilometers) from its tagging site.

The status of the population of harbor seals along the Kenai Peninsula is unknown because they are a difficult species to census. Accurate counts can only be made when they are hauled out. The total Alaska

harbor seal population probably ranges from 200,000 to 300,000 animals. Since implementation of the Marine Mammal Protection Act in 1972, hunting has been restricted to Alaska Natives. In some areas, harbor seals are an important part of the subsistence economy. The annual harbor seal harvest is about 2,500 to 4,000 animals.

Beluga Whales—The number of beluga whales (*Delphinapterus leucas*) in Cook Inlet is small—about 350 individuals in 1998—and the population is declining (Hobbs et al. 2000). The Cook Inlet stock of belugas is currently listed as "depleted" under the Marine Mammal Protection Act (Federal Register. 65:34590– 4597, 31 May 2000), but it is currently not listed as endangered under the Endangered Species Act (Federal. Register. 65:38778–38790, 22 June 2000).

The Cook Inlet population of beluga whales is thought to inhabit the Cook Inlet year round (Hazard 1988). Sightings from 1976 through 1979 indicated that beluga whales inhabit Cook Inlet during all seasons (Calkins 1983). Recent survey efforts have also confirmed the year-round presence of the species in the inlet (Rugh et al. 1998, Hansen and Hubbard 1998).

The National Marine Fisheries Service (NMFS) has conducted consistent aerial surveys for beluga whales in Cook Inlet since 1993. Through these surveys, beluga whales were found with some consistency in several areas (Rugh et al. 1998). A small group of beluga whales are regularly observed in Chickaloon Bay between the Chickaloon River and Point Possession. Small groups were also found near Turnagain Arm, Kachemak Bay, Redoubt Bay, and Trading Bay (Rugh et al. 1998). Eighty-two percent of the whales seen in the Susitna Delta and 61 percent of the whales seen elsewhere in the upper inlet were in large groups. Conversely, none of the groups seen in lower Cook Inlet were large (Rugh et al. 1998).

Although subsistence hunting has been a point of concern and an obvious source of mortality for this population, belugas are likely affected by other factors that are currently under assessment, such as changes in habitat quality (Moore et al. 2000) and declining prey availability or abundance (Anderson and Piatt, 1999; Moore et al. 2000). Increased vessel traffic may also disturb belugas (Erbe and Farmer 2000; Moore et al. 2000). Changes in environmental conditions may exacerbate losses from hunting, contribute to the ongoing population decline, or inhibit recovery.

Little Brown Bat—Although the little brown bat (*Myotis lucifugus*) is found on the Kenai National Wildlife Refuge, little is known about its distribution and movements. The little brown bat is known to feed and roost throughout southcentral and interior Alaska; however, only a tiny number of maternity colonies have ever been documented in this region.

Their distribution and abundance during the summer months is poorly understood, and even less is known about where they go in the winter. Although little brown bats from interior and southcentral Alaska are believed to fly south to hibernate where the winters are less severe, neither these migrations nor the actual locations of hibernacula important to migrating bats have been documented. The little brown bat breeds in the fall. The young are born in June or July. A single young is born each year, and the young are on their own within a month after being born.

Habitat features that are particularly important to this bat are abundant live trees, snags, and fallen logs in a variety of sizes, available surface water, karst topography (cave systems), and diversity of prey items. The U.S. Fish and Wildlife Service listed the entire genera Myotis as a conservation concern in 2003.

Other Wildlife Species

Furbearers

River Otter—The Refuge's river otter population appears to occur in relatively low numbers (Bailey, T.N. 1981). The river otter is present in the upper Kenai River and appears to prefer remote undisturbed lakes connecting the Swanson River and Swan Lake canoe systems and their associated watersheds.

River otters hunt on land and in fresh and salt water. They eat snails, mussels, clams, sea urchins, insects, crabs, shrimp, frogs, a variety of fish, and occasionally birds, mammals, and vegetable matter. They breed in spring—usually in May. Mating can take place in or out of the water. One to six pups (usually two or three) are born the next year any time from late January to June following a gestation period of 9 to 13 months.

Monitoring river otter populations in southcentral Alaska is considered to be one of the most important furbearer issues in the State. As with other furbearer species, it is difficult to conduct river otter population assessments based on live animal observations.

Signs of river otter activity are seen more often than the animals themselves. They travel several miles overland between bodies of water and develop well-defined trails that are used year after year. They may flatten and dig up the vegetation or snow over an area of several square yards. Scats, twisted tufts of grass, and small piles of dirt and vegetation are commonly found in such areas. Urine and scent deposited on these piles serve as "scent posts" that are used for communication and territorial marking.

During the winter, otters dig elaborate tunnels and feeding dens within the snow over a frozen lake or bay where fluctuations in water levels leave cracks for them to come and go. Otters travel together

and operate as a social unit but do not cooperate in hunting or share what is caught. They travel over a wide area with no apparent exclusive territories.

Beaver—Beaver (*Castor Canadensis*) are most common in the northern region of Kenai Refuge, but observed colony densities are low compared to apparent, available habitat and colony densities reported in similar habitats.

A beaver colony is governed largely by food supply. Beavers eat bark, aquatic plants, roots, and grasses. As they exhaust the food supply in the area, the beavers forage farther from their homes.

Bank dens and lodges have one chamber-like room, and at least one tunnel exits to deep water so it is free of winter ice. The den is used as a food cache, rearing area, and general home. Dens are of two types, depending on water level fluctuations. The same lodge is used by a beaver colony year after year, so some can be quite large. Bank dens are simply dug into the stream or river bank with a mass of sticks, mud, and rocks constructed over the top of the den. Lodges are constructed of the same materials as bank dens, but are located where the water level is more stable and slower moving, such as in a pond or lake.

Beaver colony densities in lakes on the Refuge in 1977 averaged 33 square miles per colony. Observed beaver colony densities in lakes in preferred beaver habitat in the canoe systems varied from 5–14 square miles per colony from 1983 through 1987.

Colonies observed along streams on the Refuge also suggest densities lower than reported in stream beaver habitat elsewhere. Colonies along streams in 1962, 1963, and 1977 averaged 0.11, 0.11, and 0.06 colonies per mile, respectively (Bailey, T.N. 1981) or about 11–20 percent of densities reported elsewhere (Boyce 1974).

Harvest of lake beaver on the Refuge is periodically high in several areas (Swan Lake Canoe System, the 1969 burn habitat south of Swanson River, and the Swanson River Canoe System areas). From 1984 through 1987, harvest rates in these areas may have been as high as 31 percent based on observed colonies and assuming five beaver per colony. The actual harvest rate is unknown because beaver colony sizes are unknown for the Refuge.

The activities of beavers can increase available habitat for certain species, such as aquatic furbearers, waterfowl, and shorebirds. As beavers cut down small trees and clear away brush, they create new habitats that are ideal food patches for other animals. Waterfowl use these areas as feeding and nesting grounds. Ponds created by beavers often serve as fish habitat. These benefits for other Refuge wildlife species fluctuate with changes in the Refuge's beaver population.

Weasel—The least weasel (*Mustela rixosa*) and the short-tailed weasel or ermine (*Mustela erminea*) range over North America and are found throughout most of Alaska. The short-tailed weasel is found on the Refuge. However, there are no documented reports of the least weasel occurring on the Kenai Peninsula—only a few scattered unconfirmed sightings (T. Bailey, personal communication).

These furbearers are the smallest members of the family mustelidae. Because they are small, they usually pass unnoticed unless caught in a trap or revealed by their tracks in fresh snow. Weasels are primarily solitary animals except during the mating and whelping seasons. Mating typically occurs in mid- to late summer. Weasels usually nest in small rodent burrows, stumps, or rock outcroppings.

The presence of weasels is almost always indicative of substantial rodent populations. Weasels must have almost daily access to rodents in order to survive. They prefer voles. When voles are not abundant, weasels will also take shrews, pikas, birds, fish, and insects. Short-tailed weasels can also kill young snowshoe hares.

Weasels use forested, brushy, and open country. Most weasel activity occurs at or near ground level. However, weasels will occasionally climb trees. Weasels have few natural enemies of significance except possibly the great horned owl and marten. Both species are apparently agile enough to occasionally catch weasels. Hawks, coyotes, and lynx also kill weasels, but such occurrences are rare.

Mink and Muskrat—Little is known about the status of mink and muskrat populations on the Kenai Refuge. The Refuge's mink and muskrat populations are thought to be largely regulated by habitat conditions.

Fish

Refuge lands include some of the most natural and productive fishery habitats on the Kenai Peninsula. There are 191 streams on the western Kenai Peninsula that are identified by ADF&G as providing spawning and rearing habitat for salmon, and 91 of these streams (48 percent) flow within the Refuge boundary (ADF&G 2003). The watersheds range in size from the 2,148-square-mile Kenai River drainage to small ones of less than 20 square miles.

Salmon returning to waters within the Refuge play a key role in maintaining the health and productivity of the ecosystem. Beyond their intrinsic and economic values, spawning salmon and their decomposing carcasses offer a vital source of energy and nutrients for many other species. A report by Cederholm et al. (2000) summarizes research conducted by various agencies over the years and demonstrates the interdependence of salmon, wildlife, plants, and their habitats.

Salmon returning to the Refuge sustain the local ecosystems and also contribute significantly to the local economy through commercial, recreational, and personal use fisheries. The ex-vessel values from the Upper Cook Inlet commercial salmon fishery averaged $22.4 million from 1960 through 2003; the peak ex-vessel value was $122 million in 1988 (Fox and Shields 2004). Fish returning to Refuge waters also attract thousands of recreational anglers each year. The economic value of recreational fisheries for the northern Kenai Peninsula Management Area was estimated at $82 million during 1986 (Jones and Stokes Associates 1987).

Refuge fish populations are managed for wild production except for one enhancement project that occurs on Hidden Lake. This enhancement project is to increase the amount of salmon available in the common property fishery. Activities to enhance the production of sockeye salmon in Hidden Lake were initiated in 1976 by ADF&G. Cook Inlet Aquaculture Association assumed responsibility for enhancement activities in 1988 and currently operates the program under a special use permit issued by the Refuge. The management objective for the project is an annual escapement of 30,000 sockeye salmon into Hidden Lake.

Fish Diversity—Waters within the Refuge support 21 different species of fish that include both anadromous and resident species. Five species of Pacific salmon are native to waters of the Refuge: Chinook, sockeye, coho, pink, and chum salmon. In addition, rainbow trout, steelhead trout, Dolly Varden, Arctic char, and lake trout are native to the Refuge. Arctic grayling and northern pike are both exotic fish species that occur on the Refuge. Most other fish species found on the Refuge offer little economic value but play vital roles in maintaining a healthy ecosystem.

Chinook Salmon—Chinook (or king) salmon is the largest of the five species of North American salmon found in Alaska. They spawn mostly in large freshwater stream systems and are known to inhabit about 218 miles of streams within the Refuge. Watersheds that provide the majority of spawning and nursery habitat for Chinook salmon on the Refuge are the Kenai, Funny, Killey, Russian, Chickaloon, and Kasilof rivers (ADF&G 2003).

Adult Chinook salmon enter Refuge waters for spawning from late May through early August. Spawning occurs from mid-July through late September. Eggs overwinter in stream gravel and hatch in early spring. Fry emerge several days after hatching and begin feeding in the streams, where they may stay for as long as two years before they make their seaward migration. Chinook salmon mature at ages ranging from three to seven years, at which time they return to their natal streams to spawn.

Chinook salmon are highly prized by recreational anglers because of their size, strength, and eating quality. The Kenai River, which is reputed to support the largest Chinook salmon in the world, supports a Chinook salmon recreational fishery of worldwide fame. The current world record on hook and line was a 97-pound fish taken in the Kenai River in 1985.

Coho Salmon—Coho (or silver) salmon use a wide range of freshwater habitats on the Kenai Refuge. They spawn or rear in at least 450 miles of Refuge streams. Major spawning and rearing areas include the Kenai, Killey, Funny, Moose, Russian, Swanson, Kasilof, Fox, and Chickaloon rivers (ADF&G 2003; Booth 1990; Booth and Otis 1996; Faurot and Palmer 1992; Jones et al. 1993).

Coho salmon fry emerge from the gravel in late spring and spend one to three years in freshwater before migrating to sea as smolts in May through mid-July. Adults return to their natal stream after spending only one year in the ocean. Spawning occurs from October through December in smaller streams but can last into March for Kenai River stocks. Coho salmon provide an important late summer and fall recreational fishery in the Kenai and Swanson rivers. They are highly desirable to anglers because of their fighting and jumping ability.

Sockeye Salmon—Sockeye (or red) salmon use about 358 miles of streams and 107,862 acres of lakes on the Kenai Refuge for spawning and rearing (ADF&G 2003). Spawning generally occurs in streams that connect with lakes, although some populations spawn in lakes and a few in streams with no lake.

Juvenile sockeye salmon normally rear for one or two years in lakes, feeding on zooplankton before smolting and migrating to the sea—usually during May and June. After two or three years at sea, they return as sexually mature adults.

The largest sockeye salmon populations on the Refuge are found in the Kenai and Kasilof river systems. The Kenai River, including the Russian River and Hidden Lake systems, is the major producer of sockeye salmon in Cook Inlet. Kenai River sockeye salmon support both a major commercial fishery in Cook Inlet and the largest recreational sockeye fishery in Alaska (Fox and Shields 2004; Gamblin et al. 2004). The Kasilof River, including Tustumena Lake, historically has been the second largest producer of sockeye salmon in Cook Inlet (Fox and Shields 2004). Thousands of Alaska residents participate in popular personal-use fisheries for sockeye salmon in the lower reaches of the Kenai and Kasilof rivers.

A number of lakes on the Refuge support populations of nonanadromous sockeye salmon (kokanee). Hidden Lake provides the largest Refuge sport fishery for this life-form.

Chum Salmon—Chum (also dog) salmon are the least abundant species of salmon on the Refuge. Small runs occur in the Fox and Martin rivers that enter Kachemak Bay (ADF&G 2003; Faurot and Palmer 1992).

Chum salmon enter Refuge streams during July and August at an age of three or four years. They spawn in riffle and upwelling areas of streams having medium-sized gravel. Eggs develop in the gravel, and fry emergence usually occurs in April and May. Fry develop for about one month in freshwater, then rear in estuarine habitats for several months before entering the ocean.

Pink Salmon—The largest run of pink (also called humpback or humpy) salmon on the Refuge occurs in the Kenai River with much smaller runs in the Kasilof, Chickaloon, Swanson, and Fox rivers, and in Big Indian and Little Indian creeks (ADF&G 2003). An even-numbered-year annual spawning pattern is characteristic of most upper Kenai Peninsula streams, whereas an odd-numbered-year spawning cycle occurs in the Fox River (Faurot and Palmer 1992).

Pink salmon fry migrate to sea when they emerge from the gravel, spend 14–16 months at sea, and return as sexually mature adults, mostly in July and August. Adults generally do not migrate far upstream; in some areas, spawning occurs in tidally influenced areas (Morrow 1980). They are the smallest of the Pacific salmon and usually weigh two to five pounds. Pink salmon are popular because they take artificial lures aggressively and are easily caught. Commercially, pink salmon are usually the most abundant in even numbered years but bring the lowest price per pound.

Rainbow Trout—Rainbow trout are found in all major Refuge watersheds except those entering Kachemak Bay. Anadromous rainbow trout (steelhead) occur in the Kasilof River watershed. Small numbers (i.e., in the 100s) of steelhead spawn in Crooked and Nikolai creeks. Resident populations are more widespread and occur in both lake and stream environments. Lake populations are common, but their presence depends on suitable spawning gravels in inlet or outlet streams. Rainbow trout seldom exceed 20 inches in length in the smaller lakes and streams, although rainbow trout in the Kenai River and steelhead attain much larger sizes.

Locally, rainbow trout are of secondary interest to anglers when salmon are available, but they are the preferred resident species during other times. They support an important fishery in the heavily used Swanson River and Swan Lake canoe systems, and the popularity of the rainbow trout fishery on the Kenai River above and below Skilak Lake is growing at a rapid pace. A genetic strain of rainbow trout that originates from the Swanson River is used by ADF&G for statewide stocking because of the vigor of this particular stock.

Dolly Varden—Dolly Varden is the most abundant species of char on the Kenai Refuge. There are several life-forms, including stream resident, stream-lake resident, and anadromous populations. This species likely inhabits a substantial portion of the 2,070 miles of Refuge streams.

Dolly Varden vary in size but most individuals are small—less than 15 inches long. Larger fish occur in the Kenai River but seldom exceed 26 inches in length. Dolly Varden, like other char, are fall spawners utilizing streams with gravel bottoms (Morrow 1980).

Anadromous populations generally spend three to four years in freshwater before smolting (Morrow 1980). The smolt spend a few weeks to several months at sea before returning to freshwater for spawning and overwintering. Several anadromous runs occur on the Refuge, but none has been well studied. Anadromous runs are present in the lower Kenai, Kasilof, and Fox rivers and may occur elsewhere, too.

Dolly Varden are important to anglers when salmon are not available. They are often common near the mouths of lakes in the spring and in rivers during late summer and early fall. In the Kenai River, the sport fishery for Dolly Varden appears to be growing at a rate similar to that observed for rainbow trout. Both species are readily caught using similar angling techniques.

Arctic Char—Arctic char are lake spawners that have been reported from nearly 50 Refuge lakes in the Swanson River watershed. Arctic char are a moderate-sized species on the Refuge; most individuals are less than 20 inches long. Because of their preference for cold, deep water, they are generally unavailable to anglers during the summer months but do contribute to the spring, fall, and winter recreational fisheries. The physical appearance of Arctic char is similar to Dolly Varden, causing many anglers to misidentify the species.

Lake Trout—Lake trout occur in Hidden, Skilak, and Tustumena lakes, the three largest lakes on the Refuge. They spawn in the fall over rocky lake bottoms. This species is long-lived with sexual maturity not usually occurring until seven years of age. Lake trout can attain large size, but most fish harvested on the Refuge are less than 10 pounds. Hidden Lake provides the best lake trout sport fishery on the Kenai Peninsula (Gamblin et al. 2004). Fishing occurs in the summer and winter.

Arctic Grayling—Arctic grayling are distributed throughout much of Alaska but originally did not occur naturally on the Kenai Refuge. Alaska Department of Fish and Game (ADF&G) stocked Arctic grayling into Twin Lakes in 1965 and into Lower Fuller Lake in 1967. Arctic grayling in Twin Lakes came from Crescent Lake, on the Chugach National Forest, while the Lower Fuller Lake stock came from Tonsina Lake near Glenallen. Arctic grayling are popular with anglers but provide limited recreational fishing on the Refuge because

Lower Fuller Lake is only 12 acres in size, and Twin Lakes are accessible only by float-equipped aircraft. Both populations are maintaining themselves through natural reproduction.

Northern Pike—Northern pike are a native species in interior and western Alaska, where they live in a natural balance with other native species. However, on the Kenai Peninsula, northern pike have been illegally transported and released into some area lakes and streams, upsetting the natural balance of species in their new environment. This species was illegally introduced into Derk's Lake in the Soldotna Creek watershed during the mid-1970s. From this initial introduction, they have spread into other waters and are now known to occur in 14 lakes and streams on the Kenai Peninsula, including some Refuge waters. The same weedy, slow-moving streams and lakes that provide excellent rearing areas for juvenile salmon and trout also attract northern pike. Northern pike have huge appetites and can have devastating effects on salmon and trout populations. Additional information on exotic and invasive species is presented in this chapter.

Other Fish Species—Other fish species found on the Refuge offer little economic value but play vital roles in maintaining a healthy ecosystem. Several of these species likely provide a valuable food resource to other wildlife species such as river otters, mink, eagles, common and Arctic loons, red-necked grebes, Arctic terns, and Bonaparte's and mew gulls. Volume 2, Appendix F provides a complete list of all fish species identified on the Refuge.

3.3.8 Concerns Regarding Wildlife Populations

3.3.8.1 Declining Moose Populations

High moose populations in Alaska, and certainly on the Kenai Peninsula, are generally associated with early successional hardwood forests and the abundance of high-quality winter browse. The 1947 and 1969 burns in the northern portion of the Refuge (GMU 15A) are widely recognized as having generated high moose populations. Peak densities of 3.6–4.4 moose per 1.4–1.7 square miles (one square kilometer) were reached 13–26 years after these fires. In contrast, moose densities in adjacent mature forests (60–90 years old) were 0.1–0.8 moose per 0.04–0.3 square miles (one square kilometer) (Loranger et al. 1991).

The moose population in GMU 15A has declined over the past two decades, in large part because of the continued maturation of the moose habitat that was created by these large fires. Recent wildfires and prescribed burns in this unit have been extremely small with respect to replacing the aging of the 1947 and 1969 burns. Management directions in the 1985 Comprehensive Conservation Plan specifically called for increasing the Refuge population to 5,500 moose, of which 3,600 would be in GMU 15A.

Although the moose population has increased since 1985 on the Refuge from 5,000 to almost 6,000 animals, this increase is not uniform in distribution. Moose populations have decreased in GMU 15A, remained stable in GMU 15B, and increased in GMU 15C. These can be attributed, in part, to the habitat conditions in each unit. GMU 15B has seen very little change in habitat conditions. No major or minor wildfires have occurred, and most is designated Wilderness. GMU 15C had large wildfires (Windy Point and Crooked Creek) and widespread logging of beetle-killed spruce on the lower Kenai Peninsula. GMU 15A, on the other hand, has continued to age since the 1969 burn; recent fires (either wildfires or prescribed burns) have been too small to produce significant moose browse.

In addition to reduced moose habitat in GMU 15A, moose-vehicle collisions, particularly on the Sterling Highway, have proved to be a significant mortality factor. In recent years, an average of 250 moose, most of which are adult females or calves, have been killed each year by vehicles on the Kenai Peninsula (Bangs et al. 1989). These are not inconsequential numbers; one telemetry study of 51 adult female moose during 1980–1986, when the vehicle collision rate was much lower, showed that four percent died from vehicle collisions (Bangs et al. 1989). Furthermore, moose-vehicle collisions are increasing; mean numbers of moose killed were 111.7 plus 19 during 1977–1982 and 216.3 plus 25 in 1984–1989 (Del Frate and Spraker 1991). As more roads are built on the Kenai Peninsula and traffic volume and speed increases, this problem will undoubtedly continue to grow.

3.3.8.2 Status of Brown Bear Populations

Currently, the brown bear population and its health on the Kenai Peninsula are not completely understood. The existing estimate of 250–300 brown bears was based on multiplying the area of suitable habitat (5,347 square miles or 13,848 square kilometers) by the assumed bear density from studies conducted elsewhere (Del Frate 1993). Some demographic parameters have been estimated, however, from telemetry data collected by the Interagency Brown Bear Study Team (IBBST). Based on 1995–1999 data, the IBBST (IBBST 2001) estimated a finite rate of population increase (λ) with 95 percent confidence intervals of 0.9364–1.0588, meaning that statistically, very little is known about the population trend. The IBBST (2001) concluded that "it is difficult to characterize the health of the Kenai Peninsula brown bear population at this time. The calculated finite rate of population increase indicates neither an increase nor a decrease: whereas demographic information (survivorship data [specifically yearlings] and the female age distribution [specifically 2–6 year old age class]) indicates the possibility that reproductive females have a low recruitment".

The number of brown bears killed in defense-of-life-or-property (DLP) has increased from less than one per year in the 1960s to five per year in the 1990s (Suring and Del Frate 2002). Eighteen DLPs were

reported in 2003, the highest year on record. However, the fact that DLPs have increased is confounded by the fact that the resident human population on the Kenai Peninsula has increased 2.2 percent per year over the same interval. DLPs may be increasing because there are more brown bear and/or because there are more humans.

Mortality due to DLPs is one facet of a landscape that is urbanizing. Suring et al. (1998) developed a model to evaluate the cumulative effects of several human actions (urbanization, non-motorized and motorized roads, hunting, grazing) on habitat capability for brown bear on the northeastern portion of the Kenai Peninsula. Habitat effectiveness, as measured by the model, decreased by more than 70 percent because of disturbance and mortality associated with facilities and current human activities on the Chugach National Forest.

3.3.8.3 Human Disturbance of Trumpeter Swans

Trumpeter swans, which are known to be sensitive to human disturbance, abandon nests and brood readily (Henson and Grant 1991). Consequently, the 1985 Comprehensive Conservation Plan protected lakes used by nesting trumpeter swans from aircraft disturbance. The trumpeter swan formerly occupied a breeding range over much of northern North America, typically in temperate forests and prairies. Due to intense exploitation by market hunters in the lower 48 states, the trumpeter swan declined rapidly through the early 1900s. By 1932, biologists knew of only 69 trumpeters in the wild (birds in Alaska were not yet known). Although trumpeter swans were first identified in Alaska in 1850, it was not until 1954 that breeding trumpeters were acknowledged to be in Alaska. An extensive aerial survey of known Alaska breeding habitat was first conducted in 1968 when U.S. Fish and Wildlife Service personnel counted 2,844 trumpeters. Trumpeters were removed from the Federal endangered species list shortly thereafter, but they continue to be classified as rare or endangered in some other States (Rosenberg and Rothe 1994). A survey conducted in 2005 indicated nearly 24,000 trumpeters in Alaska with an annual growth rate of 5.6 percent during 1968–2005. Nonetheless, the trumpeter swan remains on the National Audubon Society's Watch List.

Currently, two distinct populations of trumpeter swans are recognized in western North America (Oyler-McCance et al. 2006). The Pacific Coast population is comprised of birds nesting primarily in Alaska and western portions of the Yukon Territory and British Columbia; these birds are thought to winter on the Pacific coast in British Columbia and Washington. The Rocky Mountain population is made up of birds from the Idaho-Wyoming-Montana region, the Grande Prairie–Peace River region of Alberta, and eastern portions of British Columbia and the Yukon Territory; most of these birds winter in the greater Yellowstone region. Oyler-McCance et al. (2006) concluded that the remarkably low genetic diversity found in both populations suggests that trumpeter swans may have undergone an entire species-wide bottleneck prior to

their decline during the last century. Of all subpopulations sampled by Oyler-McCance et al. (2006), the trumpeter swans collected on the Kenai had the highest level of allelic richness (i.e., genetic diversity).

Little was known about trumpeter swans in 1957 when the first aerial trumpeter swan survey was initiated by Dave Spencer on the Kenai Peninsula. From 1957 through 1984, the known population on the Refuge remained at approximately 30 nesting pairs despite a two-fold increase in swan numbers throughout the rest of Alaska (Bailey et al. 1986). Swans are very sensitive to disturbance and may have an unsuccessful breeding season if high levels of human activity occur near their chosen nesting site. Henson and Grant (1991) found that trumpeter swans responded to aircraft by ceasing whatever activity they were engaged in—sometimes simply becoming alert but at other times, flushing from their nests. Consequently, the Alaska Department of Fish and Game recommends special habitat protection measures in most areas to ensure continued use and production by swans (Rosenberg and Rothe 1994).

The 1985 Comprehensive Conservation Plan recognized that populations of trumpeter swans were depressed, apparently due to human activities (USFWS 1985). To help ameliorate human disturbance, the preferred alternative in the 1985 Plan proposed that lakes used by nesting trumpeter swans would be protected from disturbance by aircraft (USFWS 1985, p. 131). A management objective of 40 pairs of nesting trumpeter swans was established under the preferred alternative with the caveat that "estimated populations are based on an expected average over the next 15–20 year period and are intended for general comparative purposes" (USFWS 1985, table 28, footnote, p. 161). An increase in 10 pairs over the existing 30 pairs seemed reasonable at the time given the estimated swan nesting territories lost prior to 1985 due to human disturbance. These included traditional swan nesting lakes previously abandoned by trumpeter swans in the canoe systems (e.g., Canoe Lake) and lakes that had aircraft-accessible commercial tent camps established on them (e.g., Two Island Lake). Although swans never re-established on abandoned lakes in the canoe systems, they did re-establish on some tent-camp lakes once tent-camp operators were moved to other non-swan lakes (T. Bailey, personal communication).

Two types of trumpeter swan nesting habitat exist on the Refuge: transitory and permanent. Transitory nesting habitat includes small ponds made by beavers (i.e., short-lived, 1–5 years or more). Transitory trumpeter swan nesting habitat comprises only a small fraction of total nesting habitat compared to permanent nesting habitat and varies yearly with beaver densities and distribution. Permanent nesting habitat includes lakes, ponds, and streams. Swans have traditionally used some of these lakes and ponds since at least 1957, the first year swans were censused on the Refuge. Permanent swan nesting habitat in lakes appears limited to lakes with high

alkalinity (>700 mμ-eq/l). These lakes are uncommon and comprise only 22 percent of all lakes on the Kenai Peninsula; the remainder (78 percent) are lakes of low alkalinity (<300 mμ-eq/l). These high alkalinity lakes are chemically similar to rivers and shallow aquifers and tend to be at slightly lower elevations than low alkalinity lakes. Inlet and/or outlet streams, abundant aquatic vegetation, shallow water, and productive fish populations often characterize these high alkalinity lakes (Eilers et al. 1993).

Permanent swan nesting habitat available within the Refuge has declined since 1957 (the first trumpeter swan survey) and more recently, since 1998 because of readjusted Refuge boundaries and loss of lowland trumpeter swan nesting habitat due to land exchanges with Salamatof, Kenai, and Tyonek Native Americans. The Refuge acreage gained in compensation for these losses were mountains and glaciers, which did not benefit trumpeter swans. Several lakes (e.g., Sunken Island Lake, Donkey Lake, and Elephant [Spirit] Lake) once used by nesting trumpeter swans when they were within Refuge boundaries, are no longer used for nesting since boundary readjustments have placed the lakes outside the Refuge (T. Bailey, personal communication). Permanent swan nesting habitat on the Refuge, particularly in closed-basin lakes, is likely to continue to decline in the future because of the increasing evaporation of water bodies due to global climate change (Klein et al. 2005).

The population of nesting swan pairs on the Refuge responded well to changes in aircraft restrictions. A quadratic, fixed-effects regression model suggests that the population of nesting pairs on the Refuge increased rapidly and steadily after aircraft regulations were put into place (Figure 3-19a). Recent aerial surveys indicate that as many as 50 pairs may be using the Refuge.

Evidence suggests that human disturbance on lakes outside the Refuge boundaries is hindering the establishment of new swan pairs. Although the number of nesting trumpeter swans has increased since 1957, the year of the first swan survey, and since the 1985 Plan (approximately 30 pairs), the number of nesting pairs has only increased on lakes within the Refuge (despite decreased habitat availability) and not on lakes outside Refuge boundaries—where it has remained essentially the same. This disparity in population trends inside and outside Refuge administrative boundaries is remarkable given loss of suitable habitat within the Refuge due to land exchanges and climate change. This finding is also consistent with the analysis of Kenai Peninsula swan data by Bailey and Fischbach (1995), who found that most cygnets were produced on territories with little or no human disturbance during a 37-year period from 1957 through 1994.

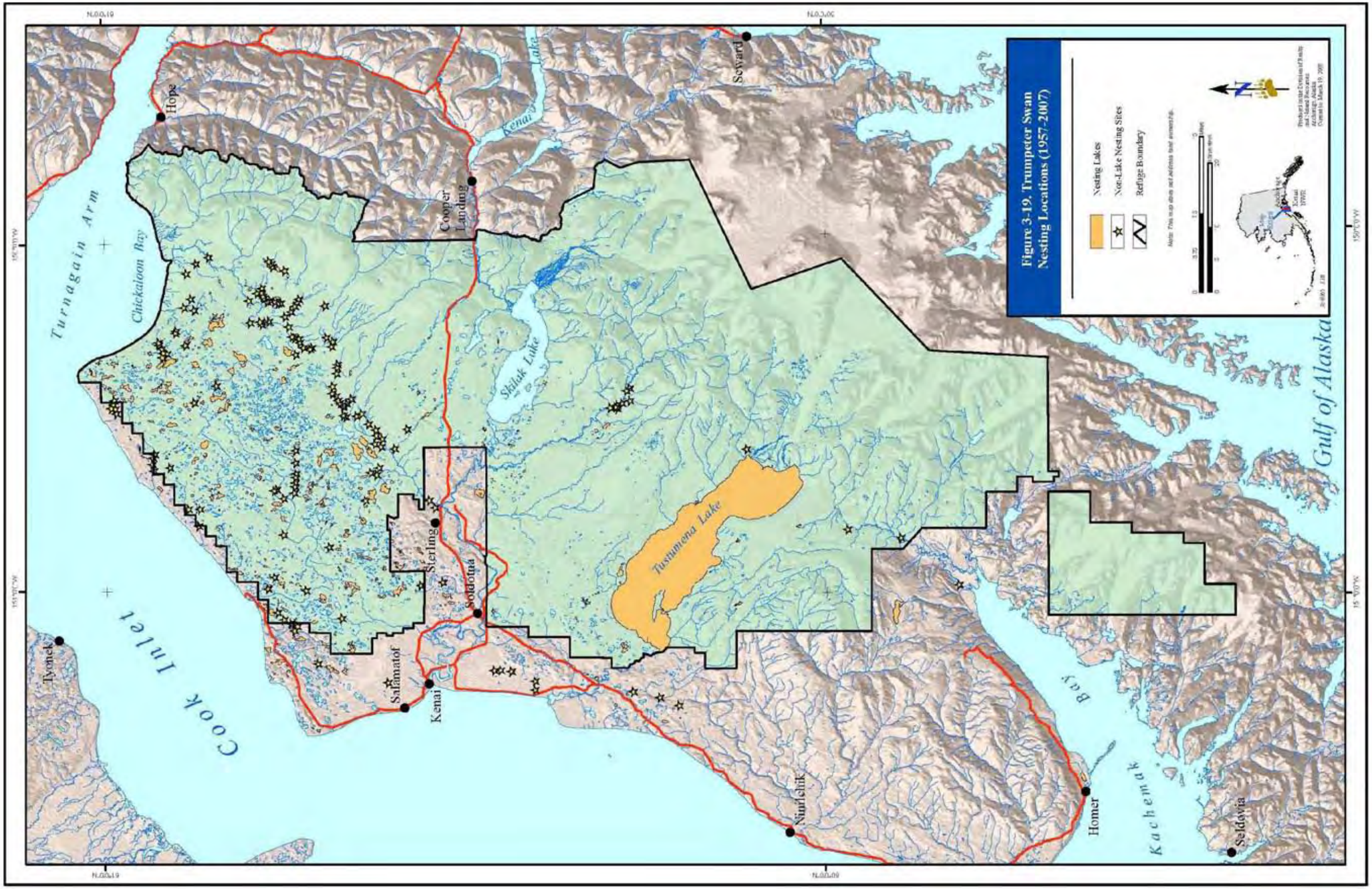


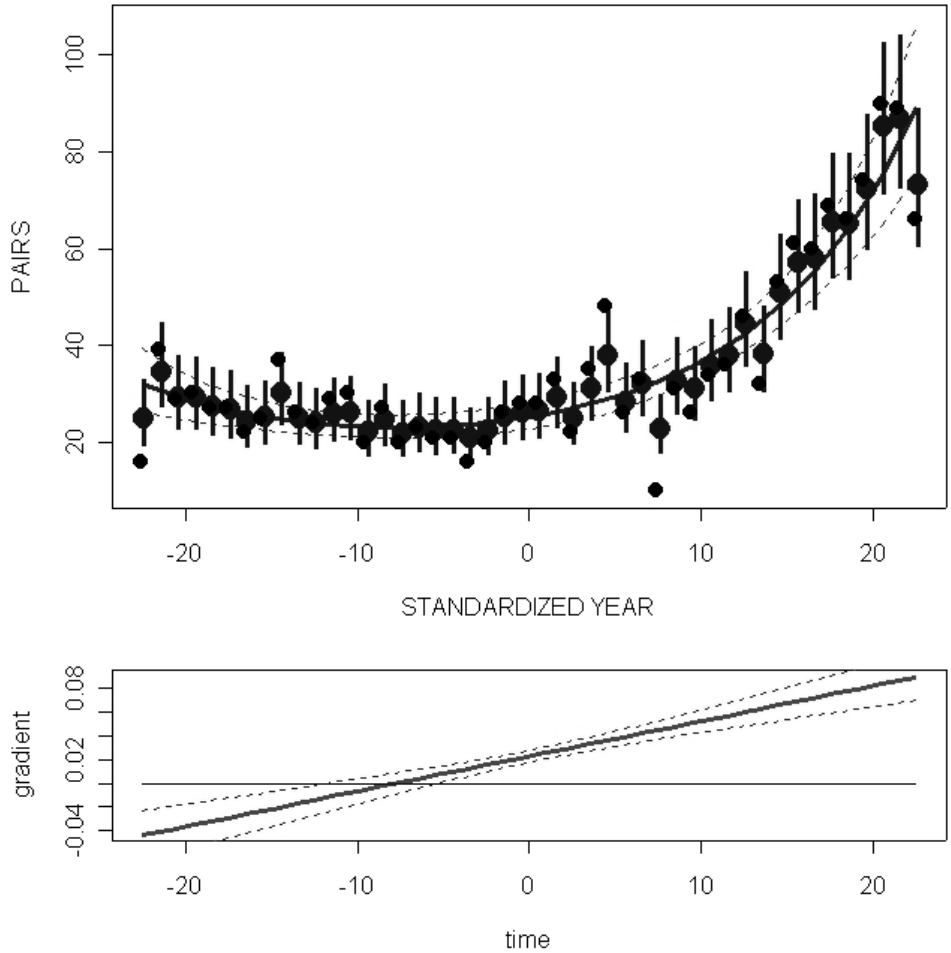
Figure 3-19. Trumpeter Swan Nesting Locations (1957-2007)

3.3.8.4 Abnormal Bills on Black-Capped Chickadees and Other Avifauna

Since 1991, when abnormal bills were first found on black-capped chickadees in King Salmon, documentation of these abnormalities has expanded throughout southcentral Alaska.

As of June 2005, there had been 2,153 reports of black-capped chickadees with deformed beaks; this represents at least 1,441 individuals (Handel et al. 2006). There have also been reports of at least 209 individual birds of 27 different species exhibiting bill abnormalities. In contrast, there were 12 reports of similar bill abnormalities in black-capped chickadees elsewhere in North America during this same period.

Figure 19a. Population trend of trumpeter swan pairs on the Kenai National Wildlife Refuge during 1957-2002



Based on fixed effects model with Poisson distribution and random effects where pair = 3.244 + year (0.0228) + year2 (0.0014). Black = observed data; blue = estimated pairs with 95% CI; dotted lines = 95% confidence band on regression. Gradient shows the instantaneous rate of change.

Most birds with abnormal bills on the Kenai Peninsula have been black-capped chickadees, but 10 other species are also represented. Typically, the upper mandible is greatly elongated, curved down, and may be crossed with the lower mandible. This abnormality may be the result of a contaminant, a virus, or even nutritional stress, but the current hypothesis is that the causal agent is likely of local origin because most of the affected populations are nonmigratory. As with abnormal wood frogs, abnormal bill development in resident bird populations may be the harbinger of a larger environmental problem and clearly warrants further research.

3.3.8.5 High Rates of Abnormalities in Wood Frogs

Biologists have found high rates of abnormalities in wood frogs (*Rana sylvatica*) since monitoring began on the Refuge in 2000. During the first year (2000) of the investigation, 30 of the 348 (or 8.6 percent) of the newly metamorphosed frogs and late-stage tadpoles examined in the field had abnormalities. The abnormality rates in sampled areas on the Refuge have been consistently elevated during the past five years of monitoring, ranging from 0.0–19.0 percent (Reeves and Trust 2005). In contrast, background abnormality rates expected in amphibian populations in North America range from zero to less than five percent (Ouellet 2000, Johnson et al. 2001). Anomalies included missing or shrunken hind legs, missing feet, partial limbs, anomalies of the skin or torso, and missing irises or eyes (Reeves and Trust 2005). Possible causal factors being investigated include contaminants, ultraviolet radiation, parasites, disease, predation, and nutrition. Preliminary results suggest that these high rates of abnormalities are not unique to the Kenai Peninsula (Reeves and Trust 2005). Regardless of the determined cause, phenomenon of this type are early harbingers of an unhealthy system.

3.3.8.6 Exotic, Invasive, and Injurious Fauna

Ruffed Grouse and Other Game/Domestic Birds—Three sources are known instances of introduced birds on the Refuge. From 1995 through 1997, ruffed grouse were transplanted from interior Alaska to the Kenai Peninsula (Steen 1997). The Refuge opposed the introduction, but Alaska Department of Fish and Game (ADF&G) approved the transplant proposal. Subsequently, birds were released within one mile of the Refuge boundary. Within one year of the introduction, broods had been spotted on the Refuge in at least two locations. Drumming surveys were conducted for the first few years post-introduction and then, because of a high mortality rate of radio-tagged birds, surveys were terminated. A few surviving birds were breeding when surveys were terminated, and it is unknown if there are still birds breeding on the Refuge.

In addition to the institutional introductions, private citizens have been purchasing and raising chicks of several species and releasing them at

their residence near the Refuge. The Central Peninsula Birding Hotline has received reports of California quail, ring-necked pheasants, chukar, northern bobwhite, and rock pigeon on the Refuge. In the case of chukar, there have been sightings of pairs exhibiting courtship behavior on land within one mile of the Refuge near the intersection of Beaver Loop Road and the Spur Highway. To date, there have been no documented cases of detrimental effects of these species on the Refuge. Nationally, all of these introduced game birds have been documented as vectors for diseases and various parasites.

The third method of introduction is range expansion from introductions elsewhere. The European starling is the only species recorded on or near the Refuge that originated outside this region.

Northern Pike—Northern pike were illegally introduced into Derk's Lake through the misguided actions of citizens. From this introduction, the pike rapidly spread throughout the Soldotna Creek drainage, including East and West Mackey lakes. From Soldotna Creek, the pike have made their way into the Kenai and Moose rivers. Northern pike were first reported in the Moose River during 1986 when a single fish was observed near a fish weir operated above the Kenai Refuge boundary (Booth and Otis 1996).

The Moose River watershed provides ideal spawning and rearing habitat for northern pike. The likely expansion of this species throughout the watershed has generated concern over the potentially devastating impact on juvenile salmon and trout. To address this concern, the Kenai Fishery Resource Office—in partnership with Kenai River Sportfishing Incorporated, Alaska Department of Fish and Game, and the Refuge—initiated a stock assessment study during 1996 (Palmer and Tonin 1996). The primary objective was to characterize the distribution and abundance of northern pike within the Moose River watershed. Approximately 4,000 hours were spent with nets and tip-ups; however, no northern pike were captured. The fact that no northern pike were captured suggests that the abundance of northern pike was very low. Since the study, information from the Statewide Harvest Survey has indicated that anglers are harvesting a small number of northern pike from lakes on the East Fork of the Moose River (Afonasi, Imeri, Watson, Egumen, Peterson, and Kelly lakes).

Canine Louse—The biting dog louse (*Trichodectes canis*) is an ectoparasite that can be transmitted through social contact between dogs, coyote, and wolves. Wolves in the early 1980s contracted this louse, probably from contact with free-ranging or feral dogs (Schwartz et al. 1983). The parasite causes itching and some loss of some guard hairs, and reduces the ability of the animals to stay warm in winter. Heavy infestation of biting dog lice creates a scruffy appearance of the hair coat from scratching and rubbing of the infested areas. In severe cases, patches of hair are missing, which greatly reduces the value of the pelt.

The parasite spread quickly through the Kenai wolf population, and earlier attempts by ADF&G and the Service to eradicate the lice by treating wolf packs with medication was unsuccessful. Coyotes also became infected with the biting dog louse but in smaller numbers (Schwartz et al. 1983).

Echinoccocus Granulosus—The tapeworm *Echinoccocus granulosus* is an internal parasite that has been found in wolves on the Kenai Peninsula. This tapeworm has a two-host life cycle, primarily in canids and moose, and rarely in humans. Adult tapeworms mature in the intestine of a wolf or other canid (called the "definitive host") and the eggs are released into the feces. The eggs enter an intermediate host (such as moose or caribou) by ingestion of feces-contaminated vegetation. The eggs hatch into larvae in the intestines of the intermediate host and travel through the lymphatic or blood system throughout the body—where they lodge within the body tissue and develop into fluid filled cysts (hydatids). Upon the death of the intermediate host (such as a moose), either through direct predation by wolves or through scavenging by coyotes on the carcass, the larvae are transmitted back to a definitive host, where they develop into adult tapeworms.

Echinococcus can have many intermediate warm-blooded hosts (e.g., humans, sheep, horses, and cattle as well as moose and caribou). Humans can acquire *Echinococcus* in the same way as other intermediate hosts (i.e., by ingestion of *Echinococcus* eggs). This occurs by hand-to-mouth contact with infected dogs or their feces. Humans infected with *Echinococcus* usually develop masses of hydatid cysts on the liver, lungs, or stomach cavity. As long as the cysts do not develop in a high-risk area of the body such as the brain, the mass can be surgically removed and is usually not life-threatening. In Alaska, there are only a handful of cases of humans contracting *Echinococcus* (also known as hydatid disease), primarily through exposure of their dogs to raw moose or caribou viscera and subsequent contact of the humans with their infected dog. The eggs of *Echinococcus* can remain dormant in below-freezing temperatures for as long as one year.

The vast majority of arthropods on Kenai Refuge are native. A few exotic species from the Old World are known to be established. The amber-marked birch leafminer (*Profenusa thomsoni*) is now common in many parts of the Cook Inlet basin. The alder woolly sawfly (*Eriocampa ovata*) is a common defoliator on alders on the Kenai Peninsula. The harvestman (*Phalangium opilio*) is often abundant on disturbed sites, but it is infrequent elsewhere.

3.3.8.7 Wildlife Diseases

Canine Parvovirus (CPV), Canine Distemper Virus (CDV)

Blood samples from wolves, coyotes, and lynx collected by Refuge biologists since 1976 have shown that both CDV and CPV occur to some degree in the wolf population on the Refuge, probably as a result of contact with domestic dogs. Exposure to CDV and/or CPV was first detected in wolves in 1979, and about 12 percent of the sampled wolf population was exposed to both viruses (Bailey et al. 1995).

Canine parvovirus is fatal to dog pups (Eugster and Nairn 1977) and captive wolf pups (Mech and Fritts 1987) and may also have caused wolf pup mortalities in Glacier National Park (Johnson et al. 1994). Bailey et al. (1995) reported that the canine parvovirus antibody occurred in 17 percent (n = 30) of Kenai wolves more than 12 weeks old from 1976–1981 and increased to 64 percent from 1983–1988 (n = 25).

Wolf pups made up a lower percentage of the wolves harvested from the mid-1980s to early 1990s, which may mean that fewer pups survived to one year of age. The prevalence of the canine parvovirus antibody has been reported as contributing to declines in the Isle Royale wolf population (Peterson 1996) and to the slow increase of wolves in Wisconsin (Wydeven et al. 1995).

Feline Panleukopenia Virus

Feline infectious peritonitis (FIP) and feline panleukopenia virus (FPV) are both contagious diseases of domestic cats. Tests have also indicated that one lynx out of 54 sampled was exposed to CDV and also tested positive to FPV.

Salmonella in Songbirds

While no die-offs of passerines have been recorded on the Kenai Refuge, large numbers of red polls were reported dead at feeders in Soldotna, Kenai, Kasilof, and the surrounding communities in the winter of 1991. Specimens sent to the United States Geological Survey (USGS), National Wildlife Health Center in Madison, Wisconsin, confirmed Salmonella bacterial infections.

3.3.8.8 Diseases that May Emerge in Wildlife Populations

Diseases—including chronic wasting disease and West Nile virus—are threatening populations of fish, wildlife, and birds throughout North America. Animal husbandry practices, movement of people and their pets, and natural migration of birds and fish all may bring diseases to the Kenai Peninsula. As seen in the contiguous United States in 2002 and 2003, outbreaks of diseases such as chronic wasting disease and West Nile virus can be devastating to wild animal populations. With active monitoring, timely management actions can reduce the effect of these diseases.

Chronic Wasting Disease—Chronic wasting disease (CWD) was first identified in captive deer in Colorado in 1967 and since has been found in wild and/or captive deer and elk in parts of at least seven other states (Montana, Wyoming, South Dakota, Kansas, Nebraska, Oklahoma, and Wisconsin) and two Canadian provinces (Alberta and Saskatchewan). Researchers speculate that CWD could have been transported long distances as a result of interstate shipment of infected animals.

CWD appears to be passed between animals via saliva, feces, or urine. Transmission between females and their fetuses (maternal transmission) does not seem to be a factor, although indirect transfer (e.g., from contaminated soil) may occur. CWD may be transmitted more readily within overpopulated herds and at deer or elk feeding stations where direct physical contact among individuals is more likely. There is no scientific evidence that CWD has been transmitted to animals other than deer and elk.

CWD is a fatal disease that attacks the brain and spinal cord of deer and elk—specifically white-tailed deer, mule deer, and Rocky Mountain elk. While the exact cause is not known, it is believed to be a prion disease. A prion is an altered protein that causes other normal proteins to change and cause spongelike holes in the brain. The origin of these prions is currently unknown. CWD is related to, but different from, scrapie in sheep and bovine spongiform encephalopathy (BSE or mad cow disease) in cattle and Creutzfelt-Jacob disease (CJD) in humans. These diseases also attack the brain and cause deterioration and eventual death. CWD has not been found in sitka deer or white-tailed deer in Maryland. It is unknown whether sitka deer are susceptible to CWD.

CWD is related to a group of diseases known as transmissible spongiform encephalopathies (TSEs). TSEs include such diseases as scrapie in sheep, bovine spongiform encephalopathy (BSE) in cattle (also known as “mad cow disease”) and Creutzfeldt-Jakob disease of humans that are diseases of the nervous system that result in distinctive lesions in the brain. The causative agent is believed to be a modified protein (prion). These modified proteins are typically found in nervous and lymphatic tissues, and recent evidence shows prions can occur in muscle tissue of mice.

West Nile Virus—West Nile Virus (WNV) is a flavivirus commonly found in Africa, West Asia, and the Middle East. It is closely related to St. Louis encephalitis virus, which is also found in the United States. The virus can infect humans, birds, mosquitoes, horses, and some other mammals. It is not known how long it has been in the United States, but scientists from the Centers for Disease Control (CDC) believe the virus has probably been in the eastern United States since the early summer of 1999—possibly longer.

Outbreaks of WNV encephalitis in humans occurred in Algeria in 1994, Romania in 1996–1997, the Czech Republic in 1997, the Democratic Republic of the Congo in 1998, Russia in 1999, the United States in 1999–2003, and Israel in 2000. Epizootics of disease in horses occurred in Morocco in 1996, Italy in 1998, the United States in 1999–2001, and France in 2000; and in birds in Israel in 1997–2001 and in the United States since 1999. WNV human, bird, veterinary, or mosquito activities have been reported from all states except Hawaii, Alaska, and Oregon.

Most often, WNV is spread by the bite of an infected mosquito. Mosquitoes are WNV carriers that become infected when they feed on infected birds. Infected mosquitoes can then spread WNV to humans and other animals when they bite.

The American crow, fish crow, and blue jay appear to be the most susceptible species. As the virus has spread into the Gulf and Midwestern states, blue jays appear to be replacing crows as the most frequently reported species with the virus. Since 1999, scientists have detected the virus in 111 species of captive and free-ranging birds. The total mortality and impact on specific avian populations is unknown.

Wildlife disease scientists are monitoring the possible increase of WNV infections in new species of birds, particularly other Corvidae species (including ravens and black-billed magpies) as it moves west. In addition, there are WNV-positive birds reported in the Canadian provinces of Saskatchewan, Manitoba, Ontario, and Quebec. Now that the virus is present in all of the Gulf Coast States, there is concern that WNV will spread to the Caribbean and Central American countries.

Rabies—Domestic animals once formed the largest reservoir for the disease; since the 1960s; however, wildlife species—especially skunks, bats, fox, and raccoons—have taken over that distinction. In 1986, there were 5,551 cases of rabies reported in the United States. Of these, 91 percent were from wildlife species.

Small rodents (such as red squirrels) and lagomorphs (such as snowshoe hares) are almost never found to be infected with rabies and have not been known to cause rabies among humans in the United States. Bites by these animals are usually not considered a risk of rabies, unless the animal was sick or behaving in any unusual manner. However, from 1985 through 1994, woodchucks accounted for 86 percent of the 368 cases of rabies among rodents reported to the CDC.

Hantavirus—Hantaviruses in the New World are associated with hantavirus pulmonary syndrome (HPS). Sigmodontine rodents carry the hantaviruses that cause HPS and are found throughout the Americas. *Sin Nombre* virus, carried by *Peromyscus maniculatus*, is the predominant cause of HPS in the United States and Canada. Mononghela, New York, Bayou, and Black Creek Canal viruses also

cause HPS and are found in eastern Canada and in the eastern and southeastern United States.

3.3.8.9 Global Climate Change

Accelerated global climate change is already affecting fish and wildlife populations on the Refuge and will likely continue to do so in the future (Inkley et al. 2004, Lynch et al. 2002, Parmesan and Galbraith 2004). Recent local increases in northwestern crows, Steller's jays, and black-billed magpies, for example, may all be range shifts—partly in response to a warmer climate west of the Kenai Mountains. In another example, Edmundson et al. (2003) showed that sockeye salmon fry in Skilak Lake have significantly declined in weight during the past decade because of a decreasing euphotic zone as a result of increased glacial melting and turbidity.

Wildlife species are closely adapted to their environments and readily respond to climate variation. However, the climate change now underway has potential to extensively affect wildlife, either directly or indirectly through responses to changing habitat conditions. When considered in combination with other factors (e.g., pollution, ozone depletion, urbanization), the potential effect is even greater. The effects of climate change on populations and range distributions of wildlife are expected to be species-specific and highly variable, with some effects considered negative and others considered positive. In North America, the ranges of habitats and wildlife are predicted to generally move northward and upward in elevation as temperatures increase. Variations in this overall pattern will depend on specific local conditions, changing precipitation patterns, and the response of different species to different components of climate change. It follows that the structure of plant–animal communities will also change (Inkley et al. 2004).

Climate change is predicted to have a major impact on the distribution and life history of parasites in ungulates (Jenkins et. al 2006). It has already increased the length of the growing season for protostrongylid development and the amount of heating available for larval development in subarctic and Arctic Canada (Kutz et. al 2005). Temperature-dependent larval development may soon not be a limiting factor in the northward range expansion of *Parelaphostrongylus odocoilei* (a lungworm parasite) into native populations of Dall's sheep in the Arctic. In subarctic regions where both *Parelaphostrongylus odocoilei* and *Protostrongylus stilesi* are endemic, the length of the parasite's growing season and amount of warming available for parasite development has increased over the last 50 years (Jenkins et. al 2006). With climate warming, the seasonal window for transmission will be significantly extended, possibly leading to amplification of parasite populations and disease outbreaks in host populations.

Not appropriately taking into account climate change is likely to result in increasing failure to reach wildlife management objectives. Wildlife managers need to become knowledgeable about climate change, ways to cope with it, and ways to take advantage of it. Management options currently available include protecting coastal wetlands to allow for sea level rise, reducing the risks to wildlife from potential catastrophic events, adjusting yield and harvest models, accounting for known climatic variations, and taking climate change into consideration when selecting the location and other characteristics of conservation areas. Wildlife managers also need to expect the unexpected and reduce non-climate stressors on ecosystems. Overall, wildlife managers can minimize negative impacts to wildlife and take advantage of positive aspects by planning ahead and employing adaptive management (Inkley et al. 2004).

3.3.8.10 Cumulative Effects of Anthropogenic Development and Activities

With an annual population growth of 2.2 percent on private lands elsewhere on the Peninsula, the integrity of the habitats provided by the Refuge over the past half century has become threatened by activities associated with the urban interface. Indeed, modeling of cumulative impacts by the Alaska Landscape Cumulative Effects Simulator (ALCES) Consortium shows that the three biggest drivers of future landscape change on the Peninsula are rural subdivision, overhanging culverts (watershed discontinuity), and climate change. These drivers are mostly outside the immediate control of the Refuge and other Federal estates (Kenai Fjords National Park, Chugach National Forest).

Although the Refuge is still quite natural over much of its 1,938,000-acre boreal forest landscape, the Refuge hosts more than 300,000 annual visitors, is one of only two refuges in Alaska on the highway system, and has been the site of commercial oil and gas activities since the early 1960s. The existing oil and gas infrastructure has 104 oil and gas pads, 188 wells, at least 90 buildings, 71 miles of pipelines, 94 miles of roads, and more than 1,800 miles of seismic lines. More than 22 miles of the Sterling Highway bisect the Refuge. Five gravel pits on the Refuge have been used to build some of these roads. The Refuge has constructed or now maintains 29 trailheads with 262 miles of trails, 13 campgrounds, 15 cabins, two visitor centers, two dump stations, the Moose Research Center, and other administrative buildings. In total, 56 square miles (145 square kilometers) or 1.9 percent of the Refuge has been developed for administration, recreation, education, maintenance, or commercial activities.

Cumulative fragmentation of the Refuge by continual improvements of the Sterling Highway and associated development of residential subdivisions is also of great concern. The total linear distance from the mouth of the Kenai River to the Seward Highway (along the eastern most edge of Kenai Lake) is 65 miles. After eliminating Kenai Lake and

Skilak Lake as natural barriers to wildlife movement, the remaining potential segment for north-south movement is 38.5 miles. However, the continuing urbanization in the Kenai-Soldotna-Sterling area and in Cooper Landing has severely bottlenecked corridors for landscape-level wildlife movement. Recently proposed highway improvement projects have great potential to restrict connectivity even more, reducing the available area for north-south movement by wildlife to less than 20 percent of the historical landscape.

The integrity of the Refuge is also threatened by the 26-mile Spur Highway extension to Point Possession adjacent to the Dave Spencer Wilderness Unit, and the extensive cabin and road development in the Caribou Hills adjacent to the southern boundary of the Andrew Simon Wilderness Unit. These urban interfaces greatly increase the likelihood of trespass by ATVs, poaching, DLP mortality of brown and black bears, litter, moose-vehicle collisions, noise and air pollution, wildlife disturbance, introduction and spread of exotic and invasive species, and fire suppression.

Indirect effects associated with environmental discontinuities due to administrative boundaries remain. The administrative boundary of the Refuge affects both structural and functional characteristics of the landscape. Because such effects may influence the ecology of the landscape and organisms inhabiting the landscape, they require specific management actions by Refuge personnel. Boundary effects may be serious enough to warrant conservation concern. For example, effects of land use on one side of the boundary may dictate management directives on the other to compensate for or ameliorate actual or potential impacts. Effects may include changes in species composition (e.g., habitat generalists, exotic and invasive species, early successional species); microclimate and soil conditions (Forman 1995); higher flux rates of nutrients, pollutants, and organisms (Landes 1998); and changes in landscape heterogeneity (Ambrose and Bratton 1990). Boundary effects may include changes in conditions favorable for competitors, predators, or parasites, which may affect adjacent lands having negative impacts on resident species (Landes 1998). Additionally, land-use or management activities occurring on one side of the administrative boundary may affect population dynamics of species of interest on the other. With more than 410 miles (660 kilometers) of administrative boundary and 472 miles (760 kilometers) of Wilderness boundary on the Refuge, the potential for significant landscape-level effects is high.

3.3.8.11 Effects of Culverts on Fisheries

Growth throughout Alaska, especially on the Kenai Peninsula, has dramatically increased in the last decade. With this increase in population has come an increase in the number of roads. The Refuge has 217 miles of roads within its boundaries; these roads cross 71 streams, 23 of which are catalogued as anadromous. The potential for

culverts to block or delay fish movement has long been recognized, but documentation about the extent of the problem has only recently begun (Rich [in review]).

Both anadromous and resident salmonids make upstream and downstream migrations. Many stream crossings create temporal, partial, or complete barriers for adult anadromous salmon during spawning and create flow barriers for juvenile salmon during seasonal movements (California Department of Fish and Game 1998). Temporal barriers can delay movement of fish for a period of time, resulting in limiting the distance adult fish can migrate upstream before spawning. Even if these stream crossings are eventually negotiated by adult fish, excess energy expended may result in their death prior to spawning. Culverts that are partial barriers exclude certain species during their life stages from portions of a watershed, while complete barriers exclude all species from portions of a watershed. These barriers limit the connectivity of habitats and can measurably reduce fish production in some watersheds (ADF&G 2003).

The connectivity of fish habitats is integral to supporting the abundance of fish species and their life stages found on the Refuge. Tributary streams, lakes, off-channel habitats, backwater areas, small ponds, and sloughs all provide critical fish habitat. Ensuring that these habitat components remain connected, allowing for the free migration of spawning adults and rearing juvenile fish, is critical for maintaining healthy fish populations.

ADF&G Habitat Division reviews requests for activities affecting anadromous fish streams and may issue permits for stream crossings, culvert installation or maintenance, and similar activities.

3.3.8.12 Loss of Biodiversity

Given the cumulating impacts of climate change, development inside and outside of Refuge boundaries, the loss of connectivity, and the increasing risk of invasive species, the potential loss of biodiversity is of great concern. The Refuge has documented more than 1,000 species of flora and fauna. Based on exhaustive species inventories in boreal forests in Sweden, the Refuge may have as many as 6,000–7,000 species. The collective lack of knowledge about which species exist on the landscape is disheartening given that accelerated climate change is expected to result in high rates of species extinction and population extirpation. The Refuge may lose much of its natural diversity before even becoming aware of the full extent of it.

3.3.9 Special Designated Areas

In addition to refuge status, the “special” status of lands within individual refuges may be recognized by additional designations, either legislatively or administratively. Special designation may also occur through the actions of other agencies or organizations. The influence

that special designations may have on the management of lands and waters within refuges may vary considerably. Kenai Refuge contains a number of special designated areas (Figure 3-20).

3.3.9.1 Legislative Designations

Kenai National Moose Range State Game Refuge

Alaska Statute 16.20.030 provides that "The land areas now included in the National Wildlife Refuge System that are cited in this subsection are designated a State game refuge, and the board shall assign them appropriate names . . . (8) Kenai National Moose Range. . . ." This legislative action has resulted in no specific regulations or follow-up actions.

Kenai River Special Management Area

The Kenai River Special Management Area (KRSMA) was formed as a unit of the Alaska State Parks System by legislative action in 1984. KRSMA encompasses those State lands and waters within the Kenai River watershed from Kenai Lake to Cook Inlet. KRSMA is managed by the Alaska Department of Natural Resources' Division of State Parks; management includes administering pubic uses and facilities within the area. Managers issue permits to guides, operate campgrounds and boat launches, and develop and enforce regulations to ensure environmental protection and public safety. KRSMA borders the Refuge and shares with the Refuge many of the same management objectives and public use responsibilities. While some jurisdictional issues remain unresolved between the Refuge and the KRSMA, a cooperative working relationship between staffs has proved successful in resolving potential management conflicts. The Refuge has a seat on the KRSMA board, which is an advisory body on State Park management issues that reports to the director of State Parks and to the Commissioner of Natural Resources. KRSMA is managed consistent with a management plan that was first completed in 1986 and revised in 1997.

Kenai Wilderness Area

The 1.32-million-acre (534,348-hectare) Kenai Wilderness, which was originally designated by Congress through the passage of ANILCA in 1980, consists of three units: the Dave Spencer Unit (187,228 acres [75,768 hectares]), which includes the Swanson River and Swan Lake National Recreation Canoe Trails; the Mystery Creek Unit (46,086 acres [18,649 hectares]); and the Andrew Simons Unit (1,087,094 acres [439,931 hectares]). The Kenai Wilderness is administered in accordance with applicable provisions of the Wilderness Act, ANILCA, and other laws and regulations governing management of the National Wildlife Refuge System.

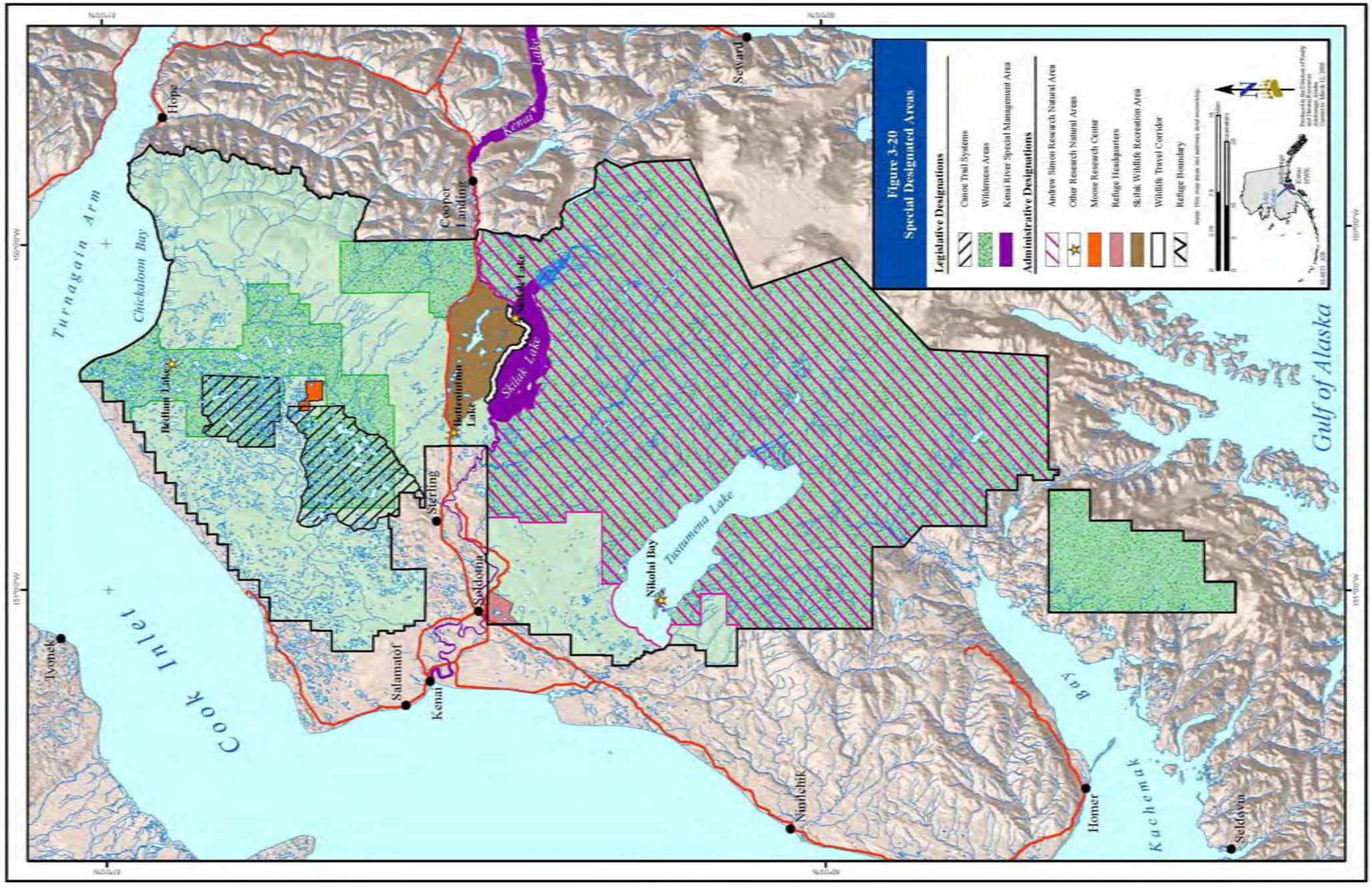


Figure 3-20. Special Designated Areas

National Recreation Canoe Trail System

The Kenai Refuge Canoe Trail System was originally constructed in the 1960s for the enjoyment of recreationists seeking a remote wilderness experience. As use increased in the 1970s, the need was recognized to formally set aside the system as a unit of the National Wilderness Preservation System, not only for wilderness recreation, but also to protect the habitat for wildlife requiring wilderness, including trumpeter swans, loons, wolves, and brown bears. In 1980, ANILCA created a new wilderness unit encompassing the Refuge Canoe Trail System. In 1981, the system received national recognition, becoming part of the National Recreation Trails System. The Kenai Refuge Canoe Trail System is separated into two areas: the Swanson River and Swan Lake routes. Both are located in the Refuge's northern lowland spruce and birch forest habitat. These canoe routes consist of lakes and rivers connected by water or land portages, creating a variety of trip options.

Research Natural Areas

The Service administers 210 Research Natural Areas (RNAs) on refuges nationwide, comprising a total of 1,955,762 acres. Kenai Refuge administers 5 of the 16 RNAs designated in Alaska, including the 830,000-acre Andrew Simons, 10-acre Bedlam Lake, 20-acre Bottinentnin Lake, 20-acre Nikolai Bay, and 20-acre Skilak Lake units. The current status of the Bottinentnin RNA is unclear; it may have been partially destroyed or degraded when the Sterling Highway was realigned.

3.3.9.2 Administrative Designations

Moose Research Center

The Kenai Moose Research Center (MRC) is a world-renowned, one-of-a-kind facility and continues to play an important role in the understanding of the nutritional, physiological, and ecological aspects of moose and other ungulates. The facility was established in 1966 as a joint effort by the U.S. Fish and Wildlife Service (Service) and the Alaska Department of Fish and Game (ADF&G). The original memorandum of agreement, signed in 1966, was updated in 2004.

The MRC is located in the Kenai Lowlands in the northern part of the Kenai Refuge and consists of four one-mile-square enclosures, two residence cabins, a workshop, a generator shed, a gas shed, a small field laboratory, and a barn and animal handling facility. The MRC was originally established to conduct research on the nutritional carrying capacity of typical Kenai Peninsula moose ranges and included research on the nutritional requirements and physiology of moose, the effects of habitat manipulation and browsing on moose-range carrying capacity, and the development of methods for measuring and monitoring moose-habitat carrying capacity.

Research has since broadened to include the development and testing of new immobilizing drugs on moose, the testing of moose capture and handling techniques, development of physical and physiological indices of moose condition and health, and the assessment of the genetic variability and heritability of physical traits (e.g., antler conformation) of moose. The MRC has also expanded its nutritional and physiological research to include caribou and now supports a research herd of approximately 25 animals derived from Nelchina caribou herd stock.

Skilak Wildlife Recreation Area

The Skilak Loop area was first recognized as a unique recreation destination in 1958 when it, along with the Chickaloon Flats and Skilak-Tustumena Benchlands, was removed from potential oil and gas leasing. Today, the 44,000-acre Skilak Wildlife Recreation Area is one of the most heavily used area, if not *the* most heavily used area, of the Refuge due to its close proximity to population centers, easy access, and diversity of public use facilities provided in a natural setting abundant with wildlife. Consumptive and non-consumptive recreational opportunities include camping, cross-country skiing, environmental education, hiking, hunting, nature photography, sportfishing, and snowshoeing. The Refuge's first administratively designated wildlife travel corridor is found within this area along the north shore of Skilak Lake. This one-half mile wide corridor, from Lower Skilak Lake Campground to the outlet of the Kenai River into Skilak Lake, will be free of development except for the existing Lower Skilak Lake Campground and Upper Skilak Lake Campground, which will remain as currently designed, and maintained to facilitate continued public use. See the Kenai National Wildlife Refuge Skilak Wildlife Recreation Area Revised Final Management Plan for more information.

3.4 Human Environment

3.4.1 Local History and Cultural Resources

The earliest prehistory of the Kenai Peninsula (Peninsula) is uncertain, known primarily from a handful of artifacts from undated contexts found at Beluga Point on Turnagain Arm, at Cooper Landing, and from various sites in Kachemak Bay. The oldest remains are assigned to the Paleoarctic tradition on stylistic grounds, with a distinctive tool kit consisting of blades and microblades struck from prepared cores. Sites elsewhere in Alaska indicate that this tradition dates to between 8000 and 4000 BC. One site on the lower Kenai River dated to 3300–3100 BC lacked diagnostic artifacts but likely represents a Northern Archaic occupation (Pipkin 1998). A slightly younger site (2500–200 BC) on the upper Kenai River may also be Northern Archaic. The tradition reflects a technology well adapted to the boreal forest and open tundra. The Kenai River sites suggest fishing played an important role in local Northern Archaic subsistence. Later materials from Beluga Point and

Chugachik Island in Kachemak Bay show affinities to the maritime Ocean Bay tradition from Kodiak and the Alaska Peninsula dating from 1900 BC to 1500 BC. Nothing similar has been found on the Kenai River.

The first long-term, intensive occupation of the region began about 1000 BC. It shows clear affinities to the Kachemak tradition of Kachemak Bay and Kodiak. On the Kenai Peninsula, an inland variant called Riverine Kachemak was based on harvesting salmon with seasonal hunting of big game. Riverine Kachemak is best documented from the Kenai River with several excavated sites in the vicinity of Moose River. Riverine Kachemak was strongly influenced by the Eskimoan Norton tradition of southwest Alaska. Between 500 and 900 AD, Kachemak people abandoned the Peninsula.

The Late Prehistoric period is also far from being well understood even though sites are numerous and widespread. Sites after 1000 AD show occupation and overlapping use of the area by both Alutiiq Eskimo and Dena'ina Athabascan people. The Kenai and Kachemak Bay Dena'ina are unique among Athabascans in having a partial maritime adaptation with technological elements adopted from Eskimo culture and given a uniquely Athabascan twist. Other Dena’ina groups, especially on the Kenai and Kasilof rivers, were fishermen and inland hunters.

Archeological studies on the Kenai Peninsula began in the 1930s. Since then, only intermittent and non-systematic work has been done with no comprehensive or systematic coverage of Refuge lands. Most of the Refuge has never been examined for cultural resources. Survey work has focused on very specific locations and usually as a response to development (e.g., in the Swanson River oil fields and along the Sterling Highway corridor). Surveys along the Kasilof and Kenai rivers have followed development of campgrounds and other recreational facilities.

Available information suggests that dry terraces near rivers and lakes, where most discoveries have been made to date, are likely to be the highest probability areas for site locations. Earlier Kachemak sites are characterized by large, shallow oval depressions representing deeply buried houses. In Kachemak Bay, ground slate tools predominated; but on the Kenai River, chipped stone tools were more important. Small, binotched pebbles (net sinkers) are probably the most common artifacts. More recent Dena’ina houses consist of large square house depressions, often with adjoining rooms and large prominent wall berms. Storage pits are also commonly found. Mounds of fire-cracked rock from steam baths and cooking fires are also prominent site features.

Few sites have been found around the lowland lakes north and west of Tustumena and Skilak lakes, but lakes with outlets to anadromous fish streams should be examined. The area south and west of Skilak and Tustumena lakes from about 400–1,000 feet (120–300 m) elevation and other areas of the Refuge above 1,000 feet may have been used for sheep and caribou hunting. Recent discoveries in melting ice and snow patches

in Canada and interior Alaska raise the possibility that sites, including well preserved organic remains, may be found around once permanent snowfields.

There are 104 known prehistoric sites on the Kenai National Wildlife Refuge (Refuge, Kenai Refuge). All of these sites are reported on the Alaska Heritage Resources Survey. Of the 104 sites, at least 21 are included within the Sqilantnu Archaeological District, which is eligible for designation as an Archaeological District by the National Register of Historic Places. An additional 44 sites below Skilak Lake outlet are included in the Stephanka's Village are also eligible. CIRI, Inc., has applied for five sites on the Refuge under section 14(h)(1) of ANCSA.

Historic records begin with the arrival of English Captain James Cook in 1778. From 1778 through 1794, several English, Spanish, and Russian expeditions explored Cook Inlet and traded with the Natives. By 1794, the Russian Lebedev-Lastochin Company had built forts at English Bay, Kasilof River, and on the north Forelands. In the late 1790s, the Kenai Peninsula Dena'ina obliterated the fort at the north Forelands and nearly destroyed Kenai, which was saved by the timely arrival of fresh Russian forces. By 1798, the newly established Russian America Company had a trade monopoly in Alaska. Fewer than 150 Russians occupied the area, but the economic system established during this time—which centered on furs—remained intact after the sale of Alaska to the U.S. in 1867.

In 1848, the mining engineer Petyr Doroshin explored Skilak Lake and the upper Kenai River for gold. Though he found traces of gold, he discouraged further development as unprofitable. Later American settlers continued to prospect the upper reaches of the river. In 1884, Joseph Cooper opened a trading post at Cooper Landing and panned gold from Kenai River and Cooper Creek. In 1890, a man named King found gold at Hope-Sunrise. In 1895, a small stampede occurred and up to 2,500 people worked Resurrection and Six-Mile rivers. A second rush in 1898 brought an estimated 10,000 people into the area. Small scale mining continued on the upper Kenai and by the early 1900s, to Indian Creek at the head of Tustumena Lake. During the 1930s, interest in the Kenai Lake region increased. Most of the miners eventually left the area for richer digs or turned to hunting, trapping, fox farming, and other activities to supplement their mining.

Fishing has been the oldest continuous industry on the Kenai Peninsula and with canneries, remains an important part of the local economy. The first cannery was built at the mouth of the Kasilof River in 1882, followed by others at Kenai (1888), Seldovia (1890s), and another at Kasilof in 1890. The fishing industry brought a large influx of people to the new towns along the coast.

In 1941, the Kenai National Moose Range (Range) was established to protect the moose found on the Kenai Peninsula. Establishing the

Range had a profound effect on local communities. In 1951, the Sterling Highway connected the Kenai Peninsula to the rest of Alaska, bringing more people into the region. Military personnel were encouraged to settle after World War II. In the mid-1950s, oil companies began to explore the northern part of the Peninsula along Swanson River. The Swanson River well, which began producing on July 23, 1957, has had far-reaching effects in Alaska—starting a major economic boom and leading to statehood for the territory.

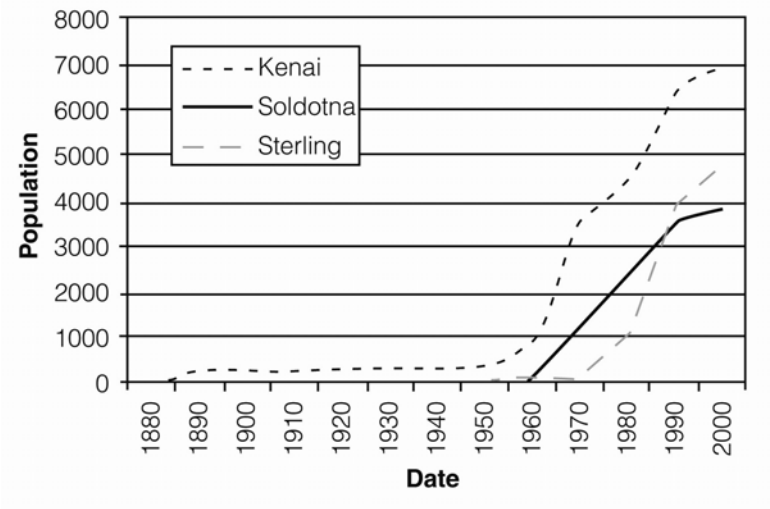
The Refuge has inventoried over 130 known historic cabins, but other historic resources, including those affiliated with mining, trapping, oil development, and road construction, have not been inventoried. The Refuge's Guide for Managing Cultural Resources (USFWS 1996) assists Refuge staff in meeting legal requirements to protect and manage cultural resources of the Refuge. It contains a list of relevant laws and guidelines and lists projects that are considered priorities for inventory, evaluation, protection, and dissemination of information.

3.4.2 Population

The Kenai Refuge lies within the Kenai Peninsula Borough (Borough), which is comprised of the Kenai Peninsula, Cook Inlet, and a large, mostly unpopulated area northeast of the Alaska Peninsula. In addition to Kenai Refuge, the Borough includes portions of Chugach National Forest and three national parks: Lake Clark, Katmai, and Kenai Fjords. The total population of the Borough was 50,980 in 2004 (Alaska Department of Commerce, Community, and Economic Development 2004b). The twin cities of Kenai and Soldotna, along with nearby Sterling, form the population center of the Borough. The Borough also includes the cities of Homer and Seward, numerous smaller communities along the road system, and several villages accessible only by boat or aircraft.

Although the City of Kenai was established before 1900, it experienced little population growth until 1957 when Alaska's first major oil strike occurred nearby. Commercial oil and gas development caused the population of Kenai and surrounding communities to explode from 1960–1970 (Table 3-2), while the populations of other Borough communities remained stable. After 1980, the other Borough communities also began to experience substantial growth as a result of high in-migration rates. The total population of the Borough has more than doubled since the first Kenai Refuge Comprehensive Conservation Plan (Plan) was completed in 1985. In recent years, the population has been increasing about two percent annually, compared to statewide growth of one percent per year (Alaska Department of Commerce, Community, and Economic Development 2004b). Table 3-3 shows population changes for selected Borough communities since 1960.

Table 3-2. Population spike in the Kenai area following the first major oil strike (1957)



** Pre-1960 data for Sterling and Soldotna are not available*
Source: Alaska Department of Commerce, Community, and Economic Development 2004b

Table 3-3. Population changes in selected communities, Kenai Peninsula Borough

Community	1960	1970	1980	1990	2000	2004
Soldotna	32	1,202	2,320	3,482	3,759	3,767
Kenai	778	3,533	4,324	6,327	6,942	6,809
Sterling	115	30	919	3,802	4,705	4,940
Homer	1,247	1,083	2,209	3,660	3,946	5,332
Seward	1,891	1,597	1,843	2,699	2,830	2,540
Cooper Landing	130	133	116	243	369	351
Anchor Point	171	102	226	866	1,845*	1,792
Moose Pass	136	53	76	81	206	220
Seldovia	460	437	479	316	286	263
Kenai Peninsula Borough	9,053	14,250	25,282	40,802	49,691	50,980

**The boundaries for Anchor Point were redrawn for the 2000 census.*
Source: Alaska Department of Commerce, Community, and Economic Development 2004b

The population of the Kenai Peninsula Borough is dwarfed by that of the municipality of Anchorage, which is only three hours by road and 15–20 minutes by air from Kenai Refuge. Anchorage is the largest city in Alaska, home to 277,498 people in 2004, or about 43 percent of the total State population (Alaska Department of Commerce, Community, and Economic Development 2004b). The Anchorage population has grown by nearly 100,000 since the first Kenai Refuge Comprehensive Conservation Plan was completed in 1985. At the same time, continuous road improvements have made travel between Anchorage and the Kenai Peninsula easier than ever.

According to data from the 2000 U.S. Census, about eight percent of Kenai Peninsula Borough residents identify themselves as all or part

Alaska Native. In comparison, Alaska Natives represent almost 17 percent of Alaska's total population (Alaska Department of Commerce, Community and Economic Development. 2004b). Nearly 87 percent of the Borough's residents identify themselves as white, compared to 71 percent statewide. Males comprise 52 percent of the Borough population.

The median age in the Borough is almost 37, which is four years older than the statewide median age. Nearly 18 percent of the Borough's population is over 55, versus 14 percent statewide. The slightly older Borough population may be due to more residents remaining when they retire and/or in-migration by retirees from other areas. The aging Borough population may be a significant force in the development of future economic and recreation patterns on the Kenai Peninsula.

3.4.3 Economy[2]

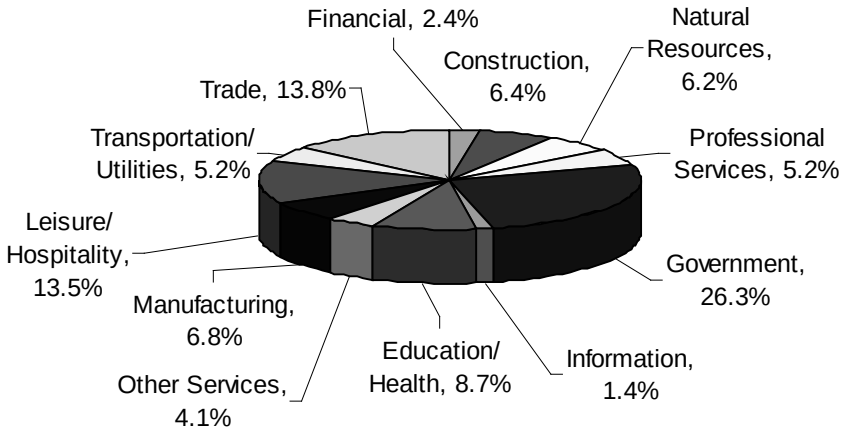
The Kenai Peninsula Borough economy is generally described as healthy and well diversified. Oil and gas production has been an important feature of the economy since Alaska's first major oil strike occurred near Kenai in 1957. Oil refineries operate just north of Kenai in Nikiski. Tourism is a second important component of the economy. State and Federal lands attract hundreds of thousands of visitors annually. The Kenai River is a major sportfishing destination for local residents, nearby Anchorage residents, and nonresident visitors. Other important economic sectors include commercial and subsistence fishing, fish processing, government, timber and lumber, agriculture, transportation, services, construction, and retail trade. Economic contributions from fish processing have declined since the mid-1990s, but the service sector (related to tourism) has grown and continues to grow.

3.4.3.1 Employment and Income

Overall employment growth in the Kenai Peninsula Borough has slowed considerably since the 1980s when it averaged five percent per year. During the 1990s, employment grew two percent per year, and growth has averaged one percent per year since 2000. The reduced pace of growth is primarily due to declines in commercial fishing and fish processing, the oil and gas industry, and timber. In contrast, the visitor industry has experienced substantial growth since the 1980s, adding several hundred jobs in the Borough since 2000. Health and social assistance employment has also grown substantially in recent years; it was the fastest growing employment category in 2002–2003. Government is the single largest employment category in the Borough. Local government employment has grown steadily in recent years, while State and Federal employment has remained stable. Figure 3-21 shows Kenai Peninsula Borough salary percentages by employment type for 2003.

[2]Except where otherwise noted, information in this section is from Fried and Windisch-Cole 2004. The Kenai Peninsula: An economy that benefits from diversity. *Alaska Economic Trends*, 24, 11, pp.3-17.

Figure 3-21. Kenai Peninsula Borough Salary Percentages by Employment Type, 2003



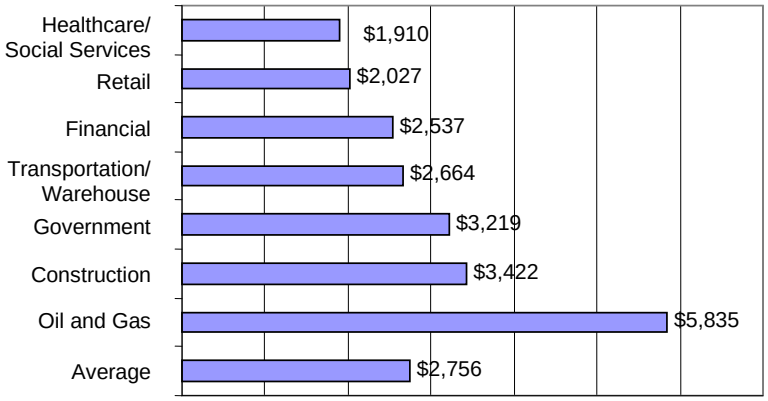
Per capita income in the Borough, adjusted for inflation, was $21,800 in 1999—well below the statewide average of $25,700. The median household income in 1999 was $46,397, and ten percent of the Borough population was living below the Federal poverty level (Alaska Department of Commerce, Community and Economic Development. 2004a).

Oil and gas is the largest source of high-paying jobs in the Borough, but declining production means that there are fewer of those jobs available; the industry lost 321 jobs from 2000–2003. Barring significant new investments in production and the current system of aging infrastructure, oil and gas income may continue to decline.

Commercial fishing, formerly the most important source of income for Borough residents, has also undergone significant declines in the last decade. These declines are due in part to reduced harvests, but in larger part to reduced prices for salmon. Participation in commercial fishing by Borough residents fell by 32 percent from 1992 through 2002. Seafood processing lost 572 jobs during the same period.

With the reduced roles of oil and gas, and commercial fishing, jobs in the service sector now play a larger role than ever in the Borough economy. However, incomes in the service sector, especially in healthcare and social services, are among the lowest in the Borough (Figure 3-22).

Figure 3-22. Kenai Peninsula Borough Average Monthly Incomes, by Industry (2003)



3.4.3.2 Economic Significance of Kenai Refuge within the Kenai Peninsula Borough Economy[3]

The Kenai National Wildlife Refuge contributes to the Borough economy primarily through the tourism and seafood industries. Refuge land and waters provide fishing and hunting opportunities, and a variety of non-consumptive activities such as hiking, boating, and wildlife watching. The Refuge also contains breeding and rearing habitat for substantial salmon populations that support fishing both on and off the Refuge.

Assessing what portion of the economic impact of any activity is directly attributable to the Refuge is difficult. A sport angler catching salmon on the Refuge is enjoying a resource that depended not only on Refuge habitat but also on several years of marine habitat. It is not possible to say what fraction of the dollars the angler spends are attributable to Refuge resources and what fraction is attributable to marine resources. Since there is no "correct" allocation of economic activities that depend on both Refuge and off-Refuge resources, it is best to analyze two different sets of activities. On-site activities are those that take place on Refuge land. Refuge-dependent activities include all on-site activities as well as off-Refuge activities that would not be possible without Refuge resources.

An estimated 303,000 visitors traveled to Kenai Refuge in 2004 for sportfishing, hunting, non-consumptive activities, or incidental purposes. The majority of these visits originated outside the Borough, either in southcentral Alaska (81,000) or outside the State (140,000). These visitation estimates, combined with visitor expenditure data collected in the mid-1990s by the Institute of Social and Economic Research (ISER) and the U.S. Fish and Wildlife Service, and commercial fishing data from Cook Inlet, provide the basis for an evaluation of the economic significance of the Kenai Refuge.

[3] Except where otherwise noted, this section is from Goldsmith, et al. 2005. *The Kenai National Wildlife Refuge: Economic Importance, 2004*. A report prepared for the U.S. Fish & Wildlife Service by the Institute of Social and Economic Research, University of Alaska Anchorage.

The economic significance of the Refuge is measured by the number of jobs and income (payroll) that visitor spending and a portion of the Cook Inlet commercial fishery generate within the Borough economy. Visitor spending creates jobs directly in the service, trade, and transportation sectors, and through the multiplier effect in many other industries. Commercial fishing directly employs some people and also supports jobs in fish processing. The estimates of jobs and income presented here were produced using the Alaska Input-Output model, developed at ISER for this purpose.

Using the same Alaska Input-Output model, ISER previously calculated the economic significance of Kenai Refuge based on visitation and commercial fishing values from 1997. The 1997-based calculations were published in 2000. In each of the following sections, where appropriate, both 1997 and 2004 estimates are provided for comparative purposes.

3.4.3.3 Economic Significance of Recreational Visits

Refuge visitors spent an estimated $23 million on their visits in 2004, compared to $21 million in 1997. These expenditures circulated in the economy, and additional jobs and payroll were produced through the economic multiplier effect. The estimated economic significance of Refuge visits in 2004 was about $10 million in payroll within the Kenai Peninsula Borough, compared to $8.7 million in 1997.

Refuge-dependent visitors (all on-site visitors plus those whose activities may have occurred elsewhere but relied on Refuge resources) spent an estimated $54 million in 2004, compared to $49 million in 1997. The economic significance of these expenditures was about $22 million in payroll and 995 annual jobs in 2004, compared to $20 million and 951 jobs in 1997. The increase in significance from 1997 to 2004 is mostly due to an increase in non-consumptive activities (Table 3-4).

Table 3-4. Economic significance of Kenai Refuge-dependent activities (1997 and 2004)

	Jobs (annual average)		Payroll ($millions)	
	1997	2004	1997	2004
Sportfishing	743	743	15.86	15.86
Sport Hunting	122	122	2.54	2.54
Non-consumptive uses	52	97	1.14	2.45
Incidental uses	34	33	0.70	0.83
Recreation	951	995	20.24	21.68
Commercial Fishing	542	323	20.21	6.63
Grand Total	**1,493**	**1,318**	**40.45**	**28.31**

3.4.3.4 Economic Significance of Cook Inlet Commercial Fishing

The Cook Inlet commercial salmon fishery is partially dependent on habitat provided by the Refuge; therefore, a portion of the economic activity associated with this fishery may be identified as Refuge-dependent. The annual value of the Cook Inlet fishery has declined

substantially since the 1980s, when the harvest was valued at about $79 million (in 2002 dollars). The annual value dropped to $43 million in the 1990s, and it averaged just $12 million from 2000 through 2003. Since the previous analysis of the economic significance of Kenai Refuge-dependent commercial fishing was completed in 2000 (using values from 1997–1998), payroll generated by commercial fishing has dropped almost 70 percent, and employment has declined by 40 percent.

For 2004, the estimated economic significance of Refuge-dependent commercial fishing and associated processing is $6.6 million in payroll and 323 annual jobs. In 1997–1998, the estimated economic significance of the Refuge-dependent commercial salmon harvest was almost $16 million in payroll and 438 jobs.

The total economic significance of Kenai Refuge combines jobs generated by Refuge-dependent recreational visits with those generated by Refuge-dependent commercial fishing and processing. This results in a total payroll of about $28 million and 1,318 annual average jobs for 2004. In 1997, total economic significance was estimated at $40.4 million and 1,492 jobs. The decline is wholly attributable to the declining value of the commercial fishery.

This section, however, only describes the economic significance of Kenai Refuge. Other aspects of the overall economic importance of Kenai Refuge are not included in this analysis. The annual operating budget for administration of the Refuge is substantial; it directly supports staff and also gives rise to additional jobs and income through the multiplier effect, but those jobs and income are not specifically analyzed here. In addition, expenditures by Refuge visitors do not all occur in the Borough—direct expenditures and their impacts also occur in gateways like Anchorage and eventually "leak" to other communities in and out of the State. Also, some commercial activities, such as petroleum production, are not included in this analysis. Finally, this analysis does not include an estimate of total economic value. Economic value is a measure of the amount of money people would be willing to pay to maintain the Refuge or any of its characteristics for all purposes.

3.4.4 Access

Kenai Refuge is one of only two Alaska refuges accessible from Alaska's contiguous highway system (Figure 3-23). Access to and within the Refuge is facilitated by natural features, such as lakes and rivers, and by constructed features, including utility corridors, seismic lines, roads, airstrips, and trails. Access to some portions of the Refuge is limited by management programs and regulations designed to protect resources from the impacts of heavy use.

3.4.4.1 Roads and Seismic Lines

When Kenai National Moose Range was originally established, it was a game range without roads in a largely undeveloped State.

Since that time, numerous factors have led to road expansion both within the Refuge boundary and across the Kenai Peninsula as a whole. There are now more than 650 miles of State-maintained roads in the Kenai Peninsula Borough and more than 100 miles of maintained roads within the Refuge boundary (Table 3-5).

Table 3-5. Roads within Kenai National Wildlife Refuge

Road Name	Length	Surface	Maintained By:
Refuge Roads			
Swan Lake	12.6 mi.	Gravel	USFWS
Engineer Lake Campground Road	0.2 mi.	Gravel	USFWS
Mystery Creek Access Road	13.7 mi.	Gravel	USFWS
Watson Lake Campground Road	0.2 mi.	Gravel	USFWS
Kelly Lake Campground Road	0.5 mi.	Gravel	USFWS
Peterson Lake Campground Road	0.8 mi.	Gravel	USFWS
Lower Ohmer Lake Campground Rd.	0.1 mi.	Gravel	USFWS
Refuge Headquarters-Area roads	0.2 mi.	Pavement	USFWS
Funny River Wood cut area	1.5 mi.	Gravel	USFWS
State Roads			
Skilak Lake Road	19.2 mi.	Gravel	AKDOT[a] and USFWS
Hidden Lake Campground Road	1.96 mi.	Pavement	AKDOT and USFWS
Upper Skilak Lake Campground Road	1.9 mi.	Gravel	AKDOT
Lower Skilak Lake Campground Road	0.9 mi.	Gravel	AKDOT
Funny River Road	6.0 mi.	Pavement	AKDOT
Ski Hill Road	1.5 mi.	Gravel	AKDOT and USFWS
Tustumena Lake Road	1.7 mi.	Gravel	USFWS and AKDOT
Sterling Highway	22.4 mi.	Pavement	AKDOT
Oil and Gas Roads			
Beaver Creek (Marathon Oil Road)	7 mi.	Gravel	Unit Operator
Swanson River Road	13 mi.	Gravel	Unit Operator
Swanson River Oil Field Network	20 mi.	Gravel	Unit Operator
Galena Spur (Finger Lakes Road)	3 mi.	Gravel	Unit Operator
Other Private Roads			
Alaska Pipeline Company/Enstar Corridor	38 mi.	Dirt/Gravel	Enstar/Alaska Pipeline Co.
Alascom Tower Access Road	0.2 mi.	Gravel	Alascom
State Comm. Tower Road	0.1 mi.	Gravel	State of Alaska

[a] *State of Alaska Department of Transportation*

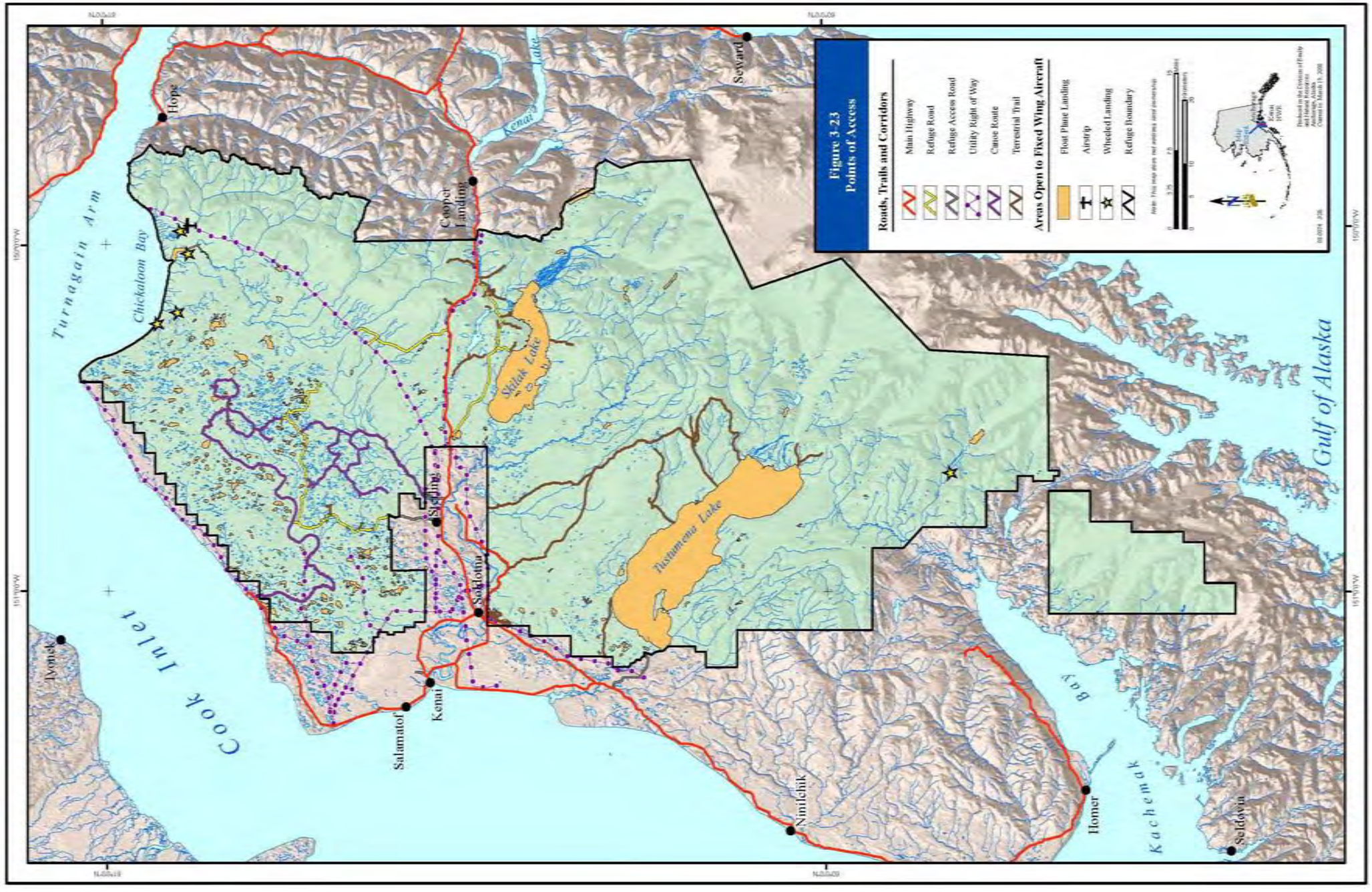


Figure 3-23. Points of Access

The first Sterling Highway route traversing the Refuge was built in 1946–1947, and Anchorage was eventually connected to the Kenai Peninsula in 1958. The present Sterling Highway was constructed in 1967, and it is now a major route for intrastate commerce and travel, and an important scenic and recreational access route. The highway is traveled by more than 4.5 million vehicles annually.

Oil and gas exploration and development have had a significant influence on road access and use within the Refuge. The Swanson River, Swan Lake, and Mystery Creek access roads originally built to support oil and gas operations are now open to public vehicles. Other industrial roads are used for hiking, snowmobiling, horseback riding, and administrative vehicle travel. The use of non-motorized wheeled vehicles, including bicycles, horse drawn wagons, and game transport carts, is currently permitted only on Refuge roads designated for public vehicle access.

In addition to formal roads, over 1,800 miles of seismic lines, cleared during exploration for oil and gas, traverse Refuge lands north of the Kenai River. On and off-Refuge seismic lines penetrate otherwise remote reaches of the southern Refuge within the Caribou Hills. These lines provide relatively easy recreational access to lands otherwise difficult to reach due to terrain or natural vegetation barriers.

3.4.4.2 Pipelines and Utility Right-of-Ways

Kenai National Wildlife Refuge has approximately 150 miles of utility and transmission lines, including roughly 70 miles of underground pipeline and several major electric transmission lines. Like seismic lines, portions of these corridors provide relatively easy recreational access to lands otherwise difficult to reach due to terrain or natural vegetation barriers.

A major gas pipeline corridor crosses the Refuge from the Sterling area north and east to Chickaloon Flats, passing beneath Turnagain Arm to Anchorage. Crude oil and natural gas pipelines connect the Swanson River Field to Nikiski. A portion of one pipeline and right-of-way corridor passes for approximately one mile through designated Refuge Wilderness near Point Possession, transmitting refined gas from refineries at North Kenai to the Anchorage area.

A major electric transmission corridor for two Homer Electric Association lines parallels the Sterling Highway and carries power to the western Peninsula. Other electric transmission and distribution line corridors traverse the Refuge near Soldotna and northeast of the city of Kenai.

ANILCA Title XI provides direction for allowing transportation and utility systems in and across conservation system units, including national wildlife refuges. However, most of the existing right-of-ways on Kenai National Wildlife Refuge predate ANILCA.

3.4.4.3 Airplane Landing Areas

Small airplanes have long been an essential mode of travel in Alaska. On Kenai Refuge, they are used in support of summer fishing on lakes and streams, ice fishing in winter, sight seeing, moose and other wildlife hunting, accessing remote cabins and locations for both short and longer stays, and other activities.

Alaska has 16 times as many aircraft per capita as the rest of the United States. According to 2005 Federal Aviation Administration (FAA) records, southcentral Alaska has more than 6,000 privately registered aircraft and nearly 7,000 licensed pilots. Anchorage, home of one of the busiest floatplane bases in the world (Lake Hood), is only about 30 minutes from the Refuge by air. As a result, Kenai Refuge receives a tremendous amount of airplane use. The greatest use occurs in summer and early fall in support of fishing and hunting activities. According to FAA records, the number of registered aircraft and pilots in Alaska has remained stable for the last twenty years. FAA Aerospace Forecasts (FAA 2009) project a one percent increase in the general aviation fleet from 2008 through 2025 and project the number of private and recreational pilots to remain static over this time period but the number of sport pilots to increase by 12.9 percent.

There are 40 registered landing fields on the Kenai Peninsula. The Kenai Airport is the primary airport serving the Refuge area, with instrument landing support and the capability to land 737 and/or 757 series aircraft. Within the Refuge are at least three functionally obsolete airstrips built in support of oil field construction or operation. These sites may be used for emergency landings, but they are not available for general recreational access. A fourth airstrip at Indian Creek, built in support of the Alaska Gas pipeline construction project, has so far remained useable due to volunteer maintenance efforts.

Beaches, lakes, and river bars also provide landing sites for small airplanes. There are 1,928 official lakes (greater than two acres in size) mapped on Kenai Refuge. Of these, 374 are within one mile of a trail or road. Assuming a minimum size of 16 acres and safe take-off distance of 1,000 feet, as many as 580 lakes within the Refuge are potentially accessible by float and ski plane. Some otherwise accessible lakes within the Kenai Wilderness are seasonally closed to airplane access to protect nesting swans.

The number of landable lakes on the Refuge was estimated by considering capabilities of the Piper "Super Cub." This provides a good representation of a common fixed-wing aircraft in Alaska capable of very short takeoffs and landings. The minimum safe distance required to take off from a lake is approximately 1,000 feet (given no obstacles, low elevation, sufficient wind, and temperature conditions). To determine if a specific lake was potentially landable, it was measured along its long axis. If the lake was less than 1,000 feet long, it was not

considered landable. A more general measure of a lake's landability was based on its size. On average, a lake that is at least 16 acres in size will produce one long axis greater than 1,000 feet. When assessing a large number of lakes for floatplane access, only lakes equal to greater than 16 acres were considered. Between 50 percent and 60 percent of the potentially landable lakes are estimated to be in Wilderness. The bulk analysis of water bodies was conducted using data created in 1975. In general this analysis assumes that lake area has not increased or decreased. However, studies have shown that many water bodies have decreased in size due to climate change and drying conditions.

Biological inventories have been completed for some, but not all, Refuge lakes. In general, lakes that support good sportfishing opportunities for trout, salmon, or char are larger lakes and/or are connected to streams. Many smaller shallow lakes have few or no sport fish but do provide important habitat for a variety of birds and mammals such as loons, ducks, swans, mink, muskrat, and beaver.

Airplanes may operate on all lakes outside the Kenai Wilderness except those lakes with recreational developments, including but not limited to campgrounds, campsites, and public hiking trails connected to road waysides. Lakes outside of designated Wilderness that are closed to aircraft operations include Afonasi, Anertz, Breeze, Cashka, Dabbler, Dolly Varden, Forest, Imeri, Lili, Mosquito, Rainbow, Silver, Upper Jean, Watson, Weed, and West. Additionally, all lakes in the Skilak Loop Area are closed to aircraft except Bottenintnin Lake (open year-round) and Hidden Lake (open for sport ice fishing only). Headquarters Lake, near Soldotna, is restricted to administrative use only. All rivers and streams of the Refuge are closed to the operation of aircraft except on the Kasilof River, Chickaloon River outlet, and the Kenai River below Skilak Lake from June 15 through March 14.

Within the Chickaloon Flats area, five designated landing sites—including three upland areas, a beach landing zone, and the unmaintained Big Indian Creek airstrip—or approximately 1.8 square miles, are open to wheeled aircraft. An additional 6.5 miles of the Chickaloon River are open to floatplane access.

Notwithstanding any other provision of Refuge regulations, the operation of aircraft is prohibited May 1–September 30, inclusive, on any lake where nesting trumpeter swans and/or their broods are present. The only exceptions are Windy, Scenic, and Lonesome lakes where the closure is May 1–September 10, inclusive. Refuge regulations and oversight of aircraft use do not extend to the airspace over the Refuge but do include all surface use, including landing, take-off, taxiing, practicing touch and go's, storage, and dropping people or items from the air to the ground (including aerial equipment drops or pesticide spraying).

All commercial use (such as air taxi operations), military exercises, and special events (such as air shows) require a special use permit. Personal and general recreational uses of aircraft do not require a Refuge permit. Smaller, personal aircraft such as powered parachutes and ultra-lights are also included in this description of aircraft and are permissible if they abide by all applicable Federal and State standards. Gliders and hang-gliders are not allowed on the Refuge. Any unlicensed aircraft may only operate on the Refuge under the conditions of a Refuge special use permit, which can include individual stipulations to help ensure compatibility and public safety. Refuge regulations (50 CFR 36.39 [i][1]) provide specific guidance on operating aircraft to ensure compatibility with Refuge purposes. The Refuge manager also has regulatory authority to temporarily or permanently restrict a use for cause (50 CFR 36.42).

3.4.4.4 Snowmachines

Snowmachine use on the Refuge includes activities related to small game hunting, trapping, ice fishing, travel to private cabins, and winter sightseeing; however, much of the use appears to be the recreational enjoyment of riding the machine with family or friends, practicing different maneuvers, or as part of other winter recreational pursuits. Snowmachine use receives special attention in ANILCA 1110(a) to protect traditional activities; however, traditional activities have not been defined for the Kenai Refuge.

Snowmachine use has been an evolving activity within the Refuge since it was first permitted. In the earliest years of the Kenai National Moose Range (Range), commercially manufactured snowmachines were unavailable and the Range was closed to motorized travel off established roads. With the initiation of oil and gas activities (ultimately permitting the use of some off-road winter travel to meet industrial needs) and the general availability of manufactured snowmachines to the public in the early to mid-1960s, public pressure increased to allow some public use of snowmachines in the Range. Such use was permitted by regulation as early as 1966 and justified as follows: "…due to a serious public relations problem, which had become critical with the development of oil and gas resources, this additional recreational use would contribute to support for and stability of the Kenai National Moose Range" (Federal Register 65-13680, 22 Dec 1965).

As early as 1966, regulations were put in place to restrict snowmachine use within the Refuge from areas important to wintering wildlife and/or other non-motorized Refuge uses. Many of the alpine areas and areas within the Swanson River and Swan Lake canoe routes were closed to snowmachine use (Figure 3-24). Snowmachines continued to be prohibited as an aid to big game hunting. In 1972, areas adjacent to the Refuge headquarters near Soldotna were put off limits to racing, and use of snowmachines on roads was also prohibited. Restrictions on the size of snowmachines (less than 40 inches wide) were maintained, and

additional adjustments to restrictions in alpine areas and within the Skilak Loop area were instituted. The 1985 Comprehensive Conservation Plan authorized 1.25 million acres (64 percent) of the Refuge to be open for snowmachine use December 1–April 30 but only after the Refuge manager determines adequate snow cover exists to protect underlying vegetation and terrain. All alpine areas have been closed to snowmachine use since 1986 with the exception of the Caribou Hills. "A single exception, the Caribou Hills, would remain open until the already heavy snowmachine use reached a level where it is adversely affecting wildlife or becomes incompatible with Refuge purposes or future management decisions" (USFWS 1985).

The allowable dates for snowmachine use have changed from January 1–March 31 to December 1–March 31; the dates are currently December 1–April 30. Under each set of dates, the opening and closing time was determined by the Refuge manager and announced to the public. The times of allowed use were authorized only when snow depths were sufficient to protect underlying vegetation and terrain. Table 3-6 chronicles the actual dates of snowmachine use on the Refuge from 1976 through 2006.

Due to variable weather conditions, the dependability of having suitable snow cover to allow snowmachine use on any given date each winter is uncertain. The open season for snowmachine use has varied 0–150 days; only once in 30 years has the Refuge been open to snowmachine use for the entire period potentially allowed by regulation. In three winters, there was inadequate snow accumulation to permit snowmachine use at all. During the other 27 years, snowmachines were allowed to use the Refuge an average of 109 days each winter.

Information on snowmachine use levels on the Refuge over time are largely anecdotal, but they are generally accepted as steadily increasing. In the Refuge's 1994 compatibility determination addressing snowmachine use, the manager wrote, "A single rider can easily travel 100–150 miles daily. Although exact figures are not known, as many as 150 snowmachines have been observed in a single day. Conservatively, 10,000–15,000 miles of snowmachine tracks may be laid on a single winter day."

Table 3-6. Dates and season of snowmachine use (1976 - 2006)

Winter	Date Opened	Date Closed	Season Length (days)
1976/1977	12/20/76	04/30/77	131
1977/1978	01/25/78	04/30/78	95
1978/1979	12/07/78	04/30/79	144
1979/1980	12/14/79	04/30/80	138
1980/1981	NOT OPENED		
1981/1982	12/01/81	04/05/82	125
1982/1983	12/01/82	03/23/83	112
1983/1984	01/06/84	03/17/84	71
1984/1985	03/06/85	04/26/85	51
1985/1986	NOT OPENED		
1986/1987	01/10/87	04/01/87	81
1987/1988	12/01/87	04/22/88	143
1988/1989	12/01/88	04/19/89	139
1989/1990	12/01/89	04/16/90	136
1990/1991	12/05/90	04/12/91	128
1991/1992	12/01/91	04/27/92	148
1992/1993	01/04/93	02/27/93	54
1993/1994	01/05/94	04/03/94	88
1994/1995	12/01/94	04/30/95	150
1995/1996	02/09/96	04/07/96	58
1996/1997	12/01/96	04/13/97	133
1997/1998	12/24/97	03/22/98	88
1998/1999	12/04/98	04/21/99	138
1999/2000	12/26/99	04/30/00	126
2000/2001	02/13/01	03/25/01	40
2001/2002	12/22/01	04/30/02	129
2002/2003	NOT OPENED		
2003/2004	12/13/03	04/18/04	127
2004/2005	12/18/04	03/19/05	91
2005/2006	01/22/06	04/09/06	77

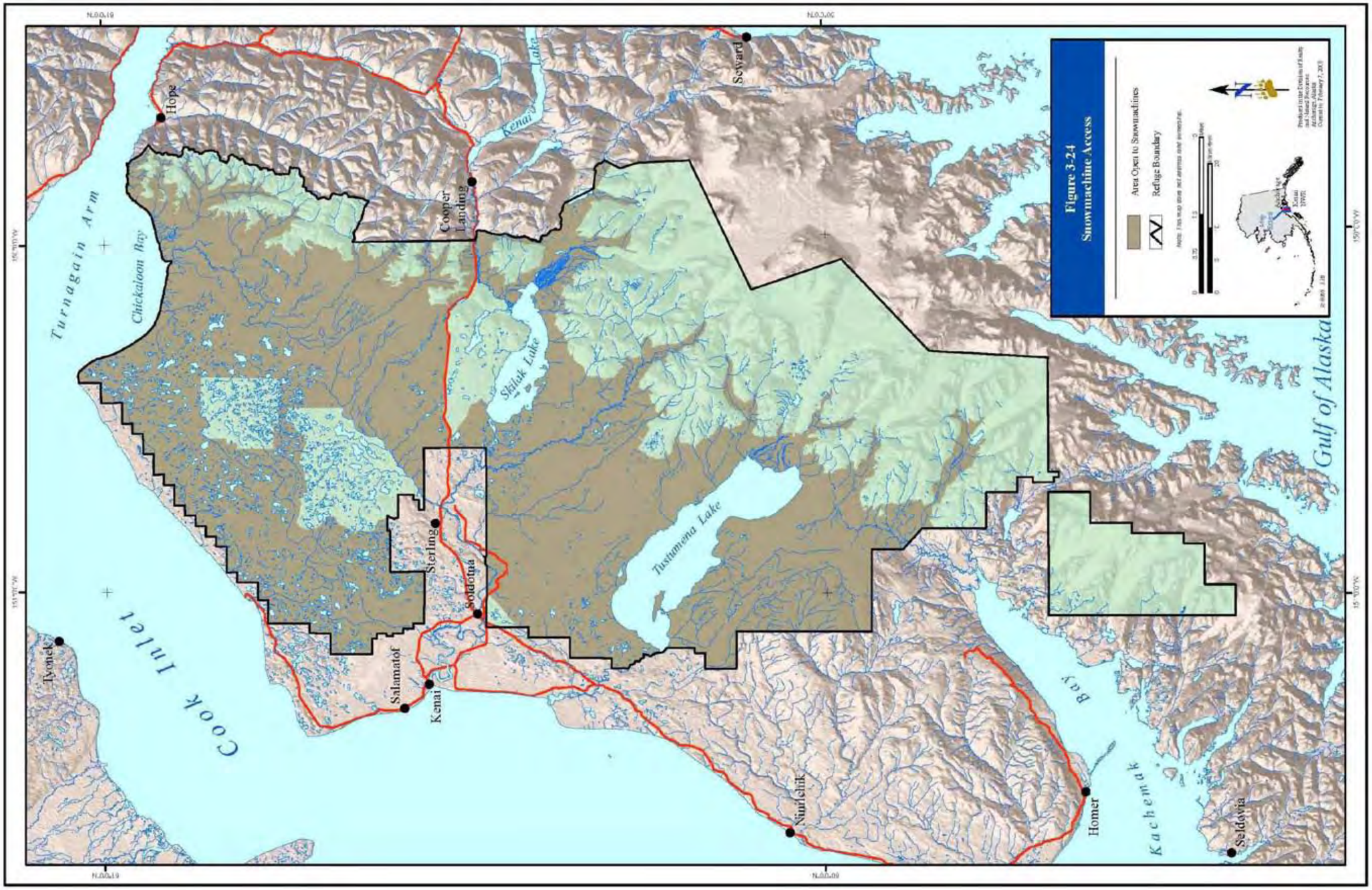
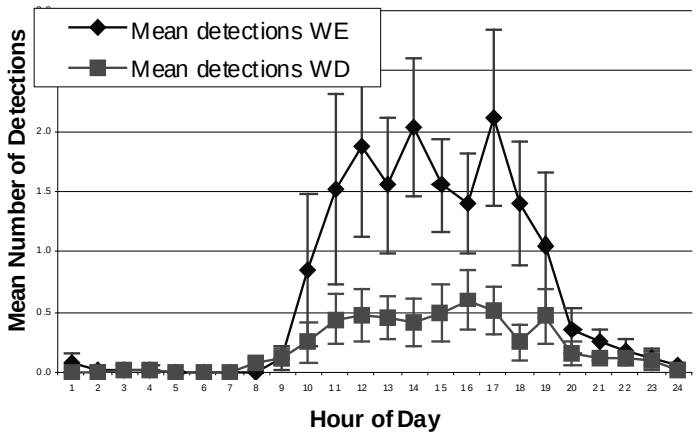


Figure 3-24. Snowmachine Access

In the past 20 years, snowmachine use has almost certainly increased due to increasing human populations on the Kenai Peninsula, increasing numbers of winter recreational cabins on State lands adjacent to the Refuge, and increased winter access via logging roads (salvage operations for spruce bark beetle-killed trees). In areas south and west of the Caribou Hills that are outside the Refuge boundaries, over 16 major snowmachine trails (over 130 miles) are maintained by private organizations, some of which are used to access the Refuge. Additionally, hundreds of miles of seismic lines are accessible in varying degrees to snowmachines. There are growing concerns that authorized use in the Caribou Hills may be exceeding levels compatible with wildlife and that unauthorized use in other alpine areas is increasing.

From early February 2005 to early March 2005, a first attempt was made to estimate snowmachine numbers entering the Refuge. In winter 2005, TRAFx™ off-road vehicle counters were installed at five off-Refuge sites: three at major trail heads south of the Kasilof River (Centennial, Clam Gulch, and Falls Creek Road) and two on Tinkle Trails, which is one of the known major entry points onto the Refuge in the Caribou Hills area. These counters detect the electromagnetic signature of passing snowmachines. Over a 25-day period encompassing four different weekends, as many as 510 snowmachines passed the sensor on Clam Gulch Trail. Most snowmachine traffic on these trails occurred between 9:00 AM and 8:00 PM (Figure 3-25). As expected, snowmachine traffic was higher on weekends than weekdays; the mean detection rate was 13.7 snowmachines per day on weekends in contrast to 3.7 per day on weekdays. On average, a snowmachine or a group of snowmachines passed every 42 minutes on weekdays and every 25 minutes on weekends. While the data represents off-Refuge use, an unknown percentage of these users are entering the Refuge.

Figure 3-25. Mean number of hourly snowmachine detections at five locations on the southern Kenai Peninsula (February 11, 2005–March 7, 2005)



Weekend (WE) vs. Weekday (WD)
Error bars represent 1 Standard Error
(Kenai National Wildlife Refuge unpublished data)

3.4.4.5 Rivers and Trails

Rivers —Rivers within the Refuge serve both as recreation destinations and as access routes to other destinations. Five major river watersheds on the Refuge encompass 44 named streams. Portions of each watershed are accessible by road, airplane, boat, and foot (Table 3-7).

Terrestrial Trails—There are approximately 110 miles (161 kilometers) of established trails on the Refuge, apart from the portage trails of the Swan Lake and Swanson River canoe routes (Table 3-8). Refuge trails have largely been unplanned, evolving from years of use by anglers, hunters, miners, and wildlife. The lack of planning is evident in such elements as trail width, tread, slope, and layout. The Refuge does not have a funded trail program or a policy for standardized trail construction and maintenance. In recent years, some minor trail improvement and maintenance projects have been completed with one-time funding and with assistance from Youth Conservation Corps and Student Conservation Association volunteers.

Horse use is permitted on Refuge trails. Most horse use occurs in conjunction with hunting and takes place on backcountry routes, seismic lines, and other de facto trails.

About 10 miles of trails around Refuge headquarters are groomed for cross-country skiing during periods of adequate snow cover. These trails complement nearby groomed trails at Skyview High School and are very popular with local residents.

A pilot study conducted by Refuge staff in 2004 used passive infrared counters to estimate temporal use of 12 trails during the period of July 10–August 4. Foot traffic was highest from 11:00 AM to 5:00 PM, peaking at 2:00 PM. It was highest overall on the weekends, particularly Sunday. Average trail use numbers jumped by approximately 90 percent from weekday to weekend day use. Of the trails evaluated during the 2004 study, the Kenai River Trail (1,179 people) and the Seven Lakes Trail (962 people), both within the Skilak Loop Wildlife Recreation Area, had the highest overall use.

Swan Lake and Swanson River Canoe Trails—These trails lie within the Dave Spencer Unit of Kenai Wilderness and they have also been designated as National Recreation Trails. Along with the Boundary Waters Canoe Area Wilderness in Minnesota, they are the only designated Wilderness canoe trails in the United States.

The Swan Lake Canoe Trail, constructed 1965–1967, is comprised of 30 lakes with interconnecting portages and a portion of the Moose River. It covers 60 miles (96.5 kilometers). The trail is used year-round, for canoeing, camping, fishing (including ice fishing), cross-country skiing, and trapping.

Table 3-7. River Access within the Kenai Refuge

River Name	Road Access[a]	Foot/Trail Access	Boat Access[b]	Aircraft Access[c]
Kenai River	Yes	Yes	Yes	Yes
Beaver Creek	Yes			
Benjamin Creek			Yes	
Cooper Creek				
Cottonwood Creek		Yes	Yes	Yes
Fuller Creek				
Funny River	Yes	Yes	Yes	
Hidden Creek	Yes	Yes	Yes	Yes
Jean Creek	Yes	Yes	Yes	
Killey River			Yes	
King County Creek			Yes	Yes
Moose River	Yes		Yes	
East Fork Moose River	Yes	Yes	Yes	
West Fork Moose River	Yes		Yes	
Pipe Creek			Yes	Yes
Russian River	Yes	Yes	Yes	Yes
Skilak River			Yes	Yes
Slikok Creek	Yes	Yes		
Surprise Creek			Yes	
Kasilof River	Yes		Yes	Yes
Bear Creek		Yes	Yes	Yes
Clear Creek		Yes	Yes	Yes
Crooked Creek	Yes			
Crystal Creek			Yes	Yes
Fox Creek				
Glacier Creek			Yes	Yes
Indian Creek		Yes	Yes	Yes
Moose Creek		Yes	Yes	Yes
Nikolai Creek			Yes	Yes
Shantatalik Creek			Yes	Yes
Chickaloon River	Yes		Yes	Yes
Big Indian Creek				Yes
Little Indian Creek				Yes
Mystery Creek	Yes			
Pincher Creek			Yes	Yes
Thurman Creek				
Swanson River	Yes		Yes	
Mink Creek	Yes			
Otter Creek				
Seven Egg Creek				
Swan Creek	Yes			
Fox River			Yes	
Clearwater Slough			Yes	
Sheep Creek			Yes	Yes

a Road access may be seasonal or off-Refuge
b Boat access may only be feasible on a portion of the river
c Aircraft access may be via the river mouth or other selected location(s)

The Swanson River Canoe Trail connects more than 40 lakes with 46 miles of the Swanson River, covering about 80 miles (128.7 kilometers). Uses are similar to those found on the Swan Lake Canoe Trail. Snowmobiling is authorized on the Swanson River portion of the trail during periods of adequate snow cover.

Some users of both trail systems have expressed concerns about heavy visitor use and crowding at certain times and locations. Peak weekend and holiday periods become congested on lakes and portages near the trailheads, but the extent of this congestion is not known—nor are the associated negative impacts. Most of the system is not designed to support heavy use. Trail construction is primitive with some log corduroy in wet areas, and maintenance is sporadic. There are no designated campsites, although many sites on lakeshores, portage trails, and islands have been "established" by years of public use. There are no toilets or other constructed facilities anywhere along the routes.

Self-registration logs are located at the three entrance points; they document visitor use from all 50 states and many foreign countries. Weekend recreationists from Anchorage are the primary users, though other local communities are also well represented. Peak seasonal use occurs from mid-May through late August; however, the area is also extensively used by hunters during moose season. Use of the canoe systems increased from about 500 individuals in 1965 to 4,200 in 1975 but then appeared to decline to a low of 1,540 in 1979. These changes in use may be real or just artifacts of the estimation methods used; self-registration logs are generally unreliable as an accurate measure of visitor use. Based on registrations, which represent an estimated 30 percent of use, the canoe trail systems received approximately 3,530 visitors during the 2004 season.

3.4.5 Facilities

The Refuge provides an array of facilities that support and encourage public use and protect Refuge resources. Among these facilities are a combined headquarters and visitor center, campgrounds, boat launches, interpretation and environmental education stations, and maintenance facilities.

3.4.5.1 Campgrounds

Within the Refuge are 15 formal campgrounds with toilets and other services (Table 3-9) and virtually limitless backcountry camping opportunities. Approximately 80,000 visitors spend the night annually in Refuge campgrounds and backcountry areas. While much camping is associated with fishing or hunting, and a portion is comprised of overnight stops by highway travelers headed to other destinations, an increasing amount is attributed to Peninsula and Anchorage residents whose primary purpose in coming to the Refuge is camping. This has been particularly evident since the rehabilitation of Hidden Lake campground in 1989 and Upper Skilak campground in 1992. Upgrades

at some of the smaller camping areas within the Skilak Wildlife Recreation Area and along Swanson River and Swan Lake roads have also occurred in recent years.

Table 3-8. Trails within Kenai National Wildlife Refuge

Trail Name	Length (miles, one-way)	Trailhead Access
Fuller Lakes	3.6	Road
Skyline	1.9	Road
Kenai River	5.0	Road
Hidden Creek	1.3	Road
Skilak Lookout	2.0	Road
Bear Mountain	0.8	Road
Seven Lakes	4.4	Road
Egumen Lake	0.3	Road
Surprise Creek	2.8	River
Cottonwood Creek	2.6	Lake
Mosquito Lake	<0.5	Road
Silver Lake	<1.0	Road
Forest Lake	<0.5	Road
Weed Lake	<0.5	Road
Drake/Skookum lakes	1.6	Road
Breeze Lake	<0.5	Road
Nest Lake	<1.0	Road
Funny River	10.4	Road
Keen-Eye	<1.0	Road
Headquarters Ski	10.0	Road
Lake Emma	3.5	Lake
Moose Creek	10.1	Lake
Bear Creek	10.3	Lake
Bear Mountain	0.8	Road
Burney's	0.6	Road
Engineer Lake	0.3	Road
Hideout	0.75	Road
Vista	1.5	Road
Centennial	1.9	Road
Upper Ohmer	<0.5	Road
Hansen Horse Trail	21.8	Road
Pollard Trail	7.2	Road/Lake

Table 3-9. Campgrounds

Campground	# of Campsites	Drinking Water	Boat Launch	Fee
Skilak Wildlife Recreation Area:				
Kenai-Russian River	9	Yes	Yes	$8.00–$10.00
Jean Lake	3	No	Yes	Free
Kelly Lake	4	Yes	Yes	Free
Peterson Lake	4	Yes	No	Free
Watson Lake	3	Yes	Yes	Free
Lower Skilak Lake	14	Yes	Yes	Free
Engineer Lake	3	Yes	Yes	Free
Lower Ohmer Lake	4	No	No	Free
Upper Skilak Lake	25	Yes	Yes	$10.00
Hidden Lake	44	Yes	Yes	$10.00
Swanson River Road:				
Dolly Varden Lake	12	Yes	Yes	Free
Rainbow Lake	3	Yes	Yes	Free
Swanson River	4	No	No	Free

3.4.5.2 Cabins

The Refuge cabin program has been significantly expanded since 2003. Restoration work has been completed on 14 historic cabins, and 5 new cabins have been constructed. A cabin management step-down plan, completed in 2004, provides details on maintenance and construction facilities, cabin locations and features, and cabin availability for public use (USFWS 2004).

Of the 13 cabins on the Refuge that are available for use by the public, 11 can be reserved in advance for a fee, and 2 are only available on a first-come, first-served basis (Table 3-10).

Table 3-10. Public use cabins

Cabin	Availability	Capacity	Access
Big Indian Creek	Reservation	6	Air, Snowmachine
Caribou Island	Reservation	6	Air, Boat, Ski, Snowmachine
Dolly Varden lake	Reservation	6	Boat
Doroshin Bay	Reservation	4	Air, Boat, Ski, Snowmachine
Engineer Lake	Reservation	4	Boat, Foot
McLain Lake	Reservation	6	Air, Boat, Snowmachine
Nurses Cabin	Reservation	4	Air, Boat, Ski, Snowmachine, Foot, Horseback
Pipe Creek	Reservation	4	Boat
Snag Lake	Reservation	6	Air, Snowmachine
Upper Ohmer Lake	Reservation	6	Road
Vogel Lake	Reservation	6	Air, Snowmachine
Emma Lake	First-come, first-served	6	Boat
Trapper Joe Lake	First-come, first, served	6	Air, Snowmachine, Ski

3.4.5.3 Interpretation and Environmental Education Facilities

Visitor Center—The Kenai National Wildlife Refuge Visitor Center provides interpretive displays and information for visitors, and shows wildlife related films. It also serves as the Refuge headquarters and provides office space to a majority of Refuge staff.

Environmental Education Center—Construction of the Environmental Education Center began in 2003 and was completed in 2005. The facility is a large (32 feet by 44 feet) log cabin adjacent to the Visitor Center and Keen Eye Nature Trail. The facility is available for education programs, Refuge-related meetings and trainings, and special events. The facility has two handicap accessible bathrooms, basic kitchen facilities, and a general meeting area with audiovisual equipment.

Visitor Contact Station—Five miles in the Refuge from the eastern boundary and at the west entrance to the Skilak Wildlife Recreation Area is the Visitor Contact Station. It is a small cabin with no electricity, one water pump, parking, and outhouses. It is open from Memorial Day through Labor Day every year to provide information and interpretative displays for visitors.

Outdoor Education Center—For educational groups planning a weekend to a week-long nature experience, the Kenai National Wildlife Refuge (Refuge, Kenai Refuge) maintains an overnight group activity area near the Swan Lake and Swanson River Canoe Trail systems. The Outdoor Education Center accommodates 30 visitors comfortably, and includes six sleeping cabins, a campfire area, picnic tables, a water pump, and outhouses. Educational groups may reserve this site free of charge but are required to help clean and maintain it.

3.4.5.4 Maintenance Facilities

Kenai Refuge maintenance facilities consist of a carpentry shop, a service shop, and an eight-stall vehicle storage warehouse (Table 3-11). The carpentry shop contains power equipment used for building wooden signs and for maintaining other Refuge facilities. In winter, the carpentry shop doubles as a warm storage area for vehicles and diesel powered heavy equipment that would otherwise be unusable due to cold temperatures. The service shop has two light-vehicle lift bays and a welding room, and contains a complement of heavy and light vehicle tools and equipment. It also houses an office area used by maintenance personnel for computer access and file storage, and as a break room. The eight-stall vehicle storage warehouse is a repository for spare parts requiring warm storage. It was modified in 2005 to house two offices for computer access and file storage.

Table 3-11. Maintenance facilities

Facility	Square Footage	Date Constructed
Carpentry shop	2,000	1982
Service shop	2,880	1980
Eight-stall dry storage	2,900	1982

3.4.5.5 Administrative Facilities

Kenai Refuge administrative facilities include a combined headquarters and visitor center building, which houses the bulk of administrative offices. About 2,500 square feet of this almost 10,000-square-foot building is dedicated to visitors. The visitor's area includes 12 static displays, a sales area dedicated to the Alaska Natural History Association, and a 30-seat audiovisual room. A Refuge residence (bunkhouse) was converted to office space in 1998 and is used by fire management personnel for computer access and file storage. The Environmental Education cabin has a 600-square-foot loft used as office space by the environmental education coordinator and seasonal staff. The Refuge aircraft hangar has a 160-square-foot area used as office space by Refuge pilots. The hangar can also be used during surge operations as an administrative center or command post due to the multiple phone line connections and power outlets installed there. For a complete list of facilities in the headquarters area, see Table 3-12 in section 3.7.1.1.

3.4.6 Public Uses

Kenai Refuge supports opportunities for wildlife-dependent recreation and associated activities, commercial services, and limited subsistence activities for qualified area residents. In the spring, summer, and fall, activities include freshwater fishing, big game and waterfowl hunting, sightseeing, wildlife viewing, rafting, camping, and hiking. During the winter, activities include trapping, cross-country skiing, snowshoeing, snowmobiling, and dog mushing. The Refuge is one of the most visited conservation system units in the State and the most visited Alaska refuge. In 2004, an estimated 500,000 people visited the Refuge, and an estimated 4.5 million viewed it as they drove through on the Sterling Highway.

The multitude of methods and locations by which visitors can access the Refuge make accurate, comprehensive estimates of use numbers very difficult; year-to-year comparisons should be made with caution. However, evidence from selected locations and programs within the Refuge indicates that participation in many Refuge activities has increased substantially since the first Kenai Refuge Comprehensive Conservation Plan (Plan) was completed in 1985. Fishing participation on the Kenai River, which has long been among the most popular Refuge activities, has more than doubled in the last 20 years; and the number of commercial services permits issued for the Refuge has

grown from 32 in 1985 to 194 in 2005. Indirect evidence also suggests that public use has increased. For example, the population of Anchorage has grown by about 100,000 people, the population of the Kenai Peninsula Borough has doubled, and summer traffic on the Sterling Highway has also doubled—all since 1985.

3.4.6.1 Fishing

The Kenai Refuge has long played a vital role in the popular recreational fisheries on the Kenai Peninsula. Several recreational fisheries occur on the Refuge, and others that occur off the Refuge are supplemented with Refuge-produced fish. These fisheries contributed 90 percent of the salmon, 77 percent of the rainbow trout, 64 percent of the Dolly Varden/Arctic char, and 57 percent of the lake trout caught in freshwater by recreational anglers on the Kenai Peninsula during 1993 (USFWS 1995). The rate of growth in participation and economic importance of recreational fisheries on the Kenai Peninsula is unequaled elsewhere in the State of Alaska. In the 15-year period of 1981–1995, inclusive, sportfishing effort on the Kenai Peninsula doubled (Mills 1992, Howe et al. 1996). During that same period, sportfishing effort on the Kenai River increased by 11 percent.

Kenai and Russian Rivers—The Kenai River and Russian River areas have experienced the greatest increase in public use and commercial services of any area on the Refuge. The Refuge includes 10 miles of the river above Skilak Lake (referred to as the upper Kenai River) and 5.5 miles below the lake (the middle Kenai River). Despite increasing use and seasonally intense angling pressure, the upper Kenai River provides important habitat for wildlife and is the most scenic and primitive stretch of the entire 82-mile river. In addition to its world famous sportfishing opportunities, the upper Kenai River supports one of Alaska's most popular non-angling float trips and commercial ventures providing scenic rafting adventures. Most public use on the upper Kenai occurs during the summer months, although fall use has increased significantly in recent years, and some fishing occurs in every season of the year.

The period since completion of the current Kenai Refuge Plan has been one of especially intense use and change on the Kenai River. The River is well known to many people due to stories and photos of shoulder-to-shoulder "combat fishing" along a short section of the bank where salmon tend to hold before moving upstream to spawn. Improvements at various put-in and take-out locations have facilitated ever-increasing boat-angling use.

While it receives much less use than the Kenai River system, the Swanson River, with its tributaries and lakes, is also a popular watershed on the Refuge. Rainbow trout and coho salmon are the most popular sport fish species in the Swanson River drainage. Most of the

public use occurs in the summer and fall; however, some lakes are also popular ice fishing destinations in the winter.

Other popular fishing areas on the Refuge include Hidden Lake, Tustumena Lake, Skilak Lake, and the Kasilof River—all of which are road accessible.

Crowding on the Kenai River—Concerns about the rapid increase of sportfishing and human settlement along the Kenai River's shorelines have been mounting for decades. Heavy visitor use has caused dramatic vegetation trampling and bank erosion along some portions of the river, as well as regular incidents of visitor competition, occasional accidents, and even outright altercations. Partially in response to these concerns, the State Board of Fisheries adopted a registration program for sportfishing guides in 1982, and the Refuge limited the available number of upper river guide permits. The number of State-registered guides on the Kenai River has grown from 171 in 1985 to 408 in 2005. The number of Refuge-permitted guides on the upper river (where guides are limited) has held steady at around 20, while the number of middle river permits has grown moderately each year to a high of about 115.

The Kenai River Carrying Capacity Study, conducted in 1992 (Shelby and Whittaker 1993), revealed that 86 percent of upper Kenai, non-motorized boaters experienced some degree of crowding on high use days, and 73 percent reported crowded conditions on low use days. These values were among the highest for perceived crowding at the 18 locations in Alaska and the lower 48 states where boaters were similarly surveyed (Shelby and Whittaker 1993). Only slightly fewer respondents considered the middle Kenai River to be crowded (67 percent of non-motorized boaters surveyed on high use days, and 55 percent on low use days). Following the carrying capacity study, a State-Federal interagency team prepared a formal plan—the *1997 Interagency Upper River Cooperative Plan*—to act on findings from the effort. Although the plan was signed by State and Federal officials, it was not fully implemented.

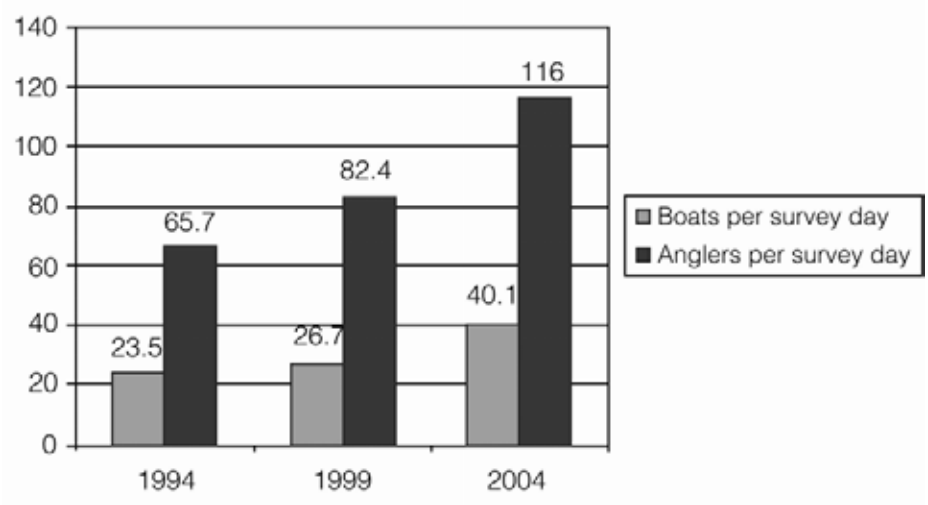
Upper Kenai River—On the upper Kenai River within the Refuge (from the boundary at the confluence with the Russian River downstream to Skilak Lake) the number of guides and guided trip starts has been limited since 1983; the current Refuge limits are 20 permitted guides, each allowed 10 trip starts per week (but no more than 4 on a given day). Despite the established boat and start limits, guided use has increased by about 30 percent in the last five years. Based on annual reports required from the permitted guides, 2004 use was about 8,020 client-days during the general fishing period of June 15–October 15 (approximately 12 weeks).

In addition to issuing a limited number of guide permits, an unlimited number of guides may be issued one Incidental Use Permit each year. Incidental permits are intended for guides who only occasionally or

"incidentally" operate on the Kenai River within the Refuge. Each permit holder is allowed up to three starts per season. From 2003–2005, an average of 21 incidental permits were issued for the upper Kenai River for fishing guides.

The guide limits in place for more than 20 years mean that much of the increased fishing use on the upper river has been in the form of unguided use. Unguided visitors must comply with general State and Refuge regulations, but they are not required to obtain a permit or comply with any special stipulations. Current management allows for unlimited use of the upper river between river mile (RM) 65 and 74 by boaters without guides. Boater access is restricted by default to three public boat launches. In 1994, an average of 66 anglers per day used this section of river from June through September, while in 2004, an average of 116 anglers per day used this same section (Figure 3-26).

Figure 3-26. Boat angling counts on the upper Kenai River (summer season)



Source: Kenai National Wildlife Refuge unpublished data

In addition to fishing, the upper Kenai River has also become a popular attraction for scenic floating. Use of the upper Kenai River for guided scenic floats has increased over the years with over 6,800 clients reported in 2002 and 2003. As with the special use permits for guided angling, the number of permits that can be issued is capped at 20 but with no restriction on the number of annual starts per permit. The Refuge issued an average of 19 permits in 2002–2005. Although the ceiling for permits was almost met, only a few guides were actually focusing efforts toward scenic float trips. Since then, 90 percent of the client use was reported from 2 of the 19 permitted float guides. However, if all special use permits for scenic floats used rafts and maintained a schedule similar to the peak users of the permit program, the use of this section of the river could increase dramatically over current levels without increasing the current 20-permit cap.

Middle Kenai River—The middle Kenai River is defined as RM 45.5 to 50, from Skilak Lake downstream to the Refuge boundary. The south shore of the middle Kenai River is designated Kenai Wilderness, and the north side is roadless land within the Refuge. The unguided public is allowed on this section of the river without restriction on the number of users, and sportfishing guide permits are issued without limit.

The Kenai River Special Management Area administrated by the Alaska Division of Parks provides additional public use, commercial, and habitat protection regulations for much of this section of the river.

In 2005, 114 special use permits were issued to individuals or businesses to provide guided sportfishing and other Refuge activities on the middle river. However, commercial use of the area is not confined to those with only a Refuge visitor services permit. The Alaska Division of Parks and Kenai Refuge maintain a cooperative agreement, and Refuge regulations assimilate State of Alaska Kenai River Special Management Area (KRSMA) permittees. Guides with a valid Kenai KRSMA permit do not need a Refuge permit for operations downstream from Skilak Lake to the Refuge boundary (river mile 45.4) if activities are confined to the Kenai River water column and access is gained from downriver. This cooperative program affects motorized boats, as drift boats logistically would have to use Lower Skilak boat launch, which requires a Refuge permit. In 2005, some 367 motor operating guides obtained KRSMA permits. In 1985, when the cooperative program was also in place, only 131 motorboat guides held KRSMA permits.

In 2004, personnel from the Kenai Fish and Wildlife Field Office conducted pilot surveys in this section of the river to try to quantify the amount of use by guided and unguided users. These surveys identified a peak count in July of 117 shoreline anglers and 69 boat-based anglers; 25 percent of the boat anglers were guided. Seventy-one percent of the boat anglers were fishing within the Refuge boundary and 27 percent of the shoreline-based anglers were on the Refuge. This survey found that 82 percent of the boats observed were motorized.

3.4.6.2 Hunting and Trapping

Hunting—Hunting is a popular public use of the Kenai Refuge. Most of Game Management Units 15A and 15B—and parts of units 15C and 7—are on Refuge lands. Within the Refuge is a trophy moose management area where hunting is allowed on a permit basis. Part of the Refuge north of the Kenai River is in a special unit where State regulations favor non-aircraft hunters, and the Skilak Wildlife Recreation Area also has special regulations for hunting.

The Refuge receives significant moose hunting pressure due to its relative accessibility from nearby population centers and the prime moose habitat that the Refuge offers. Dall sheep and mountain goat

hunters also utilize the Refuge heavily, although access to the high country areas these species inhabit is a strenuous undertaking. Upland birds and migratory waterfowl also attract hunters but not in numbers or concentrations described for moose.

The most common big-game species taken by hunters on the Refuge include: moose (*Alces alces*), Dall sheep (*Ovis dalli*), black bears (*Ursus americanus*), brown bears (*Ursus arctos*), and wolves (*Canis lupus*) (Figure 3-27 to Figure 3-31). Other frequently harvested species include spruce grouse (*Dendragapus canadensis*), willow ptarmigan (*Lagopus lagopus*), snowshoe hares (*Lepus americanus*), and fur animals, including coyote (*Canis latrans*), red fox (*Vulpes vulpes*), lynx (*Lynx canadensis*), and red squirrel (*Tamiasciurus hudsonicus*).

Figure 3-27. Moose Harvest on Game Management Units within Kenai Refuge (1984–2005)

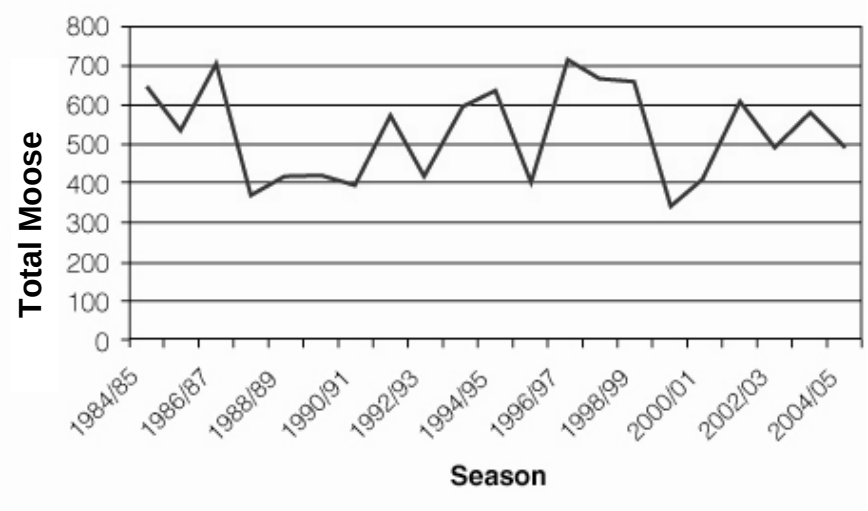


Figure 3-28. Black Bear Harvest on Game Management Units within Kenai Refuge (1985–2004)

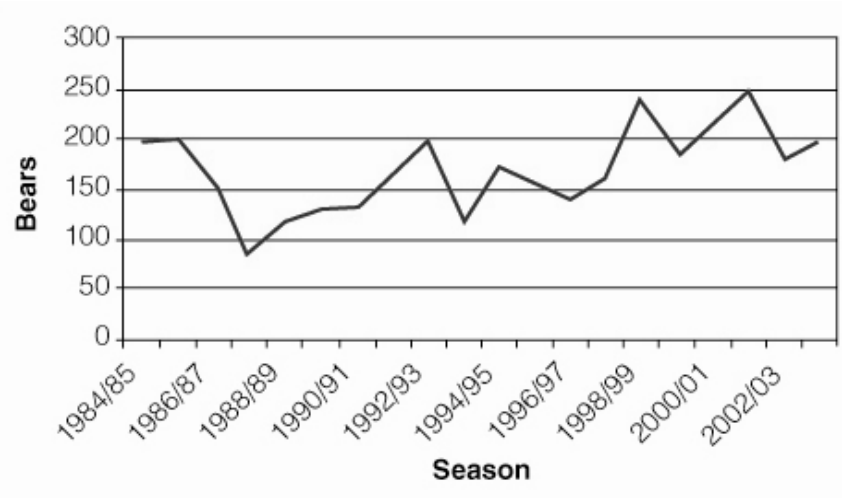


Figure 3-29. Brown Bear Harvest on Game Management Units within Kenai Refuge (1985–2005)

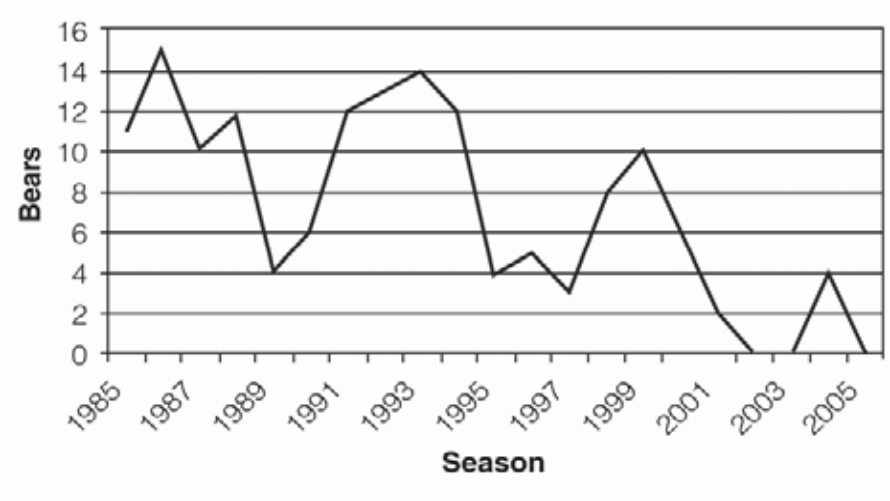


Figure 3-30. Dall Sheep Harvest on Game Management Units within Kenai Refuge (1985–2005)

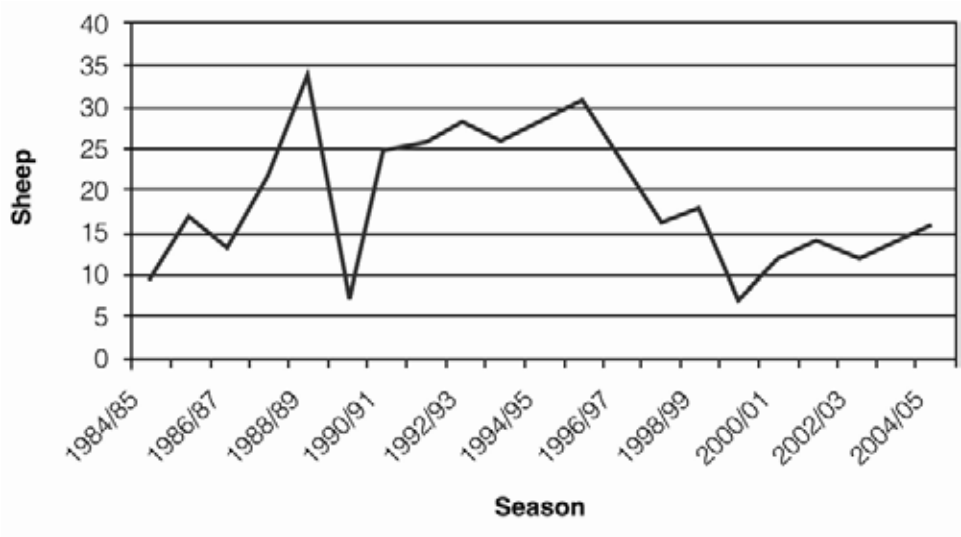
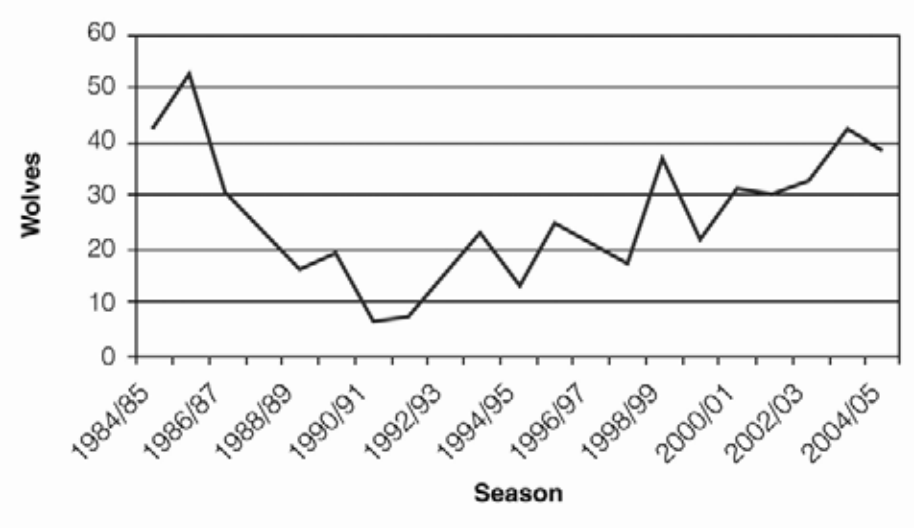


Figure 3-31. Wolf Harvest on Game Management Units within Kenai Refuge (1985–2005)

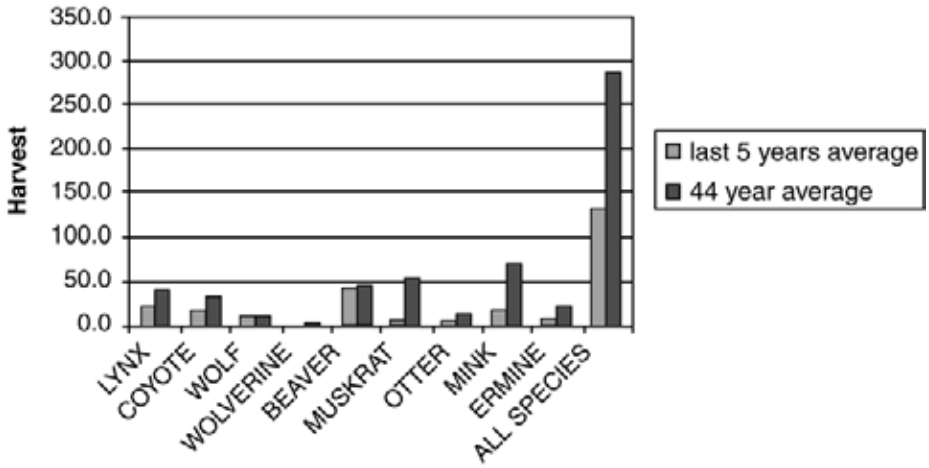


Access for hunting is available by registered motor vehicle on roads open to the public, and by foot, boat, horse, snowmachine, and aircraft. The use of wheeled carts to facilitate transport of harvested game is allowed on the Refuge only on roads open to registered motor vehicles. State regulations restrict access by aircraft to protect hunting opportunities for those unable to use aircraft.

The Skilak Wildlife Recreation Area was established in 1985 to provide increased opportunities for wildlife viewing and other non-consumptive forms of recreation. This area is closed to hunting and trapping except for a limited-permit cow moose hunt in September, taking of small game by bow and arrow October 1–March 1, and a limited firearm youth hunt for 18 days from November 1–March 1.

Trapping—Trapping remains an important activity for some Refuge users, but the popularity and success rate have waned in recent years. The ratio of the number of trapping permits to the residential population on the Kenai Peninsula has declined substantially. Also, the reported harvest of most species during the last five years is only about half of the 44-year average (Figure 3-32), suggesting reduced effort on the part of trappers.

Figure 3-32. Average trapping harvest on Kenai Refuge



3.4.6.3 Wildlife Viewing and Photography

A combination of habitat variety; abundant wildlife and fish populations; easy access by road, trail, or water; and wide ranging recreation facilities gives Kenai Refuge visitors outstanding opportunities for wildlife observation and photography. A variety of hiking trails and roadside lakes provide wildlife viewing and photography opportunities for moose, brown and black bear, lynx, and various waterfowl, raptors, and passerines. The Swan Lakes and Swanson River canoe trails are excellent venues to observe waterfowl, moose, and passerines. Bald eagles may be seen virtually anywhere on the Refuge; Dall sheep and mountain goats can regularly be observed from passing vehicles on hillsides along the Sterling Highway.

Refuge areas along Funny River Road south of the Kenai River provide visitors with additional opportunities to observe wildlife such as moose, raptors, and passerine birds. The Funny River firewood cutting area offers a gravel roadbed behind a locked gate, which provides foot access for approximately two miles into and through boreal forest with a variety of age classes of spruce and hardwoods, and cutover areas that provide early vegetative growth attractive to moose. Many Refuge locations are also designated as sites included in the Kenai Peninsula Wildlife Viewing Trail—a Peninsula-wide system that directs visitors to wildlife viewing "hot spots" on various State and Federal public lands.

Skilak Wildlife Recreation Area (Skilak WRA)—This 44,000-acre (17,806-hectare) wildlife recreation area (WRA) located between Skilak Lake and the Sterling Highway is managed to provide easily accessible opportunities for wildlife observation, interpretation, and photography. It is one of the most heavily used areas, if not the most heavily used area, of the Refuge due to its close proximity to populations centers, easy access, and diversity of public use facilities provided in a natural

setting. Recreational choices range from passive to active recreation and occur throughout the area during all seasons of the year. In the spring, summer, and fall, recreation activities include archery hunting, camping, freshwater sportfishing, hiking, nature photography, sightseeing, and wildlife viewing. During the winter, recreation activities include cross-country skiing, snowshoeing, and wildlife viewing. Most visitors participate in several activities while using the area. A step-down management plan, environmental assessment, and Finding of No Significant Impact was signed by the U.S. Fish and Wildlife Service (Alaska Regional) in May 2007 to provide direction for enhancement of public use facilities and programs in the Skilak WRA.

3.4.6.4 Interpretation and Education

Interpretation—Each summer, three Student Conservation Association resource assistants give the majority of interpretive programs. These programs include nature walks at the visitor center and campfire programs at Hidden Lake campground. In addition, special youth programs are offered each summer at the Kenai Refuge Visitor Center and at Hidden Lake campground. Interpretive programs are designed to highlight Refuge wildlife, natural history, and management. Refuge interpretive programs were attended by 1,457 participants in 2003; 1,274 in 2004; and 1,174 in 2005.

As campgrounds are renovated or new sites developed, site-specific interpretive panels are designed and installed. Presently, Hidden Lake campground has 18 panels installed, and upper Skilak and lower Skilak campgrounds each have 6 panels. Interpretive panels have also been installed at waysides along the Skilak Loop Road and at Jim's Landing. Additionally, graphics for panels to use in Refuge bulletin boards have been developed that relate wildlife observation and other recreational opportunities available in the area.

The Refuge has offered a popular weekend wildlife film series on a year-round basis since 1982. Over 100,000 people have attended these programs and gained an increased understanding and appreciation of Refuge wildlife. On weekdays during the summer months, the Refuge video, "Where Wildlife Comes First" is presented to help orient visitors to Refuge management and recreation programs.

Education—The Refuge environmental education program includes school group field trips, youth group programs, teacher and youth leader training workshops, the Outdoor Education Center, and the Youth Conservation Corps. A full-time environmental education position to provide curriculum development, continuity with the education community, and efficient operation of the Refuge environmental education program was identified and filled in 2001. Refuge environmental education programs were attended by 1,863 participants in 2003; 2,276 in 2004; and 2,630 in 2005.

On October 1, 2005, the Environmental Education Center was officially dedicated to the community. The facility is used for education programs, teacher training and workshops, and staff training. Programs are being developed to provide education opportunities for home school families, youth groups, and visitors year-round.

The Refuge Environmental Education Center, adjacent to the three-quarter-mile "Keen Eye" Nature Trail is visited by over 2,500 school age youth each year. Students have participated in field trips, which include interactive, hands-on indoor and outdoor activities on specific themes based on Kenai Peninsula Borough School District standards.

Youth groups generally have more abbreviated visits than schools. Activities focus on specific group interests that coincide with Refuge program areas (minimum impact camping, bear safety, wetlands, conservation careers, etc.).

Educator orientation sessions and workshops are well attended by local teachers and youth leaders. Over 1,400 educators have participated in Refuge-sponsored environmental education orientations, workshops, and credit courses. Increased environmental education workshops and credit courses are in high demand by educators.

The Outdoor Education Center is designed to be used by educational groups planning weekend to week-long nature activities. The center accommodates 30 comfortably and includes six sleeping cabins, a central meeting room ("Bear Den"), fire ring, picnic tables, a water pump, a barrel grill, and outhouses. Education groups may reserve this site free of charge, but they are required to help clean and maintain it. Due to the center's location at the junction of Swanson River and Swan Lake roads (approximately 30 miles from Refuge headquarters), vandalism is a recurring problem. Youth group safety at the center during the fall moose hunting season is a strong concern of parents, educators, and Refuge staff.

3.4.6.5 Commercial Services

The Refuge issues special use permits to businesses to provide guided recreational fishing, big game hunting and transport, air and water taxi services, fly-in tent camps, scenic raft trips, auto tours, guided hikes, horseback tours, and canoe trips. Commercial service opportunities are an important part of the local economy, and service providers facilitate Refuge experiences for tens of thousands of visitors each year. Federal law and U.S. Fish and Wildlife Service (Service) policy prescribe how and when special use permits are authorized. Refuge-specific policy and permit stipulations ensure visitor safety, reduce activity conflicts, protect wildlife and other resources, and limit congestion where feasible.

Commercial interest in some areas and activities on the Refuge, such as backcountry travel and canoeing, has remained stable and relatively low, while the demand to provide such services as guided sportfishing on the

upper Kenai River has exceeded available capacity. The number of permits issued has grown from 32 in 1985 to 194 in 2005, which is indicative of the growing interest in providing services and the growth of annual Refuge visitation.

3.4.6.6 Subsistence

Section 101(c) of the Alaska National Interest Lands Conservation Act (ANILCA) establishes that all conservation system units in Alaska "provide the opportunity for rural residents engaged in a subsistence way of life to continue to do so." Title VIII of ANILCA provides guidance for the management of subsistence activities on all Federal public lands in Alaska. When ANILCA expanded the National Wildlife System in Alaska, Kenai became the only Alaskan refuge without subsistence as a legislated purpose. The Federal subsistence program began in 1990 and since has evolved to include the regulation of subsistence harvest of both fish and wildlife on Federal public lands in Alaska for qualified rural residents. In the original Kenai National Wildlife Refuge Comprehensive Conservation Plan (1985) subsistence, as currently defined, was not occurring and therefore was not evaluated. Through various procedural and legal processes, subsistence has become a recognized use of Kenai Refuge.

The current subsistence hunting opportunity that is provided above and beyond State of Alaska regulatory options include:

- A year-round season for black bear for residents of Ninilchik, Port Graham, and Nanwalek within GMU 15C.
- A year-round season for black bear for residents of Ninilchik within GMU 15A and GMU 15B.
- A spring and fall season for brown bear for residents of Ninilchik in GMU 15C.
- An August 10–September 20 season for bull moose for residents of Ninilchik, Nanwalek, Port Graham, and Seldovia.
- An October 20–November 10 season for moose in GMU 15B and GMU 15C.

Other big game, small game, and trapping regulations for qualified subsistence users largely follow the same seasons and bag limits as State regulations.

From 1996 through 2006, a total of 451 Federal subsistence moose hunting permits were issued to qualifying rural residents, of which 396 reported after the hunt, and 297 of those reporting actually hunted. Residents of Ninilchik, Nanwalek (English Bay), Port Graham, and Seldovia reported taking 44 moose on Federal public lands during the Federal subsistence seasons.

In 2002, a Federal subsistence season was established on the Kenai Peninsula for trout, Dolly Varden, char, and salmon. Methods and means of take were established to be consistent with Alaska Department of Fish and Game (ADF&G) seasons, methods, and means of take.

From 2002 through March 2007, 22 subsistence fishing permits were issued to individuals from seven qualifying communities or rural areas (Ninilchik, Moose Point, Chisik Island, Tustumena Lake, Eldred Passage, Cooper Landing, and Hope). Of these permits, only eight were used, and the reported harvest was a total of 22 sockeye, 20 lake trout, 31 coho salmon, and 6 Dolly Varden.

A new salmon and resident lake trout, Dolly Varden, and rainbow trout fishery for the Kasilof River was approved in May 2007 for residents of Ninilchik. A resident fish winter fishery was newly approved in 2007 for Tustumena Lake and the Kasilof River for residents of Ninilchik. A new salmon fishery for the Kenai River was approved in May 2007 for residents of Ninilchik, Hope, and Cooper Landing. A new resident species fishery for the Kenai River was approved in May 2007 for residents of Hope and Cooper Landing. Participants in these new fisheries may use dip net and rod and reel (jigging and gillnets for the winter fishery), and all require a Federal permit with strict reporting requirements and species quotas. With these new regulations, some of the primary differences between the Federal subsistence regulations and Alaska sportfishing regulations for the take of salmon, trout, and Dolly Varden are season extensions, increased bag limits, and methods and means of take. As referenced in the supplemental regulations for rod and reel fishing on the Kenai River and Kasilof River drainages, most of the seasons, areas, harvest and possession limits, and method and means still fall under the Alaska sportfishing regulations.

From May 2007 through mid-August 2007, 191 subsistence fishing permits were issued to individuals from Hope, Cooper Landing, and Ninilchik. As of August 16, 2007, 33 permit holders reported a harvest of 444 sockeye from the Kenai River system. One permit holder reported a harvest of 25 sockeye from the Kasilof River through August 16, 2007.

In 2008, a total of 190 subsistence permits were issued for salmon and resident fish species in the Kenai and Kasilof rivers. A total of 1,464 salmon were reported harvested; no harvest of resident species was reported.

In addition to these fish species, there is a Federal subsistence season established for black bear, brown bear, moose, coyote, hare, lynx, wolf, wolverine, grouse, and ptarmigan.

3.4.7 Concerns Regarding the Human Environment

3.4.7.1 Wildland-Urban Interface Management(WUI)

The term 'Refuge/urban interface' can be used to describe an issue (or group of issues) facing Kenai National Wildlife Refuge where community-defined values, structures, watersheds, roads and highways, utilities, and/or other community resources intermingle with the natural resources and values of Refuge wildland. This juxtaposition of wild and urban lands creates an environment in which different values, land management objectives, and public expectations are in conflict. Some of the issues and potential impacts produced by or resulting from this interface condition include the following:

- The increased threat and potential catastrophic impacts of wildfire, increased public access into and use of the Refuge and its resources
- A greater probability that exotic and/or invasive plant and animal species will be introduced and become established
- Increased illegal activities such as trespass or wildlife violations
- Impacts to animal and plant populations due to over-harvesting, and more defense-of-life-or-property (DLP) mortality of bears, moose, etc.

These Refuge/urban interface issues are described in greater detail in the following sections, WUI Fire and Wildlife, Habitats, and Access.

WUI Fire—Throughout the nation, across Alaska, and here on the Kenai Peninsula, there is an expanding wildland/urban interface where the presence of wildfire is unacceptable due to the threat of catastrophic losses of the values at risk. In many areas on the western Peninsula, communities, subdivisions, individual residences, and/or businesses exist immediately adjacent to the Refuge boundary or are completely surrounded by Refuge lands. In these WUI areas, the risk of wildfire ignition and the hazards associated with wildland fire are increased. The incidence of human-caused fires is much greater in the WUI than in the wildland of the Refuge. The threat of natural and human-caused wildfires ignited on the Refuge, and traveling unchecked through continuous wildland fuels into the WUI is also very real.

In some areas of the Refuge, designated Wilderness interfaces with urban development or private lands. This Refuge Wilderness/urban interface condition occurs near the communities of Sterling, Funny River, Kasilof, and Cooper Landing, and in the remote communities of Bear Creek on Tustumena Lake and the Ninilchik Forties on the north end of the Caribou Hills. In these areas, the conflict between Wilderness values and public values is elevated. Aggressive suppression of both human-caused and natural ignitions is the more

likely management response in these interface areas, to protect human life and property. (Several natural fires in Refuge Wilderness areas were suppressed in 2006 to protect communities). Less likely responses include the use of lightning-caused fires for resource benefits or a limited suppression response in Wilderness to minimize risk to firefighters, reduce the costs of suppression, and/or mitigate the impacts of suppression activities to Wilderness values.

In response to the urban interface issues associated with Wilderness and non-Wilderness areas of the Refuge and to mitigate the impacts of catastrophic wildfire, Refuge managers have planned and completed multiple hazard fuel reduction projects. Some of these projects include a six-mile-long fuel break along Funny River Road between the communities of Soldotna and Funny River, mechanical fuel reduction and planned prescribed fires on 300 acres south of the Moose Range Meadows subdivision, mechanical fuel reduction and planned prescribed fire on 500 acres of the Lilly Lake area northeast of Sterling, and mechanical fuel reduction and prescribed fire on several units (over 6,000 acres) north and south of the Sterling Highway between Cooper Landing and Sterling. In 2005, the Refuge successfully managed two lightning-caused wildland fires for resource benefits (Irish Channel and Fox Creek) for a total of more than 27,000 acres of fuel reduction.

These treatments provide benefits in addition to fuel reduction, including improved access and/or egress safety for local residents and visitors along Funny River Road and the Sterling Highway, forest-type conversion from the more-flammable spruce forests to the less-flammable hardwood forests, and habitat benefits for wildlife that use early post-fire succession plant species. Also, large fire scars and fuel reduction treatment areas provide barriers fire managers use to contain or control wildland fires.

Wildland fire management and disaster mitigation on the Kenai Peninsula is a collaborative interagency process. Refuge managers work closely with other Peninsula land and fire management agencies, including the Alaska Division of Forestry, the Chugach National Forest, the Kenai Peninsula Borough, and others, to plan, coordinate, prioritize, and implement fire management and mitigation activities and/or projects.

Wildlife, Habitats, and Access—As more homes and subdivisions are built adjacent to the Refuge, access to previously undisturbed Refuge lands will increase, and utilization of Refuge lands and resources will increase. Consequently, detrimental impacts to wildlife and their habitats will occur. Many wildlife species prefer secluded habitats for activities, including feeding, breeding, birthing, hiding, and shelter. Increased human development and use degrades habitat effectiveness for those species, as they tend to evacuate the disturbed habitats to find more secluded areas.

Other potential impacts to wildlife include an increase of poaching and other illegal animal harvesting, more defense-of-life-and-property (DLP) kills of black and brown bears and moose, and other Refuge/urban interface issues such as moose-vehicle collisions, bird–power line collisions, and pet/wildlife conflicts. Hunting and trapping pressure may also increase for some species as the human population grows, and changes in regulations may become necessary. Some wildlife populations on the Refuge could decline below optimal or even sustainable levels.

Another issue is the introduction and establishment of exotic or invasive flora and fauna. The interagency land management community in Alaska has only recently begun to collaboratively respond to this threat. Some exotic species have already produced devastating impacts upon native species on other refuges in Alaska. Examples include the accidental introduction of Norway rats on some of the Aleutian Islands (Alaska Maritime National Wildlife Refuge) and the establishment of orange hawkweed on Camp Island (Kodiak National Wildlife Refuge). Domestic dogs on the Kenai Peninsula have spread disease and parasites to native canid populations, including canine distemper, parvo virus, and lice.

Other issues common to the growing Refuge/urban interface include increasing illegal activities and uses (hunting, trapping, and fishing violations; trespass on Refuge lands; dumping; off-road vehicle use; etc.), hazardous materials and/or contaminants spills, air and water pollution, impacts to cultural and/or historical sites and features, and more unwanted wildfires. As the human population of the Peninsula grows and as Refuge visitor use increases, developed recreation resources such as visitor centers, campgrounds, trails, cabins, and other facilities will be more heavily used and will require more maintenance to mitigate the impacts of that increased use.

3.5 Wilderness Values

3.5.1 Introduction

Section 304(g) of ANILCA requires the Service to identify and describe the special values of the Refuge, including wilderness values. The term “values” is often viewed synonymously with a range of similar terms, from subjective beliefs and preferences (e.g., family values) to more objective functions, services, and benefits (e.g., ecological values). Of interest here are the objective kinds of values, specifically those that are related to the condition and character of the natural environment.

The 1964 Wilderness Act recognized wilderness as a resource in and of itself and also established a mechanism for preserving that resource in a national system of lands. The definition of wilderness found in the act

provides a framework for identifying and describing wilderness values. According to the act, the fundamental qualities of wilderness are: undeveloped, untrammeled, natural, and outstanding opportunities for solitude, or a primitive and unconfined type of recreation. In addition, the act states that wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

Undeveloped. This is the most immediately observable and easily measured wilderness quality. Undeveloped simply means free from roads, structures, and other evidence of modern human presence or occupation. The undeveloped quality strongly influences other core wilderness values—in particular, experiential opportunities for solitude and primitive recreation. A lone structure may have only minimal impacts on natural processes while still serving as a constant reminder of human influence for recreational visitors. Certain kinds of structures or improvements may be considered desirable in a given wilderness setting (e.g., trails) or acceptable according to specific legislation, but that does not diminish their negative impact on the undeveloped quality.

Untrammeled. The Wilderness Act states that wilderness is "an area where the earth and its community of life are untrammeled by man." In other words, wilderness is essentially uncontrolled or unrestricted by purposeful human actions. Synonyms for untrammeled include unhindered, unencumbered, free-willed, and wild (Landres et al. 2005). The untrammeled quality of the wilderness resource is diminished when ecological events or processes are constrained or redirected to suit modern human ends (e.g., by suppressing naturally ignited fires or introducing non-native plants or animals).

Natural. Naturalness is a measure of the overall composition, structure, and function of native species and ecological processes in an area. In contrast to the quality of being untrammeled, the natural condition of an area may sometimes be enhanced through purposeful human action (e.g., to restore an eroded stream bank or eradicate an invasive weed).

Outstanding Opportunities for Solitude. Solitude in the wilderness context is generally understood to mean freedom from sights, sounds, and other evidence of modern man (Landres et al. 2005). While the relative amount of freedom from these things necessary to experience solitude is highly personal and variable, the Wilderness Act states only that outstanding opportunities for solitude be provided. Accordingly, encountering other people, hearing mechanized sounds (e.g., from aircraft overflights), or seeing the lights of a distant population center are all examples of things that may negatively affect solitude opportunities; while remoteness, low visitor density, and vegetative or topographic screening are things that may enhance solitude opportunities.

Outstanding Opportunities for a Primitive and Unconfined Type of Recreation. Primitive and unconfined recreation is non-motorized, non-mechanized activity that occurs in an undeveloped setting and is relatively free from social or managerial controls. Primitive recreation is also characterized by experiential dimensions such as challenge, risk, and self-reliance. Dispersed use patterns, which frequently occur where there are no facilities to concentrate use, enhance opportunities for self-reliance and also enhance opportunities for solitude. Conversely, some actions aimed at maintaining opportunities for solitude, such as limited permit management systems, may negatively affect opportunities for unconfined experiences.

Other Special Features. Lands that exhibit these core wilderness qualities may also contain additional special features with scientific, educational, scenic, or historic value. While the Wilderness Act makes it clear that these features are not wilderness qualities in and of themselves, their presence may distinguish one area with wilderness values from another. In the context of Alaska refuges, special features might include such things as active volcanoes, unique abundance or concentrations of a given species, fossil deposits, or evidence of prehistoric cultures.

3.5.2 The Kenai Wilderness

The 1.32-million-acre (534,348-hectare) Kenai Wilderness, which was originally designated by Congress through the passage of ANILCA in 1980, consists of three units: the Dave Spencer Unit (187,228 acres [75,768 hectares]), which includes the Swanson River and Swan Lake National Recreation Canoe Trails; the Mystery Creek Unit (46,086 acres [18,649 hectares]); and the Andrew Simons Unit (1,087,094 acres [439,931 hectares]). The Kenai Wilderness is administered in accordance with applicable provisions of the Wilderness Act, ANILCA, and other laws and regulations governing management of the National Wildlife Refuge System. These legal mandates affect all aspects of the administration, and commercial and public uses of the Kenai Wilderness area.

The 1985 Kenai Refuge Comprehensive Conservation Plan (USFWS 1985) established management programs to protect those areas of the Refuge designated as Wilderness. The preferred alternative and subsequent regulatory actions preserved the size and naturalness, and opportunities for primitive recreation. Conserving the pristine and unmodified character of these wild areas was a central purpose of the ANILCA legislation and the establishment of Kenai National Wildlife Refuge. Natural fish and wildlife population dynamics and habitats continue to be emphasized, although regulated visitor use, hunting, fishing, and trapping are allowed. Motorized access is permitted in specific areas for traditional activities subject to regulations from the Secretary of the Interior to protect the wilderness values.

A supplemental Wilderness review completed in 1988 recommended that an additional 195,000 acres (78,914 hectares) of Kenai Refuge be designated as Wilderness. Wilderness values that have been formally protected by Congress through Wilderness designation, and those associated with lands that have not been formally designated but are generally wild and natural, are described in the following text.

3.5.2.1 Size

The 1.32-million-acre Kenai Wilderness has not been substantially changed since its establishment in 1980. It encompasses the core acreage of all the major ecosystems of Kenai National Wildlife Refuge, from sea level to the Harding Icefield. The Kenai Wilderness was subject to existing rights and potentially affected by conveyances to private ownership. Point Possession Native Association, for example, was conveyed 4,495 acres (1,819 hectares) from Kenai Wilderness in the Point Possession area in accordance with the Alaska Native Claims Settlement Act (ANCSA). Consistent with the Kenai National Wildlife Refuge Land Protection Plan, most of those acres have been subsequently included in Kenai Wilderness after a successful re-acquisition initiative.

3.5.2.2 Naturalness and Wildness

The Kenai Wilderness represents all of the ecosystems and fish and wildlife habitats of the Refuge. The Harding Icefield, piedmont glaciers, and glacial lakes make up a significant portion of the area. Mature spruce forest covers additional portions of it. Similar to other forested areas of the Refuge, this forest has been substantially affected by an outbreak of spruce bark beetles. Fire management programs that establish areas of limited suppression have contributed favorably to a natural fire regime and an untrammeled environment. This established Wilderness area is generally natural in appearance and ecological function, although there is substantial human use and evidence of recreational use and associated impacts.

The Kenai Wilderness is located within the most heavily populated and fastest growing region of Alaska, and accessible areas receive significant annual visitation. Wildlife populations require directed management and access control to conserve natural populations and conditions. A managed fish and wildlife harvest, the Refuge permit process, and regulated access have left most populations within the Wilderness relatively natural and wild.

Wildlife such as wolves and brown bear that depend on highly natural landscapes appear to be holding their own despite the pressures of nearby population centers. Naturally re-established wolf populations have succeeded, although they face significant harvest pressure and population health issues. Brown bears remain a population of concern, but natural habitat and critical feeding areas have been protected by

Wilderness designation. A re-established caribou herd has also thrived within the natural habitats of Kenai Wilderness.

In addition to terrestrial habitat, the Kenai Wilderness continues to provide critical water quality and quantity for natural salmon spawning and rearing habitat within the Kenai River watershed and the six other major watersheds of the Kenai Peninsula.

3.5.2.3 Opportunities for Primitive Recreation

Backcountry hiking and camping, rafting, and canoeing, and a host of other primitive recreation opportunities are plentiful in the varied portions of Kenai Wilderness. Trail and off-trail access opportunities are abundant. The Swanson River and Swan Lake National Recreation Trails are located mostly within Kenai Wilderness and are a bellwether of primitive recreation opportunity.

3.5.3 Areas Recommended for Wilderness Designation in the 1988 Supplemental Review

The "Final Supplemental Environmental Impact Statement for the Wilderness Proposal of the Kenai Refuge Comprehensive Conservation Plan" was published in 1988 (USFWS 1988). The supplement was prepared to clarify to the public the exact nature of the wilderness proposal contained in the Final Kenai Comprehensive Conservation Plan (Plan) published in 1985 (USFWS 1985). The 1985 plan and the supplemental environmental impact statement (EIS) identified 195,000 acres (78,914 hectares) of the Refuge as suitable for Wilderness designation and proposed that this acreage be added to the existing Kenai Wilderness by Congress. The wilderness recommended for designation is located in two areas of the Refuge: the Chickaloon Flats/Pipeline Lowlands/Two Indians area (175,840 acres [71,160 hectares]) and an area near the outlet of Tustumena Lake (19,660 acres [7,956 hectares]).

The lands proposed for Wilderness designation support a wide range of habitats, including estuarine, alpine, shrub-lichen, lowland subalpine shrub, mature forest, lakes, and streams. These habitats, in turn, support a variety of wildlife, including wilderness-dependent species such as wolves, caribou, trumpeter swans, brown bear, Dall sheep, mountain goat, marten, wolverine, and lynx. These wildlife values, in addition to opportunities for solitude and primitive recreation, were the primary reasons for recommending these lands for Wilderness designation.

The Wilderness recommendation includes 19,660 acres (7,956 hectares) of the most important habitat from the 51,240-acre (20,736 hectares) Tustumena Outlet unit. Most of the acreage within the Chickaloon Flats/Pipeline Lowlands/Two Indians area is also included in the recommendation, except for a one-mile-wide corridor that contains a natural gas pipeline right-of-way, which was not included in

the Wilderness recommendation. The characteristics and wilderness values of these and all other units of the Refuge are described in the following section.

3.5.4 Refuge Units Outside the Designated Kenai Wilderness

As directed by sections 304(g) and 1317 of ANILCA, all Kenai Refuge lands not already designated as Wilderness were reviewed during the first Refuge planning process in the early 1980s. The wilderness values of lands not designated were identified both in the ANILCA Wilderness suitability review initiated in 1981 and in the 1988 Final Supplemental Wilderness Review and Record of Decision (USFWS 1988). Although the 1988 review only formally recommended 195,500 acres (79,116 hectares) for additional Wilderness designation, many remaining land parcels included lands with wilderness values that have been protected since that time within existing Refuge administrative management categories.

The 1988 review organized lands not designated as Wilderness in the Refuge into 10 review units totaling approximately 620,000 acres (250,905 hectares). The same units are used once again as a framework for this wilderness values description; however, some of the acreage figures have changed because of Native land conveyances, re-acquisition, and formal trades (Figure 3-33). Also, the 1988 review determined that "split-estate lands" (areas where subsurface rights are in private ownership) on the western lowland portion of the Refuge were unsuitable for Wilderness designation because they were not entirely in Federal ownership. Those lands are now included as part of this description of wilderness values.

Following are the 10 Refuge units outside of the designated Kenai Wilderness:

- Two Indians Unit
- Pipeline Lowlands Unit
- Chickaloon Flats Unit
- Lark Lake Unit
- Oil Fields Unit
- Research Center Unit
- Moose River/Mystery Creek Unit
- Skilak Loop/Lake Unit
- Headquarters Unit
- Tustumena Outlet Unit

All the units meet the basic wilderness size criteria either independently or as contiguous additions to Kenai Wilderness or other units.

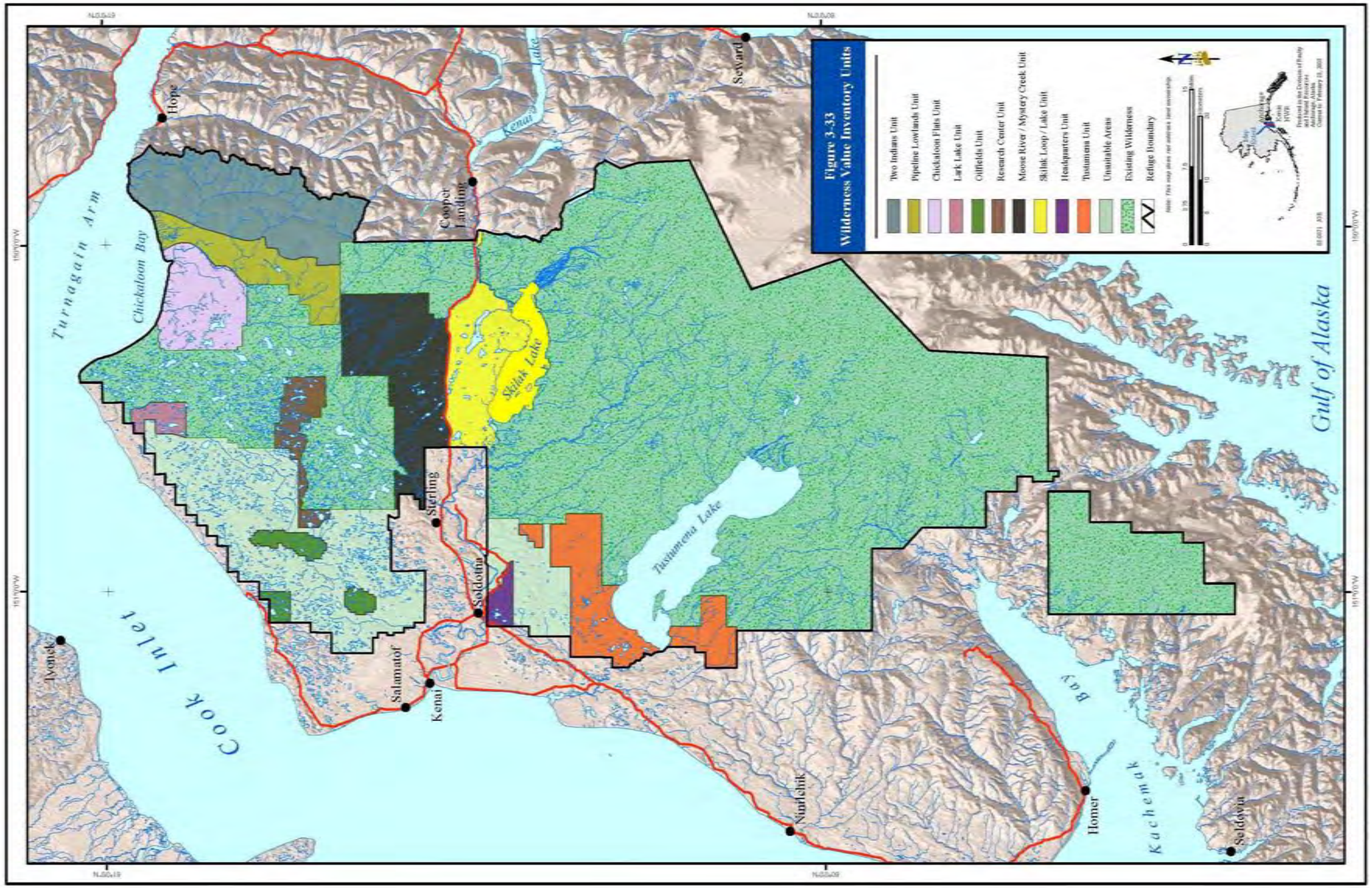


Figure 3-33. Wilderness Value Inventory Units

3.5.4.1 Two Indians Unit

Size—The Two Indians Unit (97,500 acres [39,457 hectares]) is located in the northeastern corner of the Refuge and encompasses the northwestern part of the Kenai Mountains, which run from the sea level of Cook Inlet to more than 4,000 feet (1,219 meters). The unit is bordered on the east by roadless units of Chugach National Forest and on the south by one of three segments of Kenai Wilderness. Most of this unit is included in the existing Wilderness recommendation.

Naturalness and Wildness—Mature spruce forest covers more than half the unit. Spruce bark beetles have had a substantial impact on this forest. Spruce-hemlock forest with thick moss groundcover occurs on the north-facing mountain slopes bordering the Turnagain Arm of Cook Inlet. These north-facing slopes may represent the northernmost extension of coastal rainforest in Alaska. In the upper elevations of the Kenai Mountains, the primary habitat is alpine shrub-lichen, a climax vegetation type that is very sensitive to physical disturbance. The alpine area is home to caribou and numerous other species. The northwestern edge of the unit is part of the Chickaloon estuary, which is the major waterfowl and shorebird staging area for the Kenai Peninsula.

This unit is generally natural in appearance and ecological function, although there is some evidence of human use and associated impacts. The western boundary of the unit is formed by a right-of-way access road (for the Enstar pipeline) that terminates at a small, unmaintained gravel airstrip (Big Indian Airstrip). The road, which is constructed of on-site materials, crosses numerous drainages that become muddy during wet periods.

Historically, gold mining occurred extensively in the unit, and timber for construction of the Alaska Railroad was harvested in the area. There was a historic trail along a bluff above the shore of Turnagain Arm, running from the community of Hope to Chickaloon Bay. A modern portion of the trail, running from Hope to Gull Rock, is now popular with hikers. West of Gull Rock, the trail is completely overgrown with alders.

Opportunities for Primitive Recreation—Primitive backcountry hiking and camping opportunities abound in this unit, except for areas near the unimproved Big Indian Airstrip and the pipeline access road (opened seasonally). Various forms of motorized access to this unit are either not authorized and/or are limited by terrain. Outside of the caribou and moose hunting seasons, use of the area is low, and visitors are not likely to encounter many others. Limited evidence of trapping and historical prospecting may have minor impacts on opportunities to experience solitude (escape from the distracting presence of people and modern artifacts of people). Access and travel opportunities in the unit are characterized by challenge and some degree of risk.

3.5.4.2 Pipeline Lowlands Unit

Size—This 39,040-acre (15,799 hectares) unit comprises black spruce forest and a portion (7,000 acres [2,833 hectares]) of the Chickaloon estuary. The estuary subsided as a result of the 1964 earthquake; therefore, the Refuge boundary includes a portion of the tidelands extending to the mean high water mark at the time of statehood. Protection of the estuary was the primary reason for extending the Refuge boundary to the northeast as part of ANILCA. Although under U.S. Department of Agriculture Forest Service jurisdiction, this portion of the estuary was evaluated as part of the second Roadless Area Review and Evaluation (RARE II) and recommended for Wilderness designation. Most of this unit, except for a one-mile-wide corridor encompassing a natural gas right-of-way, is included in the existing Wilderness recommendation.

Naturalness and Wildness—As described previously, the Chickaloon estuary is the major waterfowl and shorebird staging area for the Kenai Peninsula. Some 78 species of birds, including 51 species that nest in the area, are known to use the estuary. The lowlands are laced with many small streams that have their headwaters in the Two Indians unit. These streams support rainbow trout and salmon populations. Bog meadows in the unit are heavily used by moose, especially in the spring when moose feed on sprouting vegetation. Forested areas contain mixed-age trees—the result of fires that have occurred during the past 100 years. Most of the mature white spruce has been killed by spruce bark beetles.

The estuary portion of this unit has never been open to oil and gas leasing, but the remainder of the unit has been explored for oil and gas. Two natural gas pipelines and an access road cross the unit from south to north along the eastern boundary. These pipelines carry natural gas from the Kenai area to Anchorage. Clearing has occurred along the pipeline right-of-way. These linear features reduce the apparent naturalness of the area, but ecological functions receive only minimal impacts.

Opportunities for Primitive Recreation—The pipeline access road provides seasonal (hunting season) access to the public. At other times of year, access is by foot or airplane. Backcountry hiking and camping opportunities are excellent. The estuary provides outstanding waterfowl hunting and observation opportunities, but visitor use is relatively low due to challenging access. Outside of the fall hunting season, use of the unit is very low, although the gas pipeline right-of-way and access road are constant reminders of human activities for nearby visitors who can see them.

3.5.4.3 Chickaloon Flats Unit

Size—The Chickaloon Flats unit totals 45,380 acres (18,365 hectares). It includes a diverse mixture of habitats: approximately 10,080 acres

(4,079 hectares) of estuary, 12,300 acres (4,978 hectares) of intermediate forest, and 23,000 acres (9,308 hectares) of mature forest. The unit is bounded on the west and south by a segment of the Kenai Wilderness. The eastern boundary is the Chickaloon River (which separates it from the Pipeline Lowlands Unit), and the northern boundary is Chickaloon Bay. Most of this unit is included in the existing Wilderness recommendation.

Naturalness and Wildness—This unit includes the portions of the Chickaloon estuary that are not included in the units previously described; it also has bog meadows and some areas of upland spruce forest. The estuary portion of the unit has not been explored for oil and gas reserves, but other portions of the unit have been. There is little evidence, however, of past exploration activity. The habitats found within this unit, and the associated wildlife populations, are highly natural in appearance and ecological function.

Overland foot access to the unit is possible but challenging. Wheeled airplanes may land in some locations, and boat access from Chickaloon Bay and Chickaloon River is possible when tide conditions are just right. In general, access to the unit is very difficult; therefore, visitor use and associated impacts to naturalness are kept to a minimum.

Opportunities for Primitive Recreation—Backcountry hiking and camping opportunities are plentiful for those who are capable of accessing the area. Abundant and diverse waterfowl in the estuary provide superb observation and hunting opportunities. Due to difficult access, visitor experiences in this area are likely to be characterized by challenge, solitude, and some degree of risk.

3.5.4.4 Lark Lake Unit

Size—The Lark lake Unit is 8,000 acres (3,237 hectares). It is bounded on the north, east, and south by the Kenai Wilderness. On the western boundary are Refuge lands on which subsurface rights have been conveyed to private interests.

Naturalness and Wildness—This unit is composed primarily of mature spruce forest, much of which has been killed by a spruce bark beetle infestation. Evidence of past oil and gas exploration activities (seismic lines and exploratory drilling) constitute localized impacts to naturalness; however, the appearance and function of habitats and fish and wildlife populations in the area are generally unaffected by human activities. There are no roads in or near the unit. Access is almost exclusively by floatplane in the summer and ski plane or snowmachine in the winter. Consequently, the level of human use is very low.

Opportunities for Primitive Recreation—The area has excellent opportunities for camping and hiking, similar to those found in the adjacent designated Wilderness. The low level of public use means that visitors are very unlikely to encounter other humans. As in the other

units described previously, recreation experiences are likely to be characterized by challenge, solitude, and some degree of risk.

3.5.4.5 Oilfields Unit

Size—The 16,360-acre (6,621 hectares) Oilfields Unit includes the Swanson River Oil Field, the Beaver Creek Oil and Gas Field, and an area along the Refuge's western boundary near Storm Lake and the Captain Cook State Recreation Area. Throughout the unit are Refuge lands on which subsurface rights to oil, gas, and coal have been conveyed to private interests.

Naturalness and Wildness—Habitats in this unit consist primarily of mature spruce forest, with some areas of early (0–20 years) forest. As in other areas of the Refuge, most of the mature trees have been killed by spruce bark beetles. The unit contains critical moose wintering range and some of the highest moose densities in Alaska. Wolves and bears also use the area, particularly in the winter months. The Swanson River has significant runs of sockeye and coho salmon.

Portions of the unit are natural in appearance. However, an extensive network of wells, pipelines, roads, and related facilities has been developed within the Swanson River and Beaver Creek oilfields, which significantly alters the naturalness of the area. A large communication tower alters the natural viewshed, and the rumble of the Swanson River Field compressor plant can be heard throughout the unit.

Opportunities for Primitive Recreation—Access to this unit is excellent due to the network of roads (although regulations restrict public access to foot or horse travel). Primitive activity opportunities (e.g., camping, hiking, hunting) are available; however, the sights and sounds of oil field facilities are a constant reminder of industrial human activities. Visitors to this unit have limited opportunities to experience isolation, wilderness solitude, or other dimensions that characterize primitive recreation.

3.5.4.6 Research Center Unit

Size—The Research Center Unit encompasses an area of 19,520 acres (7,899 hectares) surrounded by the Kenai Wilderness. The Moose Research Center (MRC) is in the eastern part of the unit. The MRC consists of four one-square-mile fenced pens and several buildings used primarily for moose forage and physiology research.

Naturalness and Wildness—A large fire in 1947 created an area of important winter moose browse within this unit. As new trees became established and the area started to become overgrown, mechanical crushing was used to maintain moose browse. There is minimal mature forest in the unit at this time.

The area has been thoroughly explored for oil and gas potential. The Swan Lake road, an all-weather maintained road, runs along the

southern boundary of the unit and separates it from a section of the Kenai Wilderness. The Swan Lake Road provides access to the Moose Research Center, and a variety of access points for both the Swan Lake and Swanson River canoe routes are situated along its length. The Swanson River Road forms the western boundary of the unit. Two campgrounds, at Dolly Varden and Rainbow Lakes, are accessible via the Swanson River Road.

Although the unit hosts healthy natural fish and wildlife populations, overall naturalness and wildness have been compromised by forest manipulation through mechanical crushing, the Swan River and Swanson River roads, fenced research enclosures, and other facilities in the western portion of the unit. Also, the rumble of the Swanson River Oilfield compressor may be heard in some portions of the unit.

Opportunities for Primitive Recreation—Opportunities for hiking, canoeing, camping, fishing, and hunting are abundant in this unit. Some portions of the unit receive very limited public use, and a visitor would be unlikely to encounter other visitors. However, nearby roads and research facilities and the sights and sounds of oilfield facilities serve as continuous reminders of the influence of modern human activities. Opportunities for isolation, solitude, challenge, and risk are limited compared to those in other portions of the Refuge where a higher degree of naturalness is maintained.

3.5.4.7 Moose River/Mystery Creek Unit

Size—This unit is 71,120 acres (28,781 hectares) in size. It is bordered on the north and the east by the lowland and Mystery Creek portions of the Kenai Wilderness, respectively. The southern boundary is the Sterling Highway.

Naturalness and Wildness—A large portion of this unit burned in the 1947 fire that also affected other portions of the Refuge. Much of the forest that has developed since then is now of intermediate age. Between 6,000 and 8,000 acres (2,428 and 3,237 hectares) of maturing forest were mechanically crushed in the mid-1970s to improve moose habitat. Forested areas that were not affected by the fire or by crushing have received heavy impact by spruce bark beetles; most of the mature spruce trees in these areas have been killed. The Moose River in the western part of the unit is an important rainbow trout fishery and also provides spawning habitat for Chinook, coho, pink, and sockeye salmon. Moose, wolves, and brown bears also use the area.

This unit remains generally natural in appearance, and fish and wildlife populations are generally unaffected by human activities. Two natural gas pipelines and an associated access road (Mystery Creek Access Road) do, however, constitute localized impacts to apparent naturalness, and areas of crushed forest are evidence of mechanized human activities. The Sterling Highway and a developed campground

at Watson Lake along the southern portion of the unit also reduce the naturalness of immediately adjacent areas.

Opportunities for Primitive Recreation—Like many other portions of the Kenai Refuge, this unit provides excellent opportunities for hiking, camping, hunting, fishing, and wildlife observation. The Sterling Highway, Mystery Creek Access Road, and Moose River collectively provide ample access to the unit. Mystery Creek Access Road is only open to motor vehicle use by the general public during the fall hunting season, but it is used throughout the year by pipeline maintenance crews. At times, public use in and around these transportation corridors may limit opportunities to experience isolation and solitude. In other portions of the unit, visitors are unlikely to encounter other users.

3.5.4.8 Skilak Loop/Lake Unit

Size—This unit is 79,240 acres (32,067 hectares) in size. It is bounded on the north by the Sterling Highway, on the west by private lands outside the Refuge, and on the south and east by the Kenai Wilderness and the Andrew Simons Research Natural Area. The Skilak Loop Road, which was the original highway to Kenai constructed in 1947, bisects the unit. The 1947 fire that burned approximately 320,000 acres (129,499 hectares) of the Refuge, including most of this unit, was started during construction of the road.

Naturalness and Wildness—Habitats found in the unit include 8,000 acres (3,237 hectares) of mature forest, 30,000 acres (12,141 hectares) of intermediate forest, 1,000 acres (405 hectares) of lowland sub-alpine shrub, and more than 30,000 acres (12,141 hectares) of water, including 25,000-acre (10,117-hectare) Skilak Lake. Nearly all the mature spruce trees remaining after the 1947 burn have been killed by an infestation of spruce bark beetles. Mechanical habitat treatment and prescribed burning have occurred within the unit in recent years, primarily to improve moose habitat. A 5,000-acre (2,023-hectare) human-caused wildfire also occurred in 1991 entirely within the unit.

Skilak and Hidden lakes, and smaller lakes that form the headwaters of the East Fork of the Moose River, provide important fish habitats. Skilak and Hidden lakes are particularly important lakes for the production of sockeye salmon. Lake trout, one of three species of char on the Refuge, are also found in Skilak and Hidden lakes. Wolf, lynx, brown and black bear, coyote, and numerous species of small mammals and birds also utilize this area.

In the 1985 Kenai Refuge Comprehensive Conservation Plan (USFWS 1985), 44,000 acres of this unit were administratively designated the Skilak Wildlife Recreation Area. Only limited hunting is authorized in this area, and management is geared toward wildlife viewing. The unit retains much of its natural appearance and integrity, but human activities concentrated along the Skilak Loop Road system and at

adjacent recreation facilities have negative effects on overall naturalness. Naturalness is reduced to a minimum along roads and within developed campgrounds and other facilities. Skilak Lake is the dominate natural feature in the unit. This large glacial lake was an early transportation route and attracted early settlers of the area. It remains a popular attraction.

Opportunities for Primitive Recreation—This unit receives a large proportion of overall Refuge visitor use. Use is concentrated in the summer but occurs year-round. The Sterling Highway, Skilak Loop Road, and short roads into campgrounds at Skilak and Hidden lakes make the unit readily accessible. At developed sites, visitors can expect to encounter other users, especially in summer. Hiking trails and water routes extend away from developed portions of the unit and provide opportunities for more primitive recreation experiences. In all but the most remote portions of the unit, however, isolation and solitude may be somewhat limited.

3.5.4.9 Headquarters Unit

Size—The Headquarters Unit encompasses 5,120 acres (2,072 hectares). To the north and west of the unit are private lands; to the east and south are lands only partially belonging to the Refuge—either surface or subsurface rights have been conveyed to private interests.

Naturalness and Wildness—This unit is primarily mature boreal forest with some bog areas and several shallow lakes. Spruce bark beetles have had substantial impacts on stands of mature spruce trees.

The community of Soldotna is located just north of this unit, and the Soldotna airport is immediately adjacent to the northern boundary of the unit. The Refuge headquarters complex—including offices and visitor center, carpentry shop, bunkhouse, warehouse, vehicle storage buildings, and other facilities—is also located within this unit.

Although some portions of the unit appear natural, it exhibits limited naturalness overall because of its small size, the nearby presence of Soldotna, and the headquarters complex.

Opportunities for Primitive Recreation—Much of this area is seldom visited, having no roads or trails. There are maintained ski trails near the headquarters complex and de facto routes that follow old seismic exploration lines. A significant portion of the area is closed to snowmachines in support of local dog-mushing activities. Outside of the immediate confines of the headquarters complex, a visitor could experience some degree of solitude and isolation, although airport and road noise might still intrude. A visitor purposefully seeking to avoid trails and other users could conceivably travel from the headquarters parking area to the Kenai Wilderness boundary (10 miles [16 kilometers]) while traveling exclusively through terrain with no roads or trails. The headquarters area is closed to hunting and trapping and

provides unique wildlife viewing opportunities, including an interpretive trail.

3.5.4.10 Tustumena Outlet Unit

Size—This unit is 51,240 acres (20,736 hectares) in size and shares a common boundary with the largest unit of the Kenai Wilderness. It is bounded on the south and west by private Alaska Native corporation lands and to the north by lands on which subsurface rights are also in Native corporation ownership. A little more than one-third (19,660 acres [7,956 hectares]) of this unit is included in the existing Wilderness recommendation.

Naturalness and Wildness—The unit is almost entirely composed of mature forest. Some, but not all, of the mature spruce trees have been killed by spruce bark beetles. Small areas of intermediate and early forest are, in many cases, the result of mechanical crushing or fire. Lands near Tustumena Lake are highly scenic, with a diverse mix of spruce, birch, aspen, and cottonwood trees, and numerous small lakes and bogs.

About three-quarters of the unit is subject to oil and gas leasing. A few remnant seismic lines are evidence of past exploration activities. Despite these impacts, the lands in this area are highly natural in appearance and function. The 1988 Final Supplemental Wilderness Review (USFWS 1988) found that all lands in this unit qualified for designation as Wilderness, and no substantial changes have occurred since then.

Opportunities for Primitive Recreation—An easement road from the Sterling Highway to the Kasilof River provides the only overland access route to the unit. Water access via Tustumena Lake and the Kasilof River is also possible. Float planes can land on larger lakes in the area, and many winter users access the unit with snowmachines for traditional activities. One established trail—the Doc Pollard Trail—is primarily used by horseback riders to access the adjacent Kenai Wilderness. In winter, when conditions allow, a winter trail provides snowmachine access. Most visitor use occurs during the moose hunting season and during winters when conditions allow snowmachining. Outside of these time periods, visitors to the unit are unlikely to encounter other people. Given the relatively large size and remote nature of the unit (and low levels of visitor use), recreation experiences in the unit are likely to include dimensions of isolation, solitude, challenge, and associated risk.

3.5.5 Concerns Regarding Wilderness

3.5.5.1 Fire Management Impacts on Naturalness

Wildfire is a natural landscape process within forests of the Kenai Peninsula. On the Kenai Peninsula, historical fire return rates have averaged 80 years in black spruce and 400–600 years in white and Lutz spruce. Wildfire return intervals are likely changing, although the new trajectory is not apparent. Suppression of wildfire in Wilderness has increased because of concerns about an increasing human population and urban development outside Refuge boundaries. However, human-caused ignitions have also increased in recent years. Furthermore, increased fuel loads from beetle-killed trees and a drier, warmer landscape due to global climate change suggest that wildfire risk may be increasing.

The policies of all four Federal agencies responsible for managing Wilderness in the United States recognize the importance of fire as a natural ecological process and the desirability of maintaining and/or restoring the historic role of fire to wilderness ecosystems (Parsons and Landres 1998). In 1995, the Department of the Interior and the Department of Agriculture issued *Federal Wildland Fire Management: Policy and Program Review*, which provided policy direction for all Federal wildland fire activities. This document was reviewed and updated in January 2001 by an Interagency Federal Wildland Fire Policy Review Working Group. A guiding principle of this new policy is that "the role of wildland fire as an essential ecological process will be incorporated into the planning process." This new policy allows fires from natural ignition sources to be managed for resource benefits wherever an approved fire management plan is in place (USDA and USDOI 1995).

In addition to the policy and administrative constraints that have limited the use of natural fire, a number of other reasons explain why natural fire may not be allowed to burn in some Wilderness units (e.g., the risk of fire escaping onto adjacent lands managed for other purposes, the threat of unnaturally intense fires causing unacceptable resource damage, and the threat of smoke causing unacceptable impacts to surrounding areas). Together, such concerns raise serious questions about the potential for natural fire to ever be able to effectively restore (or sustain) natural fire regimes in the Kenai Wilderness.

Management-ignited prescribed fire has been the tool most advocated for mimicking or restoring natural fire regimes in Wilderness. In the contiguous 48 states, the U.S. Fish and Wildlife Service (Service) has relied almost entirely on prescribed fire to accomplish wilderness management objectives, including the reduction of hazardous fuels, range improvement, wildlife habitat enhancement, and restoration of natural fire regimes (Parsons 2000). In Alaska, four situations have

been identified in which prescribed fire could be appropriately used in Wilderness:

1. To restore or enhance habitats of Federally listed threatened and endangered species
2. To control or eradicate invasive flora
3. To increase the likelihood of a naturally ignited fire to burn unimpeded (by reducing hazardous fuels loads around structures and urban interface)
4. To mimic (long-term) or restore (short-term) a significantly altered natural fire regime

However, there continues to be considerable opposition within and outside the Service and other agencies to prescribed fire. Prescribed fire is viewed by many as an inappropriate intervention that detracts from the wild or untrammeled nature of wilderness and that conflicts with the primary purposes of Wilderness. Locally, reduced air quality from prescribed fire continues to be a concern to the Alaska Department of Environmental Conservation (DEC), fire management, and local communities. Furthermore, there is community concern about prescribed fire escaping the prescription; a hazardous fuel-reduction burn on the north shore of Kenai Lake in 2002 eventually threatened Crown Point, Lawing, and Moose Pass. Perhaps the greatest concern is that the use of prescribed fire could become an accepted alternative to natural ignitions and, as such, would soon become the dominant Wilderness fire management strategy.

3.5.5.2 Impacts of Motorized Use on Opportunities for Solitude

One of the core attributes of the wilderness resource is the opportunity to temporarily escape the sights and sounds of human activities. Opportunities for wilderness solitude on Kenai Refuge are threatened by increasing public use in general and by increasing motorized use in particular. Small airplanes are an important means of access to remote portions of the Refuge, yet their use may diminish opportunities for solitude.

During some portions of the year, a Refuge visitor would rarely be free from the sights or sounds of low-flying aircraft. In addition, Tustumena Lake currently hosts thousands of motorboat use-days during the summer months, and the Caribou Hills receive tens of thousands of snowmachine use-days during the winter. Opportunities for genuine wilderness solitude and isolation are more limited in these areas during those periods of time. While it is likely that opportunities for solitude have been diminished by increasing motorized use on the Refuge, few data are available for quantifying the reduction. A clear need exists for baseline data so that the relationship between motorized use and solitude opportunities can be better understood and monitored.

3.6 River Values

3.6.1 Introduction

Section 304(g) of ANILCA requires the U.S. Fish and Wildlife Service (Service) to identify and describe certain values of the Refuge including *"….archeological, cultural, ecological, geological, historical, paleontological, scenic, or wilderness values…"* Because river resources may contain a variety of these and other values, they need to be described and evaluated.

The Wild and Scenic Rivers Act of 1964 (U.S. Government 1968) provides a framework for identifying and describing river values. The act recognized the importance of a river's free-flowing nature and specific "outstandingly remarkable values" such as scenery, recreation, geology, fish and wildlife, history, etc. Thus, an analysis of river resources consists of an examination of the river's hydrology, including man-made alterations, and an inventory of its natural, cultural, and recreational resources. The determination that a river area contains outstandingly remarkable values is a professional judgment on the part of the planning team, based on objective, scientific analysis (Diedrich and Thomas 1999). To be assessed as outstandingly remarkable, a river-related value must be a unique, rare, or exemplary feature that is significant at a comparative regional or national scale. While the spectrum of resources that may be considered is broad, all values should be directly river-related and should:

1. Be located in the river or on its immediate shorelands (in Alaska, generally within one-half mile on either side of the river);
2. Contribute substantially to the functioning of the river ecosystem; and/or
3. Owe its location or existence to the presence of the river.

This section describes seven rivers or segments of rivers that are free-flowing and have at least one outstandingly remarkable value, and that are considered to be exceptional examples of the rivers on the Refuge (Figure 3-34). The rivers were evaluated on a number of characteristics, including abundance of and importance to fish and wildlife populations, recreation opportunities, and wildness. Volume 2, Appendix G provides additional information on the methodology used to evaluate values on these rivers.

3.6.2 Kenai River

The Kenai River runs east-west across the northern region of the Kenai Peninsula. Originating from Kenai Lake, the Kenai River flows approximately 70 miles (16 kilometers) before entering Cook Inlet. The Refuge manages 18 miles (29 kilometers) of the river, starting from its confluence with the Russian River. Private property dominates the land ownership on the remaining river downstream.

Outstandingly Remarkable Values: cultural, historic, fish, wildlife, recreation

3.6.2.1 Cultural, Historic, and Prehistoric Values

The Sqilantu Archaeological District reaches from Kenai Lake to Jim's Landing. There are at least 77 prehistoric archeological sites within the district that have been identified by the Alaska Heritage Resources Survey. The site has been proposed for listing and is eligible for the National Register of Historic Places. One site consists of a prehistoric village with 16 house pits and 62 cache pits. The site represents at least 5,000 years of human history, documents at least seven prehistoric and early historic native cultures, and may be the largest concentration of sites on the Kenai River and one of the most important sites in Alaska.

The Stephanka Village Archaeological District, downstream of Skilak Lake, holds at least 42 prehistoric sites spanning 3,500 years of human history and at least three prehistoric cultures. The site retains considerable significance for modern Kenai Peninsula Native people and has been proposed for listing on the National Register of Historic Places.

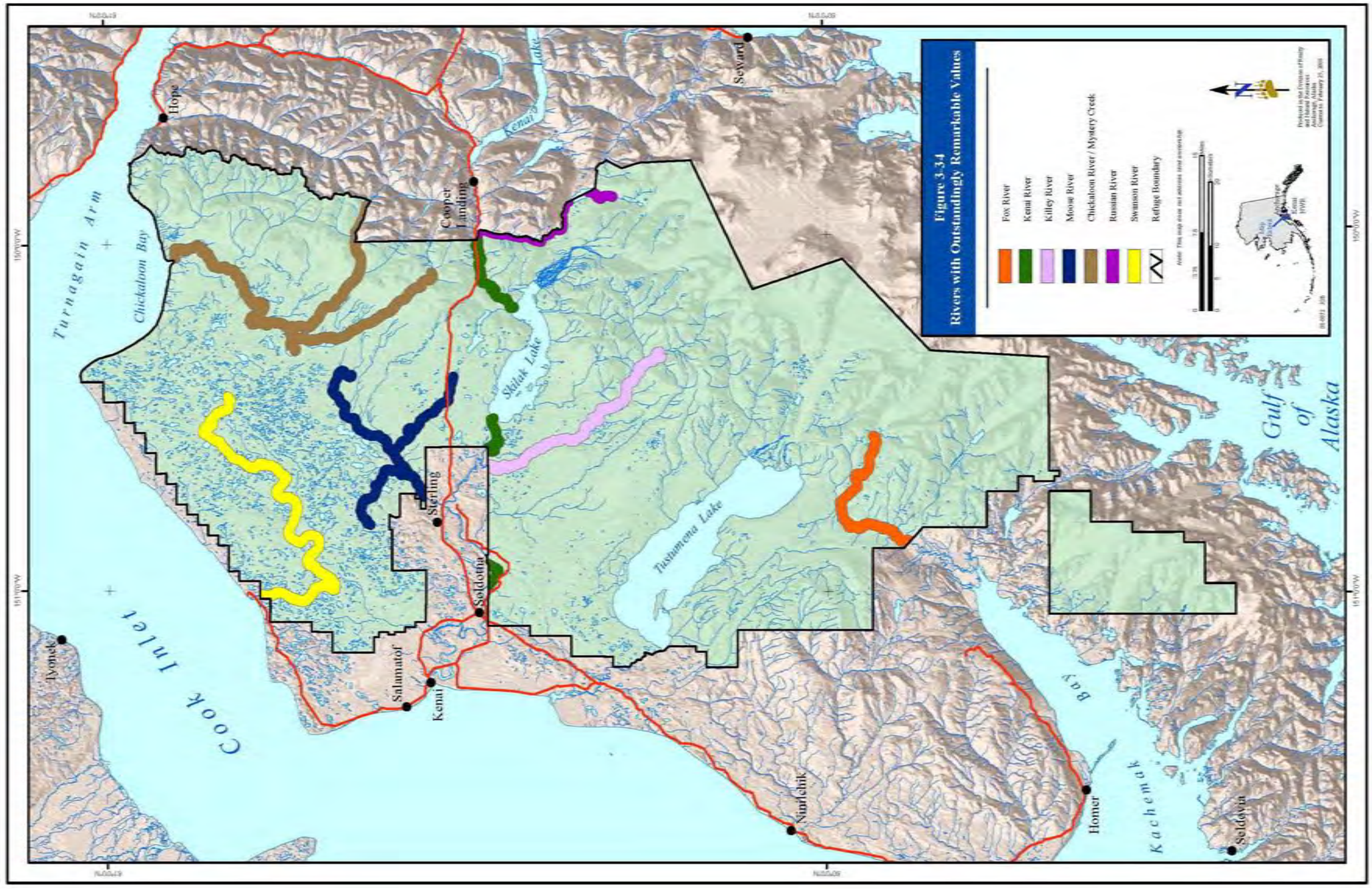


Figure 3-34. Rivers Containing Outstandingly Remarkable Values

3.6.2.2 Scenic and Geologic Values

At approximately 1.6 million acres (2,500 square miles or 6,475 square kilometers) in size, the Kenai River drainage is the largest on the Kenai Peninsula. The topography of the drainage varies from the rugged ridges of the Kenai Mountains to the nearly flat lowlands of the Kenai Peninsula. Within the Refuge, the headwaters include tributaries originating from the Harding Icefield, one of the largest icefields in Alaska. These glacial waters give the Kenai River its beautiful turquoise color.

3.6.2.3 Fish and Wildlife Values

The Kenai River boasts major runs of four Pacific salmon species (Chinook, sockeye, coho, and pink). Two distinct runs characterize Kenai River Chinook (or king) salmon. The early-run fish generally move up into tributaries of the Kenai to spawn. The second run primarily spawns in the main river and provides the large fish of angling legend. They appear to have evolved to spawn in the swift, deep main current of the Kenai River. These fish spawn primarily below Skilak Lake, although some move up between Skilak and Kenai lakes.

The abundant productivity of the Kenai River and the variety of its habitats enables the area to support large concentrations of bald eagles and many species of migratory waterfowl. Moose, caribou, wolves, bears, and other wildlife also use the river system's resources.

3.6.2.4 Recreation Values

Outstanding fishery resources make the Kenai River an extremely valuable resource to the Kenai Peninsula residents and a major attraction for visitors to Alaska. The river offers prime opportunities for fishing, boating, camping, and wildlife observation. Excellent river access is provided by boat launches, boardwalks, and a historic ferry to transport anglers to prime fishing areas.

Kenai River king salmon are world-renowned for their size. Numerous 70- and 80-pound fish are caught every year, and a few fish of 90 pounds have been landed. The world record king of 97.4 pounds was caught in 1985. Anglers come from around the world for this remarkable fishing experience.

The Kenai River also produces a major rainbow trout fishery, which is concentrated between Skilak and Kenai lakes and has gained national recognition for its 15- to 20-pound rainbows. The sockeye fishery is also robust. Although primarily a fishery used by anglers from throughout southcentral Alaska, where 60 percent of Alaska's population resides, the sockeye fishery does attract anglers from across the United States and around the world because of its accessibility from Anchorage with its international airport.

3.6.3 Swanson River

The Swanson River is located almost completely within the northern boundaries of Kenai Refuge. The Refuge manages approximately 48 (77 kilometers) of the 51 miles (82 kilometers) of river.

Outstandingly Remarkable Values: fish, wildlife, recreation

3.6.3.1 Scenic and Geologic Values

The Swanson River drainage is approximately 175,000 acres (273.4 square miles or 108 square kilometers) and is almost entirely within the Refuge. The river meanders through the Kenai Peninsula lowlands. The most notable oil discovery on the Kenai Peninsula was in 1957 within the Swanson River drainage, which led to additional hydrocarbon exploration, discovery, and economic benefits and environmental costs related to the oil industry.

3.6.3.2 Fish and Wildlife Values

The river is well known for a regionally large run of the coho (silver) salmon (*Oncorhynchus kisutch)* in the fall. Rainbow trout (*Oncorhynchus mykiss*), Dolly Varden (*Salvelinus malma Walbaum*), and sockeye (red) (*Oncorhynchus nerka*) and silver salmon inhabit most lakes. Large wildfires in 1947 and 1969 transformed large tracts of white and black spruce forests into hardwood birch and aspen forest. These hardwood forests provide outstanding moose and hare habitats, which have contributed to a dramatic increase in these populations. With the increases in moose and hare came increases in the populations of predators such as bear and wolf.

3.6.3.3 Recreation Values

As part of the nationally recognized Swanson River Canoe System, the Swanson River provides outstanding recreation opportunities. Thousands of visitors use the canoe route each year. Maintained portages link the canoe route with more than 40 lakes and 46 miles (74 kilometers) of river. The entire 80-mile (128.7-kilometer) route can be traveled in less than one week. Fishing, canoeing, camping, and wildlife viewing are very popular on the Swanson River. In addition to having a campground and excellent river access, the river has many camping opportunities on the river and connected lakes. Fishing for rainbow trout in the summer and silver salmon in the fall is excellent.

3.6.4 Moose River

The Moose River (including the east and west forks) is a tributary of the Kenai River with its confluence located in the community of Sterling. All but three of the 46 miles (74 kilometers) of river lie within the Refuge.

Outstandingly Remarkable Values: cultural, historic, prehistoric, fish, wildlife, wildness

3.6.4.1 Cultural, Historic, and Prehistoric Values

In the river corridor, nine historic and prehistoric sites have been identified by the Alaska Heritage Resources Survey. The site provides another large and dense cluster of prehistoric artifacts from the Riverine Kachemak tradition. The river is regarded as having very high cultural resource values.

3.6.4.2 Scenic and Geologic Values

The Moose River drainage is approximately 160,000 acres (250 square miles or 647.5 square kilometers) and is almost entirely within the Refuge. The river meanders through the Kenai Peninsula lowlands.

3.6.4.3 Wildness

Approximately one-half of the river is within the Dave Spencer Wilderness. Primary access into the river system is by canoe and portage. This offers visitors an outstanding opportunity for solitude and enjoyment on this undeveloped and natural river.

3.6.4.4 Fish and Wildlife Values

The Moose River supports a relatively large diversity of native fish species. In addition to four Pacific salmon species, the river also hosts Pacific lamprey (*Lampetra tridentata*), Arctic lamprey (*Lampetra japonica*), round whitefish (*Prosopium cylindraceum*), longnose sucker (*Catostomus catostomus*), and eulachon (also known as hooligan or candlefish) (*Thaleichthys pacificus*).

3.6.4.5 Recreation Values

With access to the Swan Lake Canoe System, the Moose River offers outstanding recreation opportunities. This canoe route connects 30 lakes with more than 46 miles (74 kilometers) of river. In addition to areas for camping along the river, two campgrounds are available.

3.6.5 Russian River

The Russian River is 17.3 miles (27.8 kilometers) long and located in the central Kenai Peninsula. The river is a tributary of the Kenai River, with the confluence located between Kenai Lake and Skilak Lake.

The river marks the boundary between the Chugach National Forest and Kenai Refuge lands. The Refuge, therefore, shares land ownership of the river corridor with the U.S. Department of Agriculture Forest Service. The Revised Land and Resource Management Plan for the Chugach National Forest (USDA 2002) recommends the Russian River be added to the National Wild and Scenic Rivers System, with classification of the lower portion of the Russian River as recreational. A recreational classification would allow some development of recreation facilities and new trails to accommodate river users. Designation of this river is consistent with the Wilderness Management objectives of the Service. The Service's comments on the Revised Land

and Resource Management Plan requested that the upper portion of the river be recommended for classification as a Wild River.

Outstandingly Remarkable Values: fish, wildlife, wildness, recreation

3.6.5.1 Cultural, Historic, and Prehistoric Values

The Alaska Heritage Resources Survey has identified six historic and prehistoric sites in the Russian River corridor. Evidence indicates these sites were located to take advantage of the abundant salmon resource. The river is regarded as having very high cultural resource values.

3.6.5.2 Scenic and Geologic Values

At approximately 47,000 acres (73.4 square miles or 190 square kilometer), the Russian River watershed is relatively small. However, the river is extremely important to salmon because it is one of the few clear-water streams feeding into the Kenai River. The watershed lies in Kenai Mountains, tucked between the Skilak Lake and Kenai Lake watersheds. The river provides the abundant sockeye salmon access to the very natural Upper Russian Lake.

3.6.5.3 Wildness

The segment of the Russian River passing through the Refuge lies completely within the Andrew Simons Wilderness. Although nationally recognized for its salmon fishery, the Refuge lands along the river remain undeveloped, and its clear waters remain unpolluted.

3.6.5.4 Fish and Wildlife Values

The clear waters of the Russian River provide excellent habitat for natural populations of sockeye salmon and rainbow trout. Both brown and black bears are attracted to this abundant salmon resource. Sockeye salmon (*Oncorhynchus nerka*), which provide the main fishery value, return to the Russian River in two distinct runs, termed early and late. The early-run arrives at the confluence in early June and remains for about two weeks. The fish have passed through the angling area by mid-July and spawn almost exclusively above the Russian River falls. The late-run sockeye arrive at the confluence by late July and are present in the angling areas through August. This late run has two components: a portion of the run spawns in the upper Russian River and a second segment spawns below the falls and is a component similar to the mainstream Kenai River sockeye.

3.6.5.5 Recreation Values

Excellent access, camping facilities, wildlife viewing, and fishing opportunities exist within the river corridor. The largest sockeye recreational fishery in Alaska is at the confluence of the Russian and Kenai rivers. This fishery is remarkable in its availability because it has the only large run of sockeyes readily accessible to the Anchorage urban area. The length of time the fish are available and the relative

ease with which they are caught make it a favored angling opportunity. This has made the Russian River and its confluence with the Kenai River the personal-use fishery for 60 percent of the Alaska population residing in southcentral Alaska. The annual angler effort for this fishery exceeds 450,000 hours, and annual harvest has been as many as 190,000 fish. In addition to having the sockeye recreational fishery, the Russian River also boasts a robust fishery of rainbow trout, Dolly Varden char, and pink and coho salmon.

3.6.6 Chickaloon River / Mystery Creek

The Chickaloon River is approximately 67 miles (107.8 kilometers) long (including its tributary Mystery Creek) and is located in the northeastern portion of the Refuge, west of the Mystery Hills.

Outstandingly Remarkable Values: fish, wildlife, wildness

3.6.6.1 Scenic and Geologic Values

The river drains the third-largest watershed on the Kenai Peninsula at 194,000 acres (303 square miles or 784.7 square kilometers) and lies along the western slope of the Kenai Mountains before spilling into the Chickaloon estuary.

3.6.6.2 Wildness

The Chickaloon River provides some of the most remote opportunities for solitude and primitive and unconfined recreation on the Refuge. Almost one-half of the river is within the Dave Spencer Wilderness. Access is limited to a couple of road crossings in the river's headwaters. The remote quality of the river provides for its unusually wild and natural qualities.

3.6.6.3 Fish and Wildlife Values

With the only estuary on the Refuge, the Chickaloon River provides unique and very important wildlife habitat. The estuary comprises the major waterfowl and shorebird migratory staging area on the Kenai Peninsula. The river represents one of the most natural systems left on the Refuge, supports a large native diversity of fish (12 species), and is free of known invasive species. In addition, the watershed is home to some of the largest populations of moose, caribou, wolf, and bear on the Refuge.

3.6.7 Fox River

The Fox River is south and centrally located on the Kenai Peninsula and spills into the head of Kachemak Bay. The river is approximately 30 miles (48.2 kilometers) long with the lower 10 miles (16 kilometers) crossing State lands.

Outstandingly Remarkable Values: fish, wildlife, wildness.

3.6.7.1 Scenic and Geologic Values

The Fox River drains one of the largest watersheds on the Kenai Peninsula at 280,000 acres (437.5 square miles or 1,133 square kilometers).

3.6.7.2 Wildness

The Refuge manages 75 percent of the Fox River watershed, which lies entirely within the Andrew Simon Wilderness Area.

3.6.7.3 Fish and Wildlife Values

The fishery resources of Fox River are important for Kachemak Bay commercial, subsistence, and recreational fisheries. The Fox River supports all five species of Pacific salmon present in Alaska and is considered to be the primary spawning and rearing area for Kachemak Bay coho salmon.

3.6.8 Killey River

The Killey River, situated southwest of Skilak Lake, is a glacial tributary of the Kenai River with confluence approximately 6.5 miles (10.4 kilometers) downstream from Skilak Lake. The Killey River is about 34 miles (54.7 kilometers) long, with the last two miles crossing private land.

Outstandingly Remarkable Values: fish, wildlife, wildness

3.6.8.1 Scenic and Geologic Values

The Killey River is a glacial tributary to the Kenai River, and its headwaters reach up to the Harding Icefield. The river's drainage is approximatly 150,000 acres (234.3 square miles or 606.8 square kilometers).

3.6.8.2 Wildness

The Killey River provides the most remote opportunities for solitude and primitive and unconfined recreation on the Refuge. The entire river segment is within the Andrew Simons Wilderness. Access is limited to walking in; there is no road, trail, or plane access. With its remote qualities, naturalness, and lack of development, the Killey River may be considered the wildest river on Kenai Refuge.

3.6.8.3 Fish and Wildlife Values

The river is completely clear and natural, lacking any fragmentation from roads or trails. The Killey River system provides important spawning habitat for Kenai River king salmon and is absent of any known invasive species. The river's watershed is home to the Killey River caribou population and significant populations of moose, wolf, and bear.

3.7 Refuge Infrastructure and Administration

3.7.1 Administrative Facilities[4]

3.7.1.1 Headquarters Area

The infrastructure of the Kenai National Wildlife Refuge (Refuge, Kenai Refuge) is the largest of any refuge in Alaska and one of the largest on any refuge in the United States. Kenai "real property inventory" (property that is a permanent improvement to the landscape such as buildings, trails, etc.) amounts to approximately 40 percent of the real property owned by the U.S Fish and Wildlife Service (Service) in Alaska.

Table 3-12. Facilities located at the headquarters area

Facility	Size (sq. ft.)	Date Constructed
Offices		
Administrative/Visitor Contact Station	9,798	1982
Fire Management Office	1,944	1982
Residences		
Bunkhouse	1,704	1982
Maintenance Shops		
Carpentry Shop	2,000	1982
Service Shop	2,880	1980
Storage		
Administration Storage	320	2002
Biology Storage	320	1995
Cabin Storage	320	2003
Eight-Stall Dry Storage	2,900	1982
Fire Cache	320	1991
Headquarters Lake Fuel Storage	45	1982
Flammable Materials Storage	280	1982
Vehicle Storage	8,000	1998
Visitor Services Storage	320	1995
Docks		
Headquarters Lake Aircraft Docks	27.5	1982
Cabins		
Andrew Berg Historical Cabin	168	1936
Environmental Education Cabin	1,700	2004
Other		
Outdoor Classroom Pavilion	360	1999
Raptor Rehabilitation Pen	640	1985

[4] Administrative facilities described in this section include offices; bunkhouses; vehicle, fuel, and supply storage; maintenance shops; fire caches; wildlife pens; aircraft docks, etc. The Service's primary Kenai Refuge administrative facilities are located approximately one mile south of the City of Soldotna on Ski Hill Road. Table 3-12 lists the facilities located at the Headquarters Area.

3.7.1.2 Remote Facilities

Kenai Refuge has many facilities that spread out over a very large geographical area and cover a broad range of public use, including developed campgrounds, undeveloped campsites, trails, trailheads, outhouses, fishing boardwalks, ferries, backcountry cabins, canoe launches, and roadways. Table 3-13 lists facilities located at remote sites.

Table 3-13. Remote facilities

Facility	Location	Use or Number
Administrative Facilities		
Guard Station	Skilak WRA	Seasonal Housing
Moose Range Meadows Residence	Keystone Drive	Staff Housing
Airstrips (Maintained), Landing Strips/Areas (Cleared) and Hangers		
Aircraft Hanger	Soldotna Airport	Aircraft Storage
Big Indian Airstrip	Chickaloon Flats Area	Landing/Take-Off
Campgrounds (Developed)	See section 3.4.5.1	
Campsites (Walk-In)	Skilak WRA	14
Cabins (Public Use)	See section 3.4.5.2	
Kiosks/Interpretative Displays		
Various	Skilak WRA	44
Various	Swanson River Road	8
Launch Sites (Boat and Canoe)		
Various	Skilak WRA	11
Swanson River Landing	Swanson River Road	Canoe Launch
Various	Swanson River Road Campgrounds	2
Various	Swan Lake Road	4
Other Public Use Facilities		
Amphitheater	Skilak WRA	Ranger Programs
Observation Platform	Swan Lake Road	Wildlife/Scenic Viewing
Kenai-Russian River Special Access Area	Sterling Highway	Fishing-related Accommodations
Moose Range Meadows Public Fishing Area	Keystone Drive	Fishing Boardwalks
RV Dump Station	Skilak WRA	2–Waste Disposal
Visitor Contact Station	Sterling Highway/Skilak WRA	Visitor Information
Parking Areas		
Trailhead Parking Areas	Refuge-Wide	~40
Canoe System Parking	Swan Lake Road	3
Research/Education		
Outdoor Education Center	Swan Lake Road	Overnight Educational Facility
Moose Research Center	Swan Lake Road	Research
Restrooms		
Concrete Vault Toilets	Refuge-Wide	44
Trails	See section 3.4.4.5	

3.7.1.3 Roads

The Refuge administers over 83 miles (133.6 kilometers) of roadways that range from earthen routes to paved roadways.

3.7.2 Refuge Staffing

Kenai Refuge consists of a Refuge manager, a deputy Refuge manager, and eight divisions containing 41 permanent positions:

Administrative Support Division

Information technology specialist (division chief)

Permits specialist

Refuge clerk

Budget technician

Biology Division

Supervisory fish and wildlife biologist (division chief)

Pilot biologist

Ecologist

Wildlife biologist

Database manager/ecologist

Geographic information system specialist

Biological technician (2)

Facilities Division

Supervisory facility operations specialist (division chief)

Vehicle fleet mechanic

Heavy equipment operator

Heavy equipment mechanic

Maintenance mechanic

Maintenance worker (2)

Fire Management Division

Fire management officer (division chief)

Assistant fire management officer

Fire program technician

Forestry technician (2)

Law Enforcement Division

Supervisory Refuge officer (division chief)

Refuge officers (4)

Oil and Gas Division

Oil and gas specialist

Subsistence Division

Subsistence biologist

Visitor Services Division

Supervisory park ranger (division chief)

Interpretative specialist

Environmental education specialist

Outreach specialist

Pilot/Refuge officer

Cabin manager

Volunteer coordinator

Trails manager

On a seasonal basis, the Refuge employs up to 60 additional positions.

3.8 References

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4. Environmental Consequences

4.1 Introduction

This chapter identifies, describes, and compares the consequences (or impacts) of implementing five management alternatives (including current management) proposed in chapter 2 on the physical, biological, and socioeconomic environments identified in chapter 3 of this Comprehensive Conservation Plan (Plan). Alternative A: Current Management provides the basis for comparing the effects of the action alternatives (Alternatives B–E). The effects of each alternative on Refuge resources and recreation opportunities were assessed. To facilitate development of the analysis, the physical, biological, and socioeconomic environments were subdivided into 11 resource areas, grouped into three categories:

- Physical Environment–air quality, soil resources, water quality
- Biological Environment–vegetation/habitat, wildlife
- Socioeconomic Environment–cultural resources, local economy, recreation, river values, subsistence, wilderness values

Any proposal for future development or a new use on the Kenai National Wildlife Refuge (Refuge, Kenai Refuge) would trigger the need for additional analysis and possibly an amendment to this Plan. First, an analysis of whether or not the proposed development was appropriate for the Refuge would be conducted. If it was determined to be appropriate, an evaluation of compatibility with Refuge purposes would be required. If it received a favorable compatibility determination, the project might be able to proceed or—if potential effects warranted—a site-specific analysis of the environmental effects would require following National Environmental Policy Act (NEPA) procedures with a Plan amendment.

4.2 Definition of Terms

Various terms were identified and used to provide a framework for conducting the environmental consequences analysis. These terms were used to describe the impacts on identified Refuge resources and recreation opportunities:

4.2.1 Impact Type

Beneficial Impacts

Impacts resulting from management actions that maintain or enhance the quality and/or quantity of identified Refuge resources or recreation opportunities

Adverse Impacts

Impacts resulting from management actions that degrade the quality and/or quantity of identified Refuge resources or recreation opportunities

4.2.2 Duration of Impact

Short-Term

Impacts on identified Refuge resources or recreation opportunities that occur during implementation of the management action but no longer

Medium-Term

Impacts on identified Refuge resources or recreation opportunities that occur during implementation of the management action that are expected to persist for some time into the future though not throughout the life of the Plan

Long-Term

Impacts on identified Refuge resources or recreation opportunities that occur during implementation of the management action that are expected to persist throughout the life of the Plan and possibly longer

4.2.3 Intensity of Impact

Negligible Impacts

Impacts resulting from management actions that cannot be reasonably expected to affect identified Refuge resources or recreation opportunities at the identified scale

Minor Impacts

Impacts resulting from the specified management action that can be reasonably expected to have detectable though limited effect on identified Refuge resources or recreation opportunities at the identified scale

Moderate Impacts

Impacts resulting from the specified management action that can be reasonably expected to have apparent and detectable effect on identified Refuge resources or recreation opportunities at the identified scale

Major Impacts

Impacts resulting from the specified management action that can be reasonably expected to have readily apparent and

substantial effect on identified Refuge resources or recreation opportunities at the identified scale

4.2.4 Context or Scale of Impact

Site-Specific Scale

Beneficial or adverse impacts occurring at a specific site that is relatively small in size (e.g., a well pad located within the Swanson River Oil and Gas Unit, etc.)

Local Scale

Beneficial or adverse impacts occurring throughout a locally defined area (e.g., Ski Hill Road, Chickaloon Flats, Caribou Hills, etc.)

Refuge-Wide Scale

Beneficial or adverse impacts occurring throughout the Kenai National Wildlife Refuge.

4.3 Key Indicators and Assumptions

Key indicators and various assumptions were identified and used to assist with development of the environmental consequences analysis. Key indicators (e.g., air pollution emissions, physical soil characteristics, etc.) were established for each resource (e.g., air quality, soils, etc.). These indicators were used to measure the type, duration, intensity, and scale of impact anticipated on Refuge resources and/or recreation opportunities.

In most cases, a set of assumptions were made to facilitate development of the impact analysis. Assumptions are often used to clarify the intent of the management direction; in some cases, they are used to fill in gaps where specific information is not available. General assumptions are listed under each management action (e.g., Fire Management), and specific assumptions are listed under the heading of each impact analysis (e.g., Consequences of Using Fire as a Management Tool on Air Quality).

4.4 Analyses

4.4.1 Use of Fire as a Management Tool

General Assumptions:

- Fire is a critical natural process within the Refuge.
- Prescribed and wildfires would be used to mimic natural fire regimes.

- Prescribed fire and wildfire would be used in accordance with approved habitat management plans, fire management plans, and prescribed fire plans.
- Prescribed fire would be used to minimize the risk of catastrophic wildlfires within and adjacent to expanding residential areas (i.e., the wildland-urban interface).
- Destructive or unwanted fires are less likely to occur in areas where prescribed fire has been used to manage fuels.
- Wildlfires ignited within the wildland-urban interface would be suppressed regardless of the management category in which those lands are listed.
- Large wildfires, which generally burn for longer durations, have greater impacts than prescribed fires.
- Trends in the number and size of both anthropogenic and lighting-caused fires are upward—despite increased suppression efforts.
- The measurement and/or assessment of environmental impacts from fire can take decades of monitoring and evaluation.

4.4.1.1 Physical Environment

Consequences of Using Fire as a Management Tool on Air Quality

Indicators:

- Air pollution emissions (e.g., carbon monoxide)
- Particulate matter (PM 2.5)

Assumptions:

- All fires emit air pollution. The type and proportion of emissions varies widely due to fuel character, condition, and environment; and fire behavior.
- All fires emit PM 2.5 (particulate matter up to 2.5 microns in diameter) or "fine particulates."
- The Refuge would continue to work in collaboration with the Alaska Department of Environmental Conservation on all air quality–related issues.
- Prescribed fire would be used in accordance with approved fire management plans that include smoke mitigation measures to minimize public health and visibility impacts.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, short-term impacts on air quality at the local scale due to an increase in air pollution emissions and PM 2.5 resulting from burning. The intensity of those impacts would vary due to a number of parameters (e.g.,

prescription used, fuel consumed in each combustion stage, the size of the area burned, fire behavior, other ongoing fire events, etc.). Air quality–related effects associated with fire include deposition of particulates in the vicinity of the burn area and associated loss of aesthetic appeal, local visibility reduction in areas affected by smoke and/or odor, and potential health implications associated with smoke inhalation. Minimizing the effects of fire on communities and recreation areas in and around the Kenai Peninsula, the city of Anchorage, and Tuxedni Bay—a designated Class 1 airshed in Lake Clark National Park across the Cook Inlet—would continue to be a priority for the Refuge.

Under Alternative A, prescribed fire ignitions—which generally occur during favorable fuel moisture and meteorological and/or atmospheric conditions using firing techniques that minimize smoke impacts to sensitive targets (e.g., communities, recreation areas, etc.)—would potentially have air quality impacts at the site-specific scale on approximately 618,500 acres (31 percent of the Refuge) when such prescriptions are used.

Conversely, air quality impacts associated with wildfires—which tend to burn much longer and cover larger areas than prescribed fires—could potentially be observed at the local scale on approximately 1,883,500 acres (95 percent of the Refuge) when such events are used to achieve management goals, and suppression is not initiated. Beneficial impacts on air quality would occur when and where wildfire suppression activities are conducted.

Alternative B:

Implementation of Alternative B would have adverse, short term impacts on air quality similar to those described under Alternative A, except less air pollution emissions and PM 2.5 resulting from prescribed and wildfire use would be expected because prescribed fire would be prohibited on Minimal Management lands that adjoin designated Wilderness, and use of wildland fire would not be allowed on 258,500 acres (13 percent of the Refuge) designated as Intensive and Moderate Management—or 204,000 acres more than Alternative A. Prohibiting use of wildland fire on Moderate Management lands would mean that, under Alternative B, fire could be used as a management tool on 1,680,000 acres (84.5 percent of the Refuge), compared to about 95 percent of the Refuge under Alternative A.

Alternative B would have less adverse impacts on air quality than Alternative A in the short term due to management prescriptions that favor more wildland fire suppression. In the long term under Alternative B, the risk of catastrophic fire could increase in those areas where suppression occurs, and large catastrophic fires produce much more air pollution than multiple smaller fires (i.e., prescribed fires).

Alternative C:

Implementation of Alternative C would have similar adverse, short-term impacts on air quality as those described under Alternative A, except air pollution emissions and PM 2.5 resulting from use of wildland fire could potentially be observed at the local scale on 1,938,000 acres (97.5 percent of the Refuge)—or 54,500 acres (2.5 percent) more than Alternative A when such prescriptions are used to achieve management goals, and suppression activities are not initiated.

Alternative C would have more adverse impacts on air quality than Alternative A due to management prescriptions that favor less wildland fire suppression activity.

Alternative D:

Implementation of Alternative D would have similar adverse, short-term impacts on air quality as those described under Alternative A, except more air pollution emissions and PM 2.5 would be expected at the site-specific and local scales because prescribed fire would be allowed on 1,938,000 acres (97.5 percent of the Refuge)—or 1,319,000 acres (66.5 percent) more than Alternative A—and use of wildland fire would be allowed on 1,938,000 acres (97.5 percent of the Refuge)—or 54,500 acres (2.5 percent) more than Alternative A when such prescriptions are used and suppression activities are not initiated.

Alternative D would have more adverse air quality impacts than Alternative A in the short term due to management prescriptions that allow more prescribed fire use and require less wildland fire suppression activity. In the long term, a managed fire regime that mimics the natural fire regime could theoretically reduce adverse air quality impacts.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse, short-term impacts on air quality as those described under Alternative A, except more air pollution emissions and PM 2.5 would be expected at the site-specific and local scales because prescribed fire would be allowed on 1,938,000 acres (97.5 percent of the Refuge)—or 1,319,000 acres (66.5 percent) more than Alternative A; and use of wildland fire would be allowed on 1,938,000 acres (97.5 percent of the Refuge)—or 54,500 acres (2.5 percent) more than Alternative A when such prescriptions are used and suppression activities are not initiated.

Alternative E would have more adverse air quality impacts than Alternative A in the short term due to management prescriptions that allow more prescribed fire use and require less wildland fire suppression activity. In the long term, a managed fire regime that mimics the natural fire regime could reduce adverse air quality impacts.

Consequences of Using Fire as a Management Tool on Soils

Indicators:

- Erosion

Assumptions:

- Physical soil characteristics change as a result of fire severity (i.e., peak temperature and duration) and fire frequency.
- Prescribed fire is used as a management tool when soils are moderately moist, and consequently burn at low-intensity levels.
- Wildland fires can ignite under a wide range of conditions but have greater impacts on soil resources when burning at moderate-high intensity levels.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, medium-term impacts on soil resources at the local scale due to the effects of heat on soil structure and precipitation on exposed soils. The intensity of those impacts would vary due to a number of parameters (e.g., slope, soil type, temperature, moisture content, fire frequency, and burn severity). The frequency and timing of post-fire weather events can also be a significant factor, though impacts associated with such events can not be quantified due to annual variations in rainfall amounts and intensity.

Under Alternative A, prescribed fires—which are typically low-intensity fires that have limited adverse effects on soil structure stability—could be used on approximately 618,500 acres (31 percent of the Refuge) though such use and related impacts would be limited on 196,000 acres (10 percent of the Refuge) identified as Minimal Management lands. The effects of precipitation on exposed soils could result in sheet runoff and erosion at site-specific locations where sensitive soils exist.

Conversely, wildland fires—which tend to burn much hotter than prescribed fires, disrupt organic cements, and increase water repellency—could be used on approximately 1,883,500 acres (95 percent of the Refuge). The effects of precipitation on exposed soils could result in sheet runoff and erosion at site-specific locations where sensitive soils exist. More adverse impacts would be expected where wildland fire is used as a management tool due to the larger size of affected areas and changes in soil structure as a result of high-intensity burns. Additional impacts could result if and when wildland fire suppression efforts are used. The alternative would require wildland fire suppression activity on 54,500 acres (2.5 percent of the Refuge) designated as Intensive management. Suppression operations often include ground-disturbing activities such as dozer-line or hand-line construction and tree felling, though these impacts can be minimized by using natural or existing barriers whenever possible to avoid

construction of control lines. Restoration or rehabilitation of sensitive areas before erosion occurs can also mitigate such impacts.

Alternative B:

Implementation of Alternative B would have similar adverse impacts on soil resources as those described under Alternative A, except less erosion would be expected because prescribed fire would be prohibited on Minimal management lands that adjoin designated Wilderness, and use of wildland fire would not be allowed on 258,500 acres (13 percent of the Refuge) designated as Intensive and Moderate management—or 204,000 acres more than Alternative A. Erosion would potentially be observed at site-specific locations as a result of use of wildland fire on 1,680,000 acres (84.5 percent of the Refuge) when such events are used to achieve management goals and as a result of wildland fire suppression activities on 258,500 acres (13 percent of the Refuge) designated as Intensive and Moderate management (or 204,000 acres more than Alternative A).

Alternative B would have less adverse impacts on soil resources due to fire use than Alternative A but more adverse impacts due to fire suppression activities.

Alternative C:

Implementation of Alternative C would have similar adverse, medium-term impacts on soil resources as those described under Alternative A, except more erosion would be expected at site-specific locations because prescribed fire use would not be limited on any portion of 619,000 acres (31 percent of the Refuge), and use of wildland fire would be allowed on 1,938,000 acres (97.5 percent of the Refuge)—or 54,500 acres (2.5 percent) more than Alternative A.

Alternative C would have more adverse impacts on soil resources than Alternative A due to management prescriptions that favor more fire use.

Alternative D:

Implementation of Alternative D would have similar adverse, medium-term impacts on soil resources as those described under Alternative A, except more erosion would be expected at site-specific locations because prescribed fire use would be allowed on 1,938,000 acres (97.5 percent of the Refuge)—or 1,319,000 acres (66.5 percent) more than Alternative A—and use of wildland fire would be allowed on 1,938,000 acres (97.5 percent)—or 54,500 acres (2.5 percent) more than Alternative A.

Alternative D would have more adverse impacts on soil resources than Alternative A due to management prescriptions that favor more fire use.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse, medium-term impacts on soil resources as those described under Alternative A, except more erosion would be expected at site-specific locations because prescribed fire use would be allowed on 1,938,000 acres (97.5 percent of the Refuge)—or 1,319,000 acres (66.5 percent) more than Alternative A—and use of wildland fire would be allowed on 1,938,000 acres (97.5 percent)—or 54,500 acres (2.5 percent) more than Alternative A.

Alternative E would have more adverse impacts on soil resources than Alternative A due to management prescriptions that favor more fire use.

Consequences of Using Fire as a Management Tool on Water Quality

Indicators:

- Sedimentation
- Toxic chemicals

Assumptions:

- Soil erosion and toxic chemicals affect water quality.
- Water quality impacts due to soil erosion vary based on a variety of factors, including the number and magnitude of weather events following fires and the time required for vegetation to recover on site.
- Wildland fires may have greater impacts on water quality than prescribed fires due to their larger size and ability to affect a greater number of aquatic systems (e.g., lakes, ponds, wetlands, streams, etc.).
- Water quality impacts due to toxic chemicals result from wildland fire suppression activities.

Alternative A:

Implementation of Alternative A would have adverse, short-term impacts on water quality at the site-specific scale due to the effects of soil erosion and toxic chemicals resulting from post-fire weather events and wildland fire suppression activities. The intensity of those impacts would vary due to a number of parameters (e.g., soil type, slope, the number and magnitude of weather events, burn severity, rate of vegetation recovery, type and amount of contamination, etc.). The deposition of sediments in aquatic systems from wildland fire events and wildland suppression activities (i.e., heavy equipment use, line construction) and toxic chemicals resulting from wildland fire suppression activities (i.e., fuel spills, fire retardants) could potentially affect aquatic flora and fauna health.

Under Alternative A, use of wildland fire would be allowed on approximately 1,883,500 acres (95 percent of the Refuge). Water quality impacts resulting from soil erosion would be expected to occur at site-specific locations within these acreages. Additional water quality impacts would result if and when wildland fire suppression efforts are used. The alternative would require wildland fire suppression activity on 54,500 acres (2.5 percent of the Refuge) designated as Intensive management. Impacts could be avoided or minimized by using natural or existing barriers whenever possible to avoid control line construction, using approved "screens" or foot-valves when drafting water from anadromous lakes or streams, ensuring spill mitigation fits and absorbent materials are available where fuel spills occur, avoiding refueling activities near water systems, managing fire retardant and foam application, and restoring or rehabilitating sensitive areas before water impacts occur.

Alternative B:

Implementation of Alternative B would have similar adverse, short-term impacts on water quality as those described under Alternative A, except less erosion-based impacts would be expected due to use of wildland fire on 1,680,000 acres (84.5 percent of the Refuge), and more adverse impacts would be expected due to wildland fire suppression activities on 258,500 acres (13 percent of the Refuge) designated as Intensive and Moderate management—or 204,000 acres more than Alternative A.

Alternative B would have less adverse impacts on water quality due to fire use than Alternative A but more adverse impacts as a result of fire suppression activities.

Alternative C:

Implementation of Alternative C would have similar adverse, short-term impacts on water quality as those described under Alternative A, except erosion-based impacts resulting from wildland fires would be expected to occur at site-specific location on 1,938,000 acres (97.5 percent of the Refuge)—or 54,500 acres (2.5 percent) more than Alternative A.

Alternative C would have more adverse impacts on water quality than Alternative A due to management prescriptions that favor more use of wildland fire including lands identified as Intensive Management.

Alternative D:

Implementation of Alternative D would have similar adverse, short-term impacts on water quality as those described under Alternative A, except more erosion-based impacts would be expected at site-specific locations because use of wildland fire would be allowed on 1,938,000

acres (97.5 percent of the Refuge)—or 54,500 acres (2.5 percent) more than Alternative A.

Alternative D would have more adverse impacts on water quality than Alternative A due to management prescriptions that favor more use of wildland fire.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse, short-term impacts on water quality as those described under Alternative A, except more erosion-based impacts would be expected at site-specific locations because use of wildland fire would be allowed on 1,938,000 acres (97.5 percent of the Refuge)—or 54,500 acres (2.5 percent) more than Alternative A.

Alternative E would have more adverse impacts on water quality than Alternative A due to management prescriptions that favor more use of wildland fire.

4.4.1.2 Biological Environment

Consequences of Using Fire as a Management Tool on Wildlife Habitat

Indicators:

- Habitat diversity (i.e., species composition, age structure, spatial heterogeneity, etc.)

Assumptions:

- Natural and human-induced fire events influence habitat diversity.

Alternative A (Current Management):

Implementation of Alternative A would have beneficial, long-term impacts on wildlife habitat at the Refuge-wide scale because prescribed and wildland fire can change species composition and age structure on a large scale, create mosaic vegetation patterns (spatial heterogeneity), reduce dead woody fuel accumulations, and maintain or restore natural fire regimes. The intensity of these impacts would vary due to a number of parameters, such as the timing (early versus mid- to late season), location, intensity, duration, and size of the fire—more so than the type of fire prescription used (i.e., prescribed versus wildland fire).

Early seasonal fires, whether they are human-induced or naturally generated, would burn fuels at or above the surface but rarely below the surface due to high moisture content. These fires would regenerate the species affected by the fire (particularly black spruce forests) and

thus maintain monocultures. As such, early seasonal fires would typically be suppressed. Conversely, mid- to late season fires would burn ground fuels more completely, exposing mineral soils. They would generally convert black spruce and mixed white spruce/hardwood forests to aspen and birch regeneration. Large mid- to late season fires (also known as stand replacement fires) would result in a mosaic of vegetation patterns influenced by variations in fire severity, and existing landscape topography and waterbodies. These fires are generally accepted as beneficial to wildlife species that depend on early seral stage communities (e.g., moose, snowshoe hare, etc.) and their predators (e.g., lynx, brown bear, wolves, etc.). Mid- to late season fires also mitigate fuel hazards by reducing or replacing live and dead hazard fuels with less flammable hardwood species. This type of conversion can reduce the threat of catastrophic wildfires for many decades.

Under Alternative A, prescribed fire would potentially improve habitat diversity on approximately 618,500 acres (31 percent of the Refuge) when such prescriptions are used. Such use and related beneficial impacts would be limited on 196,000 acres (10 percent of the Refuge) identified as Minimal management lands. Conversely, habitat diversity resulting from use of wildland fire would potentially improve on 1,883,500 acres (95 percent of the Refuge) when such events are used to achieve management goals, and suppression is not initiated. The alternative would require wildland fire suppression activity on 54,500 acres (2.5 percent of the Refuge) designated as Intensive management. As a result, adverse impacts would occur on fire-adapted vegetation and early seral stage wildlife species (e.g., snowshoe hare). Potential benefits would be expected for climax dependent wildlife species (e.g., boreal owl) as habitat ages.

Alternative B:

Implementation of Alternative B would have similar beneficial, long-term impacts on wildlife habitat as those described under Alternative A, except habitat diversity would be the result of changes in use of wildland fire prescriptions. Under Alternative B, habitat diversity resulting from use of wildland fire would potentially be observed on 1,680,000 acres (84.5 percent of the Refuge)—or 203,500 acres less than Alternative A, when such events are used to achieve management goals and suppression is not initiated. The alternative would require wildland fire suppression activity on 258,500 acres (13 percent of the Refuge) designated as Intensive and Moderate management—or 204,000 acres more than Alternative A. Forests on these lands would age and provide habitat for climax dependent wildlife species (e.g., martin).

Alternative B would have less beneficial impacts on wildlife habitat than Alternative A due to management prescriptions that require more wildland fire suppression activity.

Alternative C:

Implementation of Alternative C would have similar beneficial, long-term impacts on wildlife habitat as those described under Alternative A, expect habitat diversity would be the result of a slight increase in use of wildland fire and a slight decrease in wildland fire suppression activity. Under Alternative C, habitat diversity resulting from use of wildland fire could potentially be observed on 1,938,000 acres (97.5 percent of the Refuge—or 54,500 acres more than Alternative A, when such prescriptions are used to achieve management goals and suppression activities are not initiated.

Alternative C would have more beneficial impacts on wildlife habitat than Alternative A due to management prescriptions that require slightly less wildland suppression activity.

Alternative D:

Implementation of Alternative D would have similar beneficial, long-term impacts on wildlife habitat as those described under Alternative A, except habitat diversity would be the result of an increase in prescribed fire. Under Alternative D, habitat diversity resulting from prescribed fire could potentially be observed on 1,938,000 acres (97.5 percent of the Refuge)—or 1,361,500 acres more than Alternative A, when such prescriptions are used to achieve management goals.

Alternative D would have more beneficial impacts on wildlife habitat than Alternative A due to management prescriptions that favor more prescribed fire use and slightly less wildland fire suppression activity.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar beneficial, long-term impacts on wildlife habitat as those described under Alternative A, except habitat diversity would be the result of an increase in prescribed fire. Under Alternative E, habitat diversity resulting from prescribed fire could potentially be observed on 1,938,000 acres (97.5 percent of the Refuge)—or 1,361,500 acres more than Alternative A, when such prescriptions are used to achieve management goals.

Alternative E would have more beneficial impacts on wildlife habitat than Alternative A due to management prescriptions that favor more prescribed fire use and slightly less wildland fire suppression activity.

4.4.1.3 Human Environment

Consequences of Using Fire as a Management Tool on Recreation

Indicators:

- Recreation access
- Participation in recreation activities (e.g., annual visitor use days for each of the "big six": hunting, fishing, wildlife viewing, wildlife photography, interpretation, and education)

Assumptions:

- Fires may indirectly affect certain recreation activities by altering wildlife habitats.
- Constructed fire lines, fuel breaks, and temporary trails can provide unplanned recreation access to areas that might otherwise have remained inaccessible.
- Active fires may directly affect recreation activities via temporary area closures and access restrictions, and smoke, which may discourage recreation participation.
- Wildland fires may occur virtually anywhere on the Refuge, and they tend to burn longer and more intensely than prescribed fires. All other things being equal, wildland fires are more likely to have adverse impacts on recreation activities, and prescribed fires are more likely to have beneficial impacts on recreation activities.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, short-term impacts on recreation. Impacts would be major at the site-specific scale when compared to current conditions due to access restrictions imposed in the vicinity of active fires to ensure public safety.

Conversely, beneficial, medium-term impacts on some consumptive (e.g., moose hunting) and non-consumptive (e.g., wildlife viewing) recreation activities would be expected. The intensity of the impacts would vary based on the specific characteristics of the fire; but in general, dense mature forests would be converted to early seral stage forests, which benefits early seral stage wildlife species and recreation opportunities for those species. Additional beneficial impacts would be expected due to fire management activities (e.g., timber clearing for fuel breaks) that create new recreation access routes. The intensity and duration of the impacts would vary based on the amount of management implemented and the timing of actions taken to close and/or rehabilitate de facto access routes (if any).

Under Alternative A, prescribed fire could occur on approximately 618,500 acres (31 percent of the Refuge) on lands designated as Intensive, Moderate, and Traditional management, plus Minimal management lands where prescribed fire would be limited but not prohibited. The beneficial effects of fire on wildlife habitat and wildlife-dependent recreation activities would be maximized on this portion of the Refuge, while potential adverse impacts (site closures, access restrictions, smoke) would be minimized.

Alternative B:

Implementation of Alternative B would have similar adverse and beneficial impacts on recreation as those described under Alternative A, except that prescribed fire would be prohibited on Minimal management lands that adjoin designated Wilderness, and use of wildland fire would not be allowed on 258,500 acres (13 percent of the Refuge) designated as Intensive and Moderate management (or 204,000 acres more than Alternative A). Prohibiting use of wildland fire on Moderate management lands would mean that, under Alternative B, fire could be used as a management tool on 1,680,000 acres (84.5 percent of the Refuge) compared to about 95 percent of the Refuge under Alternative A.

Alternative B would have less adverse and less beneficial impacts on recreation than Alternative A.

Alternative C:

Implementation of Alternative C would have similar adverse and beneficial impacts on recreation as those described under Alternative A, except that under Alternative C, prescribed fire could be used without restriction on 385,000 acres (19.5 percent of the Refuge) designated as Minimal management lands; and under Alternative A, use of prescribed fire would be limited but not prohibited on Minimal management lands. In practical terms, this subtle difference would be unlikely to cause measurably different impacts on recreation.

Alternative D:

Implementation of Alternative D would have similar adverse and beneficial impacts on recreation as those described under Alternative A, except that under Alternative D, prescribed fire could be used in all management categories, including Wilderness. Using prescribed fire in Wilderness would potentially expand the scale and increase the intensity of impacts described under Alternative A because the portion of the Refuge on which prescribed fire is allowed would increase by two-thirds. The actual scale and intensity of impacts would vary depending on the location, timing, duration, and size of prescribed fires.

Alternative D would have more adverse and more beneficial impacts on recreation than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse and beneficial impacts on recreation as those described under Alternative A, except that under Alternative E, prescribed fire could be used in all management categories, including Wilderness. Using prescribed fire in Wilderness would potentially expand the scale and increase the intensity of impacts described under Alternative A because the portion of the Refuge on which prescribed fire is allowed would increase by two-thirds. The actual scale and intensity of impacts would vary depending on the location, timing, duration, and size of prescribed fires.

Alternative E would have more adverse and more beneficial impacts on recreation than Alternative A.

Consequences of Using Fire as a Management Tool on Subsistence

Indicators:

- Presence of subsistence resources (e.g., moose, snowshoe hare, lynx, wolverine, wolves)
- Access to subsistence resources

Assumptions:

- As a dynamic process, fire affects both the abundance and distribution of subsistence resources and their habitats across the landscape and through time (e.g., the present decline in moose habitat conditions is consistent with the natural fire return interval).
- Prescribed fires and wildland fires of equal size have similar effects on the distribution and abundance of subsistence resources.

Alternative A (Current Management):

Implementation of Alternative A would have beneficial, long-term impacts on the presence of subsistence resources. The intensity of the impacts would vary based on the characteristics of fire events; but in general, changes in the abundance of subsistence resources—particularly early seral stage-dependent wildlife species (e.g., moose, snowshoe hare)—would be expected at the Refuge-wide scale. Under Alternative A, prescribed fire would potentially improve habitat for subsistence resources on approximately 618,500 acres (31 percent of the Refuge) when such prescriptions are used. Such use, and related beneficial impacts, would be limited on 196,000 acres (10 percent of the Refuge) identified as Minimal management lands. Conversely, habitat for subsistence resources resulting from use of wildland fire would

potentially improve on 1,883,500 acres (95 percent of the Refuge) when such events are used to achieve management goals and suppression is not initiated. The alternative would require wildland fire suppression activity on 54,500 acres (10 percent of the Refuge) designated as Intensive management.

Adverse, short-term impacts on access to subsistence resources would be expected when areas with active fires are temporarily closed to public use and thick smoke reduces visibility during hunting seasons. Impacts would be major at the site-specific scale when compared to existing conditions.

Conversely, beneficial, medium-term impacts on access to subsistence resources would occur at the local scale due to suppression activities, which often create fire lines and fuel breaks that subsequently become unofficial public access routes until the Refuge obtains adequate resources to complete rehabilitation. The intensity and duration of the impacts would vary based on the amount of management implemented and the timing of actions taken to close and/or rehabilitate de facto access routes (if any).

Alternative B:

Implementation of Alternative B would have similar beneficial and adverse, short- to long-term impacts on subsistence as those described under Alternative A, except the abundance of subsistence resources, particularly early seral stage–dependent wildlife species, would be adversely affected by suppression activities. Under Alternative B, the abundance of subsistence resources resulting from use of wildland fire would potentially be observed on 1,680,000 acres (84.5 percent of the Refuge) when such events are used to achieve management goals and suppression is not initiated, and as a result of wildland fire suppression activities on 258,500 acres (13 percent of the Refuge) designated as Intensive and Moderate management. Forests on these lands would age and habitat would be provided for climax dependent wildlife species (e.g., martin)—more so than subsistence species and their predators (e.g., lynx, wolves).

Alternative B would have less beneficial impacts on subsistence than Alternative A due to management prescriptions that favor more wildland fire suppression.

Alternative C:

Implementation of Alternative C would have similar beneficial, short-term impacts on subsistence as those described under Alternative A, except the abundance of subsistence resources, particularly early seral stage–dependent wildlife species, would benefit from a slight increase in use of wildland fire on 1,938,000 acres (97 percent of the Refuge)—or 54,500 acres (2.5 percent) more than Alternative A, when such prescriptions are used to achieve management goals, and suppression

activities are not initiated. The alternative would require slightly less wildland suppression activity than is proposed under Alternative A.

Alternative C would have more beneficial impacts on subsistence than Alternative A due to management prescriptions that favor more early seral stage communities for subsistence species and their predators.

Alternative D:

Implementation of Alternative D would have similar beneficial, long-term impacts on subsistence as those described under Alternative A, except the abundance of subsistence resources, particularly early seral stage–dependent wildlife species, would benefit from an increase in prescribed and use of wildland fire. Prescribed fire use would be allowed on 1,938,000 acres (97.5 percent of the Refuge)—or 1.319,000 acres (66.5 percent) more than Alternative A—and wildlife fire use would be allowed on 1,938,000 acres (97.5 percent)—or 54,500 acres (2.5 percent) more than Alternative A. The alternative would allow much more prescribed fire use and require slightly less wildland fire suppression activity than Alternative A.

Conversely, Alternative D would have similar adverse and beneficial impacts on access to subsistence resources as those described under Alternative A, except temporary access restrictions near active wildfires and reduced visibility from smoke could occur more frequently and possibly for longer periods of time. Long-term impacts on access to subsistence resources along fire lines and fuel breaks would likely occur over a smaller area of the Refuge as both prescribed fire and wildland fire are used more often than fire suppression.

Alternative D would have more beneficial impacts on subsistence than Alternative A due to management prescriptions that favor more prescribed fire use and slightly less wildland fire suppression activity.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar beneficial, long-term impacts on subsistence as those described under Alternative A, except the abundance of subsistence resources (particularly early seral stage–dependent wildlife species) would benefit from an increase in prescribed and use of wildland fire. Prescribed fire use would be allowed on 1,938,000 acres (97.5 percent of the Refuge)—or 1.319,000 acres (66.5 percent) more than Alternative A—and wildlife fire use would be allowed on 1,938,000 acres (97.5 percent)—or 54,500 acres (2.5 percent) more than Alternative A. The alternative would allow much more prescribed fire use and require slightly less wildland fire suppression activity than Alternative A.

Conversely, Alternative E would have similar adverse and beneficial impacts on access to subsistence resources as those described under Alternative A, except temporary access restrictions near active

wildfires and reduced visibility from smoke could occur more frequently and possibly for longer periods of time. Long-term impacts on access to subsistence resources along fire lines and fuel breaks would likely occur over a smaller area of the Refuge as both prescribed fire and wildland fire are used more often than fire suppression.

Alternative E would have more beneficial impacts on subsistence than Alternative A due to management prescriptions that favor more prescribed fire use and slightly less wildland fire suppression activity.

Consequences of Using Fire as a Management Tool on Wilderness Values

Indicators:

- Untrammeled condition (i.e., free of intentional human manipulation)
- Opportunities for solitude
- Opportunities for primitive and unconfined types of recreation
- Ecological, scientific, and scenic values

Assumptions:

- At the landscape level, effects and influence of prescribed fire are equal to lightning-caused wildland fire.
- Population growth and development in areas adjacent to the Kenai Wilderness area are expected to continue increasing at the current rate.

Alternative A (Current Management):

Implementation of Alternative A would have an overall beneficial, long-term impact on wilderness values within the Kenai Wilderness area and five identified Refuge units (Moose River/Mystery Creek, Pipeline Lowlands, Chickaloon Flats, Two Indians, and Lark Lake) by generally allowing fire to fulfill its natural role with little interference or evidence of fire suppression activities in these areas. A high degree of naturalness and opportunities for primitive recreation (characterized by solitude) would result from fire management activities at these locations.

Conversely, Alternative A would result in adverse, long-term impacts to wilderness values in those portions of the Kenai Wilderness area near the wildland-urban interface. The removal of natural fire, construction of fire lines, use of retardants, and cutting of trees would continue to adversely affect naturalness and the untrammeled condition within approximately 30,000 acres (2 percent) of the Wilderness area. Fire suppression activities would have adverse, short-term impacts on wilderness solitude, the intensity of which would vary with the suppression methods used (e.g., solitude would be less affected by the

noise from axes and pack stock than from chainsaws and helicopters). As the frequency of fire ignition continues to increase and development continues to encroach upon areas adjacent to the Kenai Wilderness area, more wildfires would be suppressed—resulting in adverse impacts to larger portions of the Kenai Wilderness area. In certain situations where aggressive fire suppression methods become necessary, adverse site-specific impacts would be major and long term.

Implementation of Alternative A would have adverse, long-term, minor to moderate impacts on wilderness values within the western and central portions of Kenai Refuge (Oilfields, Headquarters, Skilak Loop, Research Center, and Tustumena Outlet units). Naturalness is the wilderness value most likely to be affected because these units possess relatively few opportunities for solitude and primitive recreation. These areas are outside the Kenai Wilderness area and are closer to populated areas and valuable property, so it is likely aggressive suppression methods would be used more frequently and in larger areas than would occur within the Wilderness area. Impacts could be avoided in much of these areas under Moderate management, where use of wildland fire would continue to be allowed. Impacts of suppression on the remaining Refuge lands in these units under Intensive management would be negligible, as these lands possess few wilderness values. Adverse, long-term impacts of minor intensity would result on ecological and scientific values. These impacts would be most noticeable where suppression actions reduce the Refuge's ability to study effects of natural fire or where unique or important habitats are significantly altered by the construction of fire lines and fuel breaks.

Alternative B:

Implementation of Alternative B would have similar beneficial and adverse impacts on wilderness values as those described under Alternative A, except more adverse impacts to naturalness and solitude from fire suppression activities would be expected. Additional adverse impacts would be expected on lands under Minimal management, where use of wildland fire would no longer be an option—likely increasing the use of fire suppression.

Alternative B would have more adverse impacts on wilderness values than Alternative A.

Alternative C:

Implementation of Alternative C would have similar beneficial and adverse impacts on wilderness values as those described under Alternative A, except adverse impacts to ecological and scientific values, naturalness, and solitude from fire suppression activities would occur less often and would be less noticeable with use of wildland fire as an option on nearly the entire Refuge, likely decreasing the use of fire suppression.

Alternative C would have less adverse impacts on wilderness values than Alternative A.

Alternative D:

Implementation of Alternative D would have similar beneficial and adverse impacts on wilderness values as those described under Alternative C, except less adverse impacts to the naturalness and solitude from fire suppression activities would be expected, and impacts would be less noticeable, as both prescribed and use of wildland fire would be an option on nearly the entire Refuge, likely decreasing the use of fire suppression. Implementation of Alternative D could have adverse, minor, long-term impacts to the ecological and scientific values on a local scale. While the use of prescribed fire within the Kenai Wilderness area would represent an alteration of natural processes and a deviation from primeval influences, these impacts would be minimized if the use of this management strategy is only occasional and affects relatively small areas over time.

Alternative D would have less adverse impacts on wilderness values than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar beneficial and adverse impacts on wilderness values as those described under Alternative C, except less adverse impacts to the naturalness and solitude from fire suppression activities would be expected, and impacts would be less noticeable, as both prescribed and use of wildland fire would be an option on nearly the entire Refuge, likely decreasing the use of fire suppression. Implementation of Alternative E could have adverse, minor, long-term impacts to the ecological and scientific values on a local scale. While the use of prescribed fire within the Kenai Wilderness area would represent an alteration of natural processes and a deviation from primeval influences, these impacts would be minimized if the use of this management strategy is only occasional and affects relatively small areas over time.

Alternative E would have less adverse impacts on wilderness values than Alternative A.

4.4.2 Swanson River Oil and Gas Unit

General Assumptions:

- Existing industrial activities would not decrease during the life of this Plan.
- Existing facilities and infrastructure would remain at current levels or increase during the life of the field since such facilities are considered “assets” to the operator.

4.4.2.1 Physical Environment

Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Soils

Indicators:

- Physical characteristics: compaction, soil permeability, water repellency
- Contaminates (e.g., antifreeze, methanol, solvents, fuels, oil, PCBs, etc.)

Assumptions:

- Physical soil characteristics are degraded by construction activities and presence of permanent structures on the landscape.
- Approximately 1,000 acres (43,560,000 square feet or 12 percent of the leased area) of natural habitat has been replaced with an anthropogenic footprint associated with commercial oil and gas production and exploration (e.g., roads, well pads, buildings, etc.).
- Best management practices would be implemented during restoration efforts to minimize erosion.

Alternative A (Current Management):

Implementation of Alternative A would consist of management activities during and after the life of the project that might affect soil characteristics. The impacts associated with these proposed activities are analyzed in the following text.

<u>Exploration, Development, and Production During the Life of the Project</u>
Conducting oil and gas exploration and development activities within the Swanson River Oil and Gas Unit during the life of the project would continue to have adverse, long-term impacts on physical soil characteristics due to soil compaction and contamination resulting from such activities. Impacts would be major at site-specific locations when compared to existing natural conditions. Soil compaction would increase under the weight of heavy machinery and infrastructure associated with such activities. Soil permeability would decline, water repellency would increase, and loss of soil function would be expected. Soil contamination resulting from accidental spills associated with development and production activities would be expected.

<u>Restoration Activities During and After the Life of the Project</u>
Removing and restoring oil and gas-related industrial roads and facilities not needed to support ongoing oil and gas operations during the life of the project would have beneficial, long-term impacts on physical soil characteristics when and where such activities occur. Impacts would be major at site-specific locations when compared to

existing developed conditions, though actual impacts are expected to be negligible because such facilities are expected to be considered as assets by the operator and would, in most cases, not be removed during the life of the project. If restoration work was conducted, soil compaction would decrease, soil permeability would increase, water repellency would decrease, and soil function would improve at site-specific locations.

Removing and restoring *most* oil and gas-related industrial roads and facilities (at the Refuge manager's discretion) after the life of the project would have beneficial, long-term impacts on physical soil characteristics when and where such activities occur. Although an assessment of the number and diversity of potential sites to be restored has not been conducted, and soils benefiting from the alternative can not be calculated, impacts would be expected to be major at site-specific locations within the lease area when compared to existing developed conditions. Soil compaction and water repellency would diminish, and soil permeability and function would improve where roads and facilities are removed and the sites restored. Once vegetation reestablishes itself on a site, either through direct restoration efforts or natural regeneration, short-term adverse impacts resulting from restoration activities would diminish, and long-term beneficial impacts would result.

Alternative B:

Implementation of Alternative B would have similar impacts on physical soil characteristics as those described under Alternative A during the life of the project. After the life of the project, Alternative B would require removal and restoration of *all* existing oil and gas related industrial roads, pipelines and associated fixtures, and facilities, and resulting beneficial impacts would be greater than those obtained under Alternative A.

Alternative B would have more adverse, short-term and more beneficial, long-term impacts on soil resources than Alternative A.

Alternative C:

Implementation of Alternative C would have similar impacts on physical soil characteristics as those described under Alternative A during the life of the project. After the life of the project, Alternative C would have adverse, long-term impacts on physical soil characteristics at site-specific locations along public use trails and at five primitive camping areas provided for under this alternative. Although the number and/or length of public use trails has not been determined, and the size or location of five primitive camping areas have not been assessed, adverse impacts at these locations would be expected to be comparable to those observed at existing developed sites within and adjacent to the oil and gas unit with similar soil conditions.

Alternative C would have less adverse, short-term and less beneficial, long-term impacts on soil resources resulting from restoration activities, and more adverse, long-term impacts resulting from public use activities than Alternatives A.

Alternative D:

Implementation of Alternative D would have similar impacts on physical soil characteristics as those described under Alternative A during the life of the project. After the life of the project, Alternative D would have adverse, long-term impacts at site-specific locations on roads and trails retained for public and administrative uses and at two developed campgrounds provided for under this alternative. Although the number and/or length of roads and trails have not been determined, and the size or location of two campgrounds have not been assessed, adverse impacts at these locations would be expected to be comparable to that observed at existing developed sites within and adjacent to the oil and gas unit with similar soil conditions.

Alternative D would have less adverse, short-term and less beneficial, long-term impacts resulting from restoration activities than Alternative A, and more adverse, long-term impacts resulting from public and administrative uses than Alternatives A after the life of the project.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar impacts on physical soil characteristics as those described under Alternative A during the life of the project. After the life of the project, Alternative E would have adverse, long-term impacts at site-specific locations on roads and trails retained for public and administrative uses and at two developed campgrounds provided for under this alternative. Although the number and/or length of roads and trails have not been determined, and the size or location of two campgrounds have not been assessed, adverse impacts at these locations would be expected to be comparable to that observed at existing developed sites within and adjacent to the oil and gas unit with similar soil conditions.

Alternative E would have less adverse, short-term and less beneficial, long-term impacts resulting from restoration activities than Alternative A, and more adverse, long-term impacts resulting from public and administrative uses than Alternatives A after the life of the project.

4.4.2.2 Biological Environment

Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wildlife Habitat

Indicators:

- Habitat loss
- Habitat fragmentation
- Frequency of exotic and/or invasive species

Assumptions:

- Approximately 1,000 acres (43,560,000 square feet or 12 percent of the leased area) of natural habitat has been replaced with an anthropogenic footprint associated with commercial oil and gas production and exploration (e.g., roads, well pads, buildings, etc.).
- Best management practices would be implemented during restoration efforts to maximize the recovery of wildlife habitat.

Alternative A (Current Management):

Implementation of Alternative A would consist of management activities during and after the life of the project that might affect wildlife habitat. The impacts associated with these proposed activities are analyzed in the following text.

<u>Exploration, Development, and Production During the Life of the Project</u>
Conducting oil and gas exploration and development activities within the Swanson River Oil and Gas Unit during the life of the project would have adverse, long-term impacts on wildlife habitat due to habitat loss, habitat fragmentation (i.e., splitting of natural ecosystems into smaller and more isolated units), and presence of exotic and/or invasive flora resulting from such activities. Impacts would vary based on the scale of activity conducted; but in general, further exploration and development would have major impacts at the site-specific scale due to loss of habitat, moderate impacts at the local scale due to additional habitat fragmentation in the unit, and moderate impacts at the site-specific scale due to increased frequency of exotic and/or invasive flora.

<u>Restoration Activities During and After the Life of the Project</u>
Removing and restoring oil and gas-related industrial roads and facilities not needed to support ongoing oil and gas operations during the life of the project would have beneficial, long-term impacts on wildlife habitat when and where such activities occur. Impacts would be major at the site-specific locations when compared to existing developed conditions, though actual impacts are expected to be negligible because such facilities are expected to be considered as assets by the operator and would, in most cases, not be removed during

the life of the project. If restoration work was conducted, wildlife habitat would increase, habitat fragmentation would decline if roads and/or pipeline corridors were restored, and the spread of exotic and/or invasive species would diminish.

Removing and restoring *most* oil and gas related industrial roads and facilities (at the Refuge manager's discretion) after the life of the project would have beneficial, long-term impacts on wildlife habitat when and where such activities occur. Although an assessment of the number and diversity of potential sites to be restored has not been conducted, and the amount of wildlife habitat benefiting from the alternative cannot be calculated, in general, major impacts would be expected at site-specific locations within the lease area compared to existing developed conditions. Wildlife habitat would increase, habitat fragmentation would decline, and the spread of exotic and/or invasive species would diminish.

Alternative B:

Implementation of Alternative B would have similar impacts on wildlife habitat as those described under Alternative A during the life of the project. After the life of the project, Alternative B would have more adverse, short-term impacts due to restoration activities (particularly those associated with removal of buried pipelines) and more beneficial, long-term impacts due to the scale of the restoration effort than those resulting from Alternative A.

Alternative C:

Implementation of Alternative C would have similar impacts on wildlife habitat as those described under Alternative A during the life of the project. After the life of the project, Alternative C would have similar beneficial, long-term impacts as those described under Alternative A, except some additional adverse, long-term impacts would be expected at the site-specific and local scales as up to five primitive camping areas would be constructed. Although an assessment of potential sites to be restored and/or developed has not been conducted, and the amount of wildlife habitat benefiting or adversely affected by management decisions can not be calculated, in general, impacts would be major at site-specific locations where facilities remain, public use facilities are constructed, exotic and/or invasive species increase, or restoration activities are implemented. Additional moderate impacts would be expected at the local scale due to development of public use facilities and resulting habitat fragmentation in the lease area.

Alternative C would have more adverse, long-term impacts on wildlife habitat than Alternative A.

Alternative D:

Implementation of Alternative D would have similar adverse, long-term impacts on wildlife habitat as those described under Alternative A during the life of the project. After the life of the project, similar beneficial, long-term impacts would occur as those described under Alternative A, except some additional adverse, long-term impacts would be expected at the site-specific and local scales as *some* linear features (e.g., roads, and hiking and horse trails) would remain and up to two developed campgrounds would be constructed. Although an assessment of the number and diversity of potential sites to be restored and/or developed has not been conducted, and the amount of wildlife habitat benefiting or adversely affected by management decisions can not be calculated, in general, impacts would be major at site-specific locations where facilities remain, public use facilities are constructed, exotic and/or invasive species increase, or restoration activities are implemented. Additional moderate impacts would be expected at the local scale due to retainment of public use facilities and resulting habitat fragmentation in the lease area.

Alternative D would have more adverse impacts on wildlife habitat than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse, long-term impacts on wildlife habitat as those described under Alternative A during the life of the project. After the life of the project, similar beneficial, long-term impacts would occur as those described under Alternative A, except some additional adverse, long-term impacts would be expected at the site-specific and local scales as *some* linear features (e.g., roads, and hiking and horse trails) would remain, and up to two developed campgrounds would be constructed. Although an assessment of the number and diversity of potential sites to be restored and/or developed has not been conducted, and the amount of wildlife habitat benefiting or adversely affected by management decisions can not be calculated, in general, impacts would be major at site-specific locations where facilities remain, public use facilities are constructed, exotic and/or invasive species increase, or restoration activities are implemented. Additional moderate impacts would be expected at the local scale due to retainment of public use facilities and resulting habitat fragmentation in the lease area.

Alternative E would have more adverse impacts on wildlife habitat than Alternative A.

Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wildlife

Indicators:

- Wildlife presence

Assumptions:

- Human activity causes disturbance to wildlife at varying degrees depending on the type of activity, intensity of the activity, timing of the activity, number of activities occurring simultaneously, and wildlife species affected.
- Disturbance-related impacts include direct mortality (immediate, on-site death), indirect mortality (eventual, premature death), lowered productivity (reduced fecundity or survival rate), reduced habitat use, and stress.

Alternative A (Current Management):

Implementation of Alternative A would consist of management activities during and after the life of the project that might affect wildlife habitat. The impacts associated with these proposed activities are analyzed in the following text.

<u>Exploration, Development, and Production During the Life of the Project</u>
Conducting oil and gas exploration, development, and production activities within the Swanson River Oil and Gas Unit during the life of the project would have adverse, long-term impacts on the presence of some wildlife species due to habitat loss and fragmentation, and disturbance associated with industrial and human use. Impacts due to habitat loss and fragmentation would be minor at the local scale, though some beneficial, long-term impacts would be expected of some species (e.g., bird species) as a result of increasing edge habitat. Adverse impacts associated with disturbance resulting from industrial and human use would be moderate at the local scale. Increased wildlife-vehicle collisions (i.e., direct mortality), reduced habitat use, stress, and lowered productivity would be expected of some species.

<u>Restoration Activities During and After the Life of the Project</u>
Removing and restoring industrial roads and facilities not needed to support ongoing oil and gas operations and/or such facilities after the life of the project would have beneficial, long-term impacts on the presence of some wildlife species due to increases in habitat, decreasing fragmentation, and declines in industrial and human use. Actual impacts are expected to be negligible during the life of the project because such facilities would continue to be considered as assets by the operator and would, in most cases, not be removed during the life of the project. The intensity of those impacts would be moderate at the local

scale if and when roads, pipelines, buildings, and well pads are removed, habitat is restored, fragmentation diminishes, and human activity in the area ceases. Some adverse, short-term impacts would be expected at site-specific locations during restoration activities due to increased levels of noise and human activity. Additional adverse, long-term impacts would be expected on the presence of some wildlife species (e.g., edge-dwelling bird species) as a result of declining fragmentation and loss of edge habitat.

Alternative B:

Implementation of Alternative B would have similar beneficial and adverse, long and short-term impacts on wildlife presence during and after the life of the project as those described under Alternative A, except such impacts would be major at the local scale. Under Alternative B, *all* oil and gas related roads, pipelines and associated fixtures, and facilities would be removed and the sites restored. As a result, wildlife presence would be expected to improve due to increases in habitat, decreasing fragmentation, and declines in industrial and human use.

Alternative B would have more beneficial impacts on wildlife than Alternative A.

Alternative C:

Implementation of Alternative C would have similar beneficial and adverse, long- and short-term impacts on wildlife presence during and after the life of the project as those described under Alternative A, except some additional adverse, long-term impacts would be expected at the local scale as up to five primitive camping areas would be constructed. Although an assessment of potential sites to be restored and/or developed has not been conducted, and the amount of wildlife habitat benefiting and/or adversely affected by management decisions can not be calculated, in general, minor impacts would be expected at the local scale given the type (i.e., non-motorized) and intensity (i.e., low density) of public use anticipated in the area.

Alternative C would have more adverse impacts on wildlife than Alternative A.

Alternative D:

Implementation of Alternative D would have similar beneficial and adverse, long- and short-term impacts on wildlife presence during and after the life of the project as those described under Alternative A, except more impacts would be expected at the local scale as *some* additional linear features (e.g., roads, and hiking and horse trails) would remain, and up to two developed campgrounds would be constructed. Although an assessment of potential sites to be restored and/or developed has not been conducted, and the amount of wildlife habitat

benefiting and/or adversely affected by management decisions can not be calculated, in general, moderate impacts would be expected at the local scale given the type (i.e., motorized) and intensity (i.e., higher density) of public use anticipated in the area.

Alternative D would have more adverse impacts on wildlife than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar beneficial and adverse, long- and short-term impacts on wildlife presence during and after the life of the project as those described under Alternative A, except more impacts would be expected at the local scale as *some* additional linear features (e.g., roads, and hiking and horse trails) would remain, and up to two developed campgrounds would be constructed. Although an assessment of potential sites to be restored and/or developed has not been conducted, and the amount of wildlife habitat benefiting and/or adversely affected by management decisions can not be calculated, in general, moderate impacts would be expected at the local scale given the type (i.e., motorized) and intensity (i.e., higher density) of public use anticipated in the area.

Alternative E would have more adverse impacts on wildlife than Alternative A.

4.4.2.3 Human Environment

Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on the Local Economy

Indicators:

- Number of jobs in the local economy
- Number of skilled employees and local businesses that contribute to economic stability

Assumptions:

- Once structures or facilities are removed and rehabilitated, no additional restoration or rehabilitation will be required.

Alternative A (Current Management):

Implementation of Alternative A would consist of management activities during and after the life of the project that might impact the local economy. The impacts associated with these proposed activities are analyzed in the following text.

Exploration, Development, and Production During the Life of the Project

Conducting oil and gas exploration and development activities within the Swanson River Oil and Gas Unit during the life of the project would have beneficial, long-term impacts on the local economy due to the number of jobs filled, skilled workers employed, and local businesses benefiting from such activities. The intensity of the impacts would vary based on the scale of activity conducted; but in general, further exploration and development would have major impacts at the local scale due to financial assets generated by local employees and businesses that are ultimately circulated throughout the local economy.

Restoration Activities During and After the Life of the Project

Removing and restoring oil and gas-related industrial roads and facilities not needed to support ongoing oil and gas operations during the life of the project would have beneficial, short-term impacts on the local economy when and where such activities occur. The intensity of the impact would vary depending on the size of the project; but in general, actual impacts are expected to be negligible because such facilities are expected to be considered as assets by the operator and would, in most cases, not be removed during the life of the project.

Removing and restoring *most* oil and gas-related industrial roads and facilities (at the Refuge manager's discretion) after the life of the project would have beneficial, medium-term impacts on the local economy when and where such activities occur. Although an assessment of the number and diversity of potential sites to be restored has not been conducted, and the benefits to the local economy can not calculated, in general, impacts would be expected to be moderate at the local scale when compared to existing conditions. Other beneficial, long-term, minor impacts would be realized as *some* roads and facilities are retained for public use, and visitors to the Swanson River Oil and Gas Unit contribute to the local economy.

Alternative B:

Implementation of Alternative B would have similar impacts on the local economy as those described under Alternative A during the life of the project. After the life of the project, Alternative B would require removal and restoration of *all* existing oil and gas related industrial roads, pipelines and associated fixtures, and facilities. As such, Alternative B would have beneficial, medium-term impacts on the local economy due to the number of skilled workers employed and local businesses benefiting from such activities. These operations would likely result in a number of new employment opportunities and local contracting businesses in the area. Impacts would be major at the local scale due to financial assets generated by local employees and businesses that are ultimately circulated throughout the local economy.

Alternative B would have more beneficial, medium-term impacts on the local economy than Alternative A due to the size of the restoration effort, but less beneficial, long-term impacts due to decreases in recreational access to the area.

Alternative C:

Implementation of Alternative C would have similar impacts on the local economy as those described under Alternative A during the life of the project. After the life of the project, Alternative C would have similar beneficial impacts on the local economy as those described under Alternative A. Restoration efforts associated with removal of *all* pipelines and associated fixtures, and *all* facilities built to support industry would have moderate impacts on the local economy, as would allowances for enhanced visitation through development and public use of trails and five primitive camping areas.

Alternative C would have more beneficial, long-term impacts on the local economy than Alternative A due to increases in recreational access to the area.

Alternative D:

Implementation of Alternative D would have similar impacts on the local economy as those described under Alternative A during the life of the project. After the life of the project, Alternative D would have similar beneficial impacts on the local economy as those described under Alternative A due to restoration of *some* roads, and *most* pipelines and associated fixtures, and facilities. Additional beneficial, long-term impacts on the local economy would be expected as a result of enhanced visitation through vehicle access, and construction and public use of two developed campgrounds.

Alternative D would have more beneficial, long-term impacts on the local economy than Alternative A due to increases in recreational access to the area.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar impacts on the local economy as those described under Alternative A during the life of the project. After the life of the project, Alternative E would have similar beneficial impacts on the local economy as those described under Alternative A due to restoration of *some* roads, and *most* pipelines and associated fixtures, and facilities. Additional beneficial, long-term impacts on the local economy would be expected as a result of enhanced visitation through vehicle access, and construction and public use of two developed campgrounds.

Alternative E would have more beneficial, long-term impacts on the local economy than Alternative A due to increases in recreational access to the area.

Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Recreation

Indicators:

- Wildlife presence
- Recreation access
- Availability of recreation facilities
- Opportunities for wildlife-dependent recreation activities
- Recreation opportunity setting classification

Assumptions:

- The Swanson River Road would remain in place as a motorized access route into the canoe system.
- The Swanson River Oil and Gas Unit is currently closed to public vehicle use and thus receives limited public use.
- Roads facilitate recreation access but reduce wildlife presence.
- Future discretionary selection of individual roads and facilities for removal and restoration would be aimed at maximizing wildlife benefits while minimizing adverse impacts to recreation.
- Recreation opportunity settings are defined as discrete combinations of physical, biological, social, and managerial conditions that facilitate particular kinds of recreation experiences. Opportunity settings can be inventoried and arrayed along a continuum from wilderness (no roads, limited facilities, dispersed use, and little management presence) to urban-industrial (paved roads, extensive development, dense use, obvious management presence).
- The Swanson River Oil and Gas Unit is currently described as a roaded, semi-natural recreation opportunity with industrial developments and activities.

Alternative A (Current Management):

Implementation of Alternative A would consist of management activities during and after the life of the project that might impact recreation. The impacts associated with these proposed activities are analyzed in the following text.

Exploration, Development, and Production During the Life of the Project

Conducting oil and gas exploration and development activities within the Swanson River Oil and Gas Unit during the life of the project would have negligible impacts on the recreation opportunity setting because such developments are expected to be limited, given projected generation capabilities. Although some support facilities may be constructed in the future, the intensity of impacts associated with those developments would not be sufficient to change the setting from a roaded, semi-natural recreation opportunity with industrial developments and activities to something more than that (e.g., urban industrial setting).

Restoration Activities During and After the Life of the Project

Removing and restoring oil and gas-related industrial roads and facilities not needed to support ongoing oil and gas operations during the life of the project would have adverse, short-term impacts on recreation when and where such activities occur. Impacts would be major at the site-specific scale and moderate at the local scale when compared to existing conditions due to temporary displacement of recreation users and/or prohibitions placed on some activities, though actual impacts are expected to be negligible because such facilities are expected to be considered as assets by the operator and would, in most cases, not be removed during the life of the project.

After the life of the project, Alternative A would retain *some* roads and facilities for public use after the life of the project. Although camping facilities would not be provided, retention of some roads would facilitate visitation above current levels of public use. The net effect of Alternative A would be conversion of the unit from a roaded, semi-natural setting with industrial features, to a roaded, semi-natural area containing some buildings used for administrative and/or public use. As such, Alternative A would have beneficial, long-term impacts of moderate intensity on recreation due to enhanced public access. Additional beneficial, long-term impacts would be expected on wildlife presence as portions of the area are returned to natural habitat and industrial noise diminishes. The intensity of the impacts would be minor due to vehicle and human use in the area at or above current levels.

Alternative B:

Implementation of Alternative B would have similar impacts on recreation as those described under Alternative A during the life of the project. After the life of the project, Alternative B would require removal and restoration of *all* existing oil and gas related industrial roads, pipelines and associated fixtures, and facilities. As such, Alternative B would have adverse, medium-term impacts on recreation due to extensive removal and restoration activities that would displace users and/or prohibit certain activities. These impacts are expected to be moderate at the local scale and major at the site-specific scale.

Beneficial, long-term impacts of major intensity would be expected on wildlife presence as the area is returned to natural habitat and industrial noise diminishes. Conversely, restoration efforts proposed under Alternative B would have adverse, long-term impacts on recreation access. The intensity of the impacts would be major when compared to Alternative A because all roads would be removed and no trails would be developed. The net effect of Alternative B, after all restoration is completed, would be conversion of the unit from a roaded, semi-natural setting with industrial features to a wilderness-like setting with no roads or developments of any kind.

Alternative B would provide more opportunities for primitive recreation opportunities in a wilderness setting, but those benefits would be available to fewer people than under Alternative A.

Alternative C:

Implementation of Alternative C would have similar impacts on recreation as those described under Alternative A during the life of the project. After the life of the project, Alternative C would have similar adverse, short-term impacts as those described under Alternative A due to removal and restoration activities that would temporarily displace recreation users and/or prohibit certain activities. Indirect beneficial, long-term impacts on wildlife-dependent recreation activities would be expected as *most* roads are converted to public use trails, and *some* remaining roads, and *all* pipelines and associated fixtures, and facilities are removed and restored. Removing selected roads and converting others to public use trails would have adverse, long-term impacts of moderate intensity on recreation access compared to Alternative A, which *may* retain *some* roads for public vehicle use. Constructing up to five primitive camping areas would have beneficial, long-term impacts of minor intensity on recreation opportunities compared to Alternative A, which would not provide any such facilities. The net effect of Alternative C after implementation would be conversion of the unit from a roaded, semi-natural setting with industrial features to non-roaded, highly natural setting with foot trails and primitive camping facilities.

Alternative C would provide more opportunities for primitive recreation opportunities in a natural setting than under Alternative A.

Alternative D:

Implementation of Alternative D would have similar impacts on recreation as those described under Alternative A during the life of the project. After the life of the project, Alternative D would have similar adverse, short-term impacts as those described under Alternative A due to removal and restoration activities that would temporarily displace recreation users and/or prohibit certain activities. Beneficial, long-term impacts on wildlife-dependent recreation activities would be

expected as *most* roads and *some* existing facilities are retained for public use and trails are developed. Alternative D would have beneficial, long-term impacts of minor intensity on recreation access when compared to Alternative A due to allowances made for bicycle use in the area. Constructing up to two developed campgrounds would have beneficial, long-term impacts of moderate intensity on recreation opportunities compared to Alternative A, which would not provide such facilities. The net effect of Alternative D, after all restoration is completed, would be conversion of the unit from a roaded, semi-natural setting with industrial features to a roaded, natural setting with developed camping facilities and buildings.

Alternative D would provide more opportunities for developed camping, wildlife-dependent recreation activities, and bicycling than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar impacts on recreation as those described under Alternative A during the life of the project. After the life of the project, Alternative E would have similar adverse, short-term impacts as those described under Alternative A due to removal and restoration activities that would temporarily displace recreation users and/or prohibit certain activities. Beneficial, long-term impacts on wildlife-dependent recreation activities would be expected as *most* roads and *some* existing facilities are retained for public use and trails are developed. Alternative E would have beneficial, long-term impacts of minor intensity on recreation access when compared to Alternative A due to allowances made for bicycle use in the area. Constructing up to two developed campgrounds would have beneficial, long-term impacts of moderate intensity on recreation opportunities compared to Alternative A, which would not provide such facilities. The net effect of Alternative E, after all restoration is completed, would be conversion of the unit from a roaded, semi-natural setting with industrial features to a roaded, natural setting with developed camping facilities and buildings.

Alternative E would provide more opportunities for developed camping, wildlife-dependent recreation activities, and bicycling than Alternative A.

Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Subsistence

Indicators:

- Presence of subsistence resources in historic and/or natural abundances
- Access to subsistence resources
- Participation in subsistence

Assumptions:

- Primary subsistence resources within the Swanson River Oil and Gas Unit would continue to be moose, hare, grouse, ptarmigan, lynx, coyote, wolf, coho salmon, and rainbow trout.
- Numbers of moose in Game Management Unit 15A will continue in a natural decline regardless of any action in the proposed alternatives.
- Adequate harvest regulations, law enforcement, and speed limits can mitigate impacts associated with overharvest, poaching, and wildlife-vehicle collisions, respectively.

Alternative A (Current Management):

Implementation of Alternative A would consist of management activities during and after the life of the project that might have impacts on subsistence. The impacts associated with these proposed activities are analyzed in the following text.

<u>Exploration, Development, and Production During the Life of the Project</u>

Conducting oil and gas exploration, development, and production activities within the Swanson River Oil and Gas Unit during the life of the project would continue to have adverse, long-term impacts on the presence of subsistence resources due to habitat loss and disturbance associated with such activities. Impacts associated with habitat loss would vary based on the scale of the activity conducted; but in general, further development would have minor impacts at the local scale due to habitat loss and fragmentation. Indirect mortality and lowered productivity of some individuals would be expected. Impacts associated with disturbance resulting from industrial and human uses would be major at the site-specific scale and moderate at the local scale. If additional roads are constructed to support exploration, development, and production activities, additional adverse, long-term impacts would be expected as the seasonal and dispersal movements of moose, wolves, coyotes, and lynx are affected. Increased wildlife-vehicle collisions, reduced habitat use, stress, and lowered productivity would be expected of some species. Some beneficial, long-term impacts may result from roads that are closed or minimally used as they facilitate

travel throughout the area by some subsistence resources. Additional road development would have negligible impacts on subsistence access and participation since these roads would not be open to public use.

Restoration Activities During and After the Life of the Project
Removing and restoring oil and gas-related industrial roads and facilities not needed to support ongoing oil and gas operations during the life of the project would have beneficial, long-term impacts on subsistence resources when and where such activities occur. Impacts would be minor at the local scale when compared to existing conditions, though actual impacts are expected to be negligible because such facilities are expected to be considered as assets by the operator and would, in most cases, not be removed during the life of the project.

Removing and restoring *most* oil and gas-related industrial roads and facilities (at the Refuge manager's discretion) after the life of the project would have beneficial, long-term impacts on the presence of subsistence resources. The intensity of the impacts would be moderate due to increases in habitat availability, decreases in habitat fragmentation, and diminished industrial disturbance. Additional beneficial impacts would be expected on subsistence access and participation due to allowances made for year-round use of at least *some* industrial roads. Some adverse, long-term impacts would be expected as the seasonal and dispersal movements of moose, wolves, coyotes, and lynx are affected by roads open to public use. Increased wildlife-vehicle collisions, reduced habitat use, stress, and lowered productivity would be expected of some species. Some beneficial, long-term impacts may result from roads that are closed or minimally used as they facilitate travel throughout the area by some subsistence resources.

Alternative B:

Implementation of Alternative B would have similar impacts on subsistence resources as those described under Alternative A during the life of the project. After the life of the project, Alternative B would require removal and restoration of *all* existing oil and gas-related industrial roads, pipelines and associated fixtures, and facilities. As such, Alternative B would have beneficial, long-term impacts on subsistence resources due to increases in habitat availability, decreases in habitat fragmentation, and diminished industrial disturbance. Impacts would be major as wildlife-vehicle collisions become a non-factor, habitat use increases, stress declines, and natural levels of productivity are achieved. Conversely, Alternative B would have adverse, long-term impacts on subsistence access and participation due to removal and restoration of all roads within the unit. The intensity of the impacts would be moderate because 53 percent of all moose harvest within the Refuge occurs within 0.6 miles of a road, and the alternative would eliminate 8 percent of all road access within the Refuge.

Alternative B would have more adverse, long-term impact on subsistence within the Swanson River Oil and Gas Unit than Alternative A due to the extensive size of the restoration effort.

Alternative C:

Implementation of Alternative C would have similar impacts on subsistence as those described under Alternative A during and after the life of the project except the intensity of the impacts would be greater due to increased visitation facilitated by hiking and horse trails and up to five primitive camping areas proposed for development after the life of the project.

Alternative C would have more adverse, long-term impacts on subsistence resources and more beneficial, long-term impacts on subsistence access and participation than Alternative A.

Alternative D:

Implementation of Alternative D would have similar impacts on subsistence as those described under Alternative A during and after the life of the project except the intensity of the impacts would be greater and would occur on a slightly larger scale due to increased visitation facilitated by road and trail access and up to two developed campgrounds proposed for development after the life of the project. The combination of motorized access and increased participation in the area would have a greater adverse impact on subsistence species such as moose, wolves and lynx, and a corresponding greater beneficial impact on more adaptive subsistence species such as coyotes.

Alternative D would also have more adverse, long-term impacts on subsistence resources and more beneficial, long-term impacts on subsistence access and participation than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar impacts on subsistence as those described under Alternative A during and after the life of the project except the intensity of the impacts would be greater and would occur on a slightly larger scale due to increased visitation facilitated by road and trail access and up to two developed campgrounds proposed for construction after the life of the project. The combination of motorized access and increased participation in the area would have a greater adverse impact on subsistence species such as moose, wolves and lynx, and a corresponding greater beneficial impact on more adaptive subsistence species such as coyotes.

Alternative E would also have more adverse, long-term impacts on subsistence resources and more beneficial, long-term impacts on subsistence access and participation than Alternative A.

4.4.2.4 River Values

Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on River Values

Indicators:

- River values: wildlife, recreation

Assumptions:

- Although 7.5 miles of the Swanson River passes through the Swanson River Oil and Gas Unit, noise levels associated with oil and gas production affects recreation-related river values beyond the unit's boundaries.
- The number of anthropogenic features associated with oil and gas activities crossing the Swanson River would increase from current levels (i.e., four anthropogenic features) during the life of the project.

Alternative A (Current Management):

Implementation of Alternative A would consist of management activities during and after the life of the project that might have impacts on river values. The impacts associated with these proposed activities are analyzed in the following text.

<u>Exploration, Development, and Production During the Life of the Project</u>

Conducting oil and gas exploration, development, and production activities within the Swanson River corridor during the life of the project would have adverse, long-term impacts on river-related wildlife values at the site-specific scale due to loss of habitat; habitat fragmentation, and/or disturbance; and river-related recreation values at the local scale due to noise and declining visual quality resulting from such activities. The intensity of those impacts would vary based on the scale of new activity conducted and the river values affected. In general, further exploration, development, and production would have minor impacts on some wildlife species at the site-specific scale as river corridor habitat is replaced with oil and gas related facilities (i.e., roads, pipelines, etc.) and additional fragmentation occurs. Wildlife avoidance and legal and illegal take of fish and wildlife would be expected to increase over current levels as a result of additional activity. Further development within the river corridor would have moderate impacts on river-based recreation at the site-specific scale if additional roads, pipelines, and other anthropogenic structures are constructed within it. Increasing levels of noise and declines in visual quality would be expected as a result of such activity. These impacts would be major if new structures actually cross the river and river-based recreation activities (i.e., canoeing, boating, etc.) are affected by it.

Restoration Activities During and After the Life of the Project
Removing and restoring *most* of the remaining oil and gas related industrial roads and facilities within the river corridor during and/or after the life of the project would have beneficial, long-term impacts on river-related wildlife and recreation values at the site-specific and local scales. Although an assessment of the number and diversity of potential sites to be restored has not been conducted, and the amount of wildlife habitat benefiting from the alternative cannot be calculated, in general, impacts would be major at the site-specific scale and local scale if, when, and where facilities are removed, habitat is restored, and fragmentation declines. As a result, the presence of wildlife would increase. Additional beneficial impacts would be expected at site-specific locations as oil and gas related roads and structures are removed from the river corridor, visual quality improves, noise associated with industrial development ceases, and unimpeded river recreation is ensured.

Alternative B:

Implementation of Alternative B would have similar beneficial and adverse, long-term impacts on river-related wildlife and recreation values as those described under Alternative A except beneficial impacts would be greater after the life of the project when *all* oil and gas related roads, pipelines and associated fixtures, and facilities are restored.

Alternative B would have more beneficial impacts on river-related wildlife and recreation values than Alternative A due to the intensity of the restoration effort.

Alternative C:

Implementation of Alternative C would have similar beneficial and adverse, long-term impacts on river-related wildlife and recreation values as those described under Alternative A.

Alternative D:

Implementation of Alternative D would have similar beneficial and adverse, long-term impacts on river-related wildlife and recreation values as those described under Alternative A.

Alternative E:

Implementation of Alternative E would have similar beneficial and adverse, long-term impacts on river-related wildlife and recreation values as those described under Alternative A.

4.4.2.5 Wilderness Values

Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wilderness Values

Indicators:

- Untrammeled condition (i.e., free of intentional human manipulation)
- Opportunities for solitude
- Opportunities for primitive and unconfined types of recreation

Assumptions:

- Due to terrain and vegetation, roads, facilities, and public use activities associated with the Swanson Oil and Gas Unit are not visible from the Kenai Wilderness area.

Alternative A (Current Management):

Implementation of Alternative A would consist of management activities during and after the life of the project that might affect wilderness values. The impacts associated with these proposed activities are analyzed in the following text.

<u>Exploration, Development, and Production During the Life of the Project</u>
Conducting oil and gas exploration and development activities within the Swanson River Oil and Gas Unit during the life of the project would have adverse, long-term impacts on wilderness values when and where such activities occur. Impacts would be major at the local scale due to alteration of the landscape from a natural, forested setting to an anthropogenic, developed setting, which affects the untrammeled condition of the unit.

<u>Restoration Activities During and After the Life of the Project</u>
Removing and restoring oil and gas-related industrial roads and facilities not needed to support ongoing oil and gas operations during the life of the project would have adverse, short-term impacts on wilderness values when and where such activities occur. Impacts would be minor at the local scale due to declining opportunities for solitude when and where such activities occur, though actual impacts are expected to be negligible because such facilities are expected to be considered as assets by the operator and would, in most cases, not be removed during the life of the project.

After the life of the project, Alternative A would retain *some* roads and facilities for public use, but camping facilities would not be provided. As such, Alternative A would have beneficial, long-term impacts on wilderness values when and where such restoration activities occur. Wilderness values would be enhanced further if all roads and facilities

were to be removed. Impacts would be minor at the local scale when compared to existing conditions due to conversion from an anthropogenic, developed setting to a natural, forested setting containing some anthropogenic features, which would affect the untrammeled appearance of the unit. Although some opportunities for solitude and primitive recreation would be provided, retention of some roads and facilities would provide access to the area, and increased levels of public use would be expected.

Alternative B:

Implementation of Alternative B would have similar impacts on wilderness values as those described under Alternative A during the life of the project. After the life of the project, Alternative B would require removal and restoration of *all* existing oil and gas related industrial roads, pipelines and associated fixtures, and facilities. As such, Alternative B would have beneficial, long-term impacts on the untrammeled condition of the unit due to extensive removal and restoration activities that would convert an anthropogenic, developed setting to a natural, forested setting. The intensity of the impacts would be major when compared to Alternative A.

Conversely, restoration efforts proposed under Alternative B would have adverse, long-term impacts to primitive recreation opportunities with closure of all roads and trails. Although the untrammeled condition of the unit would be improved after all restoration is completed, the net effect of Alternative B would be that opportunities for solitude and primitive recreation would be limited to those able to access the unit by floatplane.

Alternative B would have more beneficial impacts on the untrammeled condition of the unit and more adverse impacts on opportunities for solitude and primitive recreation than under Alternative A.

Alternative C:

Implementation of Alternative C would have similar impacts on wilderness values as those described under Alternative A during the life of the project. After the life of the project, Alternative C would have similar beneficial, long-term impacts on wilderness values as those described under Alternative A except moderate impacts would be expected as *most* roads are converted to public use trails; all remaining roads, pipelines and associated fixtures, and facilities are removed and restored; and up to five primitive camping areas are constructed.

Alternative C would improve the untrammeled condition of the unit and provide more opportunities for solitude and primitive recreation than provided for under Alternative A.

Alternative D:

Implementation of Alternative D would have similar impacts on wilderness values as those described under Alternative A during the life of the project. After the life of the project, Alternative D would have similar beneficial, long-term impacts on wilderness values as those described under Alternative A except the unit would appear less natural as *most* roads and *some* existing facilities are retained for public use, and up to two developed campgrounds may be constructed.

Alternative D would provide fewer opportunities for solitude and primitive recreation in an untrammeled condition than provided for under Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar impacts on wilderness values as those described under Alternative A during the life of the project (in that no significant changes to the numbers of facilities and roads would be realized until after industrial use has terminated). After the life of the project, Alternative E would have similar beneficial, long-term impacts on wilderness values as those described under Alternative A except the unit would appear less natural as *most* roads and *some* existing facilities are retained for public use, and up to two developed campgrounds may be constructed.

Alternative E would provide fewer opportunities for solitude and primitive recreation in an untrammeled condition than provided for under Alternative A.

4.4.3 Beaver Creek Oil and Gas Unit

General Assumptions:

- Existing industrial activities would not decrease during the life of this Plan.
- Existing facilities and infrastructure would remain at current levels or increase during the life of the oil and gas unit since such facilities are considered “assets” to the operator.

4.4.3.1 Physical Environment

Consequences of Implementing Beaver Creek Oil and Gas Unit Management Strategies on Soils

Indicators:

- Physical characteristics: compaction, soil permeability, water repellency

Assumptions:

- Approximately 129 acres (5,619,240 square feet or 3 percent of the leased area) of natural habitat has been replaced with an anthropogenic footprint associated with commercial oil and gas production and exploration (e.g., roads, pipelines, well pads, seismic lines, etc.).
- Physical soil characteristics are degraded by construction activities and the presence of permanent structures on the landscape.
- Best management practices would be implemented during restoration efforts to minimize erosion.

Alternative A (Current Management):

Implementation of Alternative A would have similar impacts on physical soil characteristics as those described under *Alternative A: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Soils*.

Alternative B:

Implementation of Alternative B would have similar impacts on physical soil characteristics as those described under *Alternative B: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Soils*.

Alternative B would have more adverse, short-term impacts due to restoration activities and more beneficial, long-term impacts on physical soil characteristics than Alternative A.

Alternative C:

Implementation of Alternative C would have similar impacts on physical soil characteristics as those described under *Alternative C: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Soils*, except adverse, long-term impacts would result from development and use of two primitive camping areas.

Alternative C would have less adverse short-term, less beneficial long-term, and more adverse long-term impacts than Alternative A.

Alternative D:

Implementation of Alternative D would have similar impacts on physical soil characteristics as those described under *Alternative D: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Soils*, except adverse, long-term impacts would result from construction and use of up to one developed campground.

Alternative D would have less adverse short-term, less beneficial long-term, and more adverse, long-term impacts than Alternatives A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar impacts on physical soil characteristics as those described under *Alternative E: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Soils*.

Alternative E would have more adverse, short-term impacts due to restoration activities and more beneficial, long-term impacts on physical soil characteristics than Alternative A.

4.4.3.2 Biological Environment

Consequences of Implementing Beaver Creek Oil and Gas Unit Management Strategies on Wildlife Habitat

Indicators:

- Habitat loss
- Habitat fragmentation
- Frequency of exotic and/or invasive species

Assumptions:

- Approximately 129 acres (5,619,240 square feet or 3 percent of the leased area) of natural habitat has been replaced with an anthropogenic footprint associated with commercial oil and gas production and exploration (e.g., roads, pipelines, well pads, seismic lines, etc.).
- Best management practices would be implemented during restoration efforts to maximize the recovery of wildlife habitat.

Alternative A (Current Management):

Implementation of Alternative A would have similar impacts on wildlife habitat as those described under *Alternative A: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wildlife Habitat*.

Alternative B:

Implementation of Alternative B would have similar impacts on wildlife habitat as those described under *Alternative B: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wildlife Habitat*.

Alternative B would have more adverse, short-term impacts due to restoration activities and more beneficial, long-term impacts on wildlife habitat than Alternative A.

Alternative C:

Implementation of Alternative C would have similar impacts on wildlife habitat as those described under *Alternative C: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wildlife Habitat*, except adverse impacts would result from development of up to two primitive camping areas.

Alternative C would have more adverse, long-term impacts on wildlife habitat than Alternative A.

Alternative D:

Implementation of Alternative D would have similar impacts on wildlife habitat as those described under *Alternative D: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wildlife Habitat*, except adverse impacts would result from construction of up to one developed campground.

Alternative D would have more adverse, long-term impacts on wildlife habitat than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar impacts on wildlife habitat as those described under *Alternative E: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wildlife Habitat*.

Alternative E would have more adverse, short-term impacts due to restoration activities and more beneficial, long-term impacts on wildlife habitat than Alternative A.

Consequences of Implementing Beaver Creek Oil and Gas Unit Management Strategies on Wildlife

Indicators:

- Wildlife presence

Assumptions:

- Human activity causes disturbance to wildlife at varying degrees depending on the type of activity, intensity of the activity, timing of the activity, number of activities occurring simultaneously, and wildlife species affected.
- Disturbance-related impacts include direct mortality (immediate, on-site death), indirect mortality (eventual, premature death), lowered productivity (reduced fecundity or survival rate), reduced habitat use, and stress.

Alternative A (Current Management):

Implementation of Alternative A would have similar impacts on wildlife presence as those described under *Alternative A: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wildlife*.

Alternative B:

Implementation of Alternative B would have similar impacts on wildlife presence as those described under *Alternative B: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wildlife.*

Alternative B would have more adverse, short-term impacts due to restoration activities and more beneficial, long-term impacts on wildlife than Alternative A.

Alternative C:

Implementation of Alternative C would have similar impacts on wildlife presence as those described under *Alternative C: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wildlife*, except adverse impacts would result from development of up to two primitive camping areas.

Alternative C would have more beneficial impacts on wildlife than Alternative A.

Alternative D:

Implementation of Alternative D would have similar impacts on wildlife presence as those described under *Alternative D: Consequences of Implementing Swanson River Oil and Gas Unit Management*

Strategies on Wildlife, except adverse impacts would result from construction and use of up to one campground.

Alternative D would have more adverse impacts on wildlife presence than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar impacts on wildlife presence as those described under *Alternative E: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wildlife.*

Alternative E would have more adverse, short-term impacts due to restoration activities and more beneficial, long-term impacts on wildlife than Alternative A.

4.4.3.3 Human Environment

Consequences of Implementing Beaver Creek Oil and Gas Unit Management Strategies on the Local Economy

Indicators:

- Number of jobs in the local economy
- Number of skilled employees and local businesses which contribute to economic stability

Assumptions:

- Once structures or facilities are removed and rehabilitated, no additional restoration or rehabilitation will be required.

Alternative A (Current Management):

Implementation of Alternative A would have similar impacts on the local economy as those described under *Alternative A: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on the Local Economy*.

Alternative B:

Implementation of Alternative B would have similar impacts on the local economy as those described under *Alternative B: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on the Local Economy*.

Alternative B would have more beneficial, medium-term impacts on the local economy than Alternative A due to the scale of the restoration effort, but less beneficial, long-term impacts due to decreases in recreational access to the area.

Alternative C:

Implementation of Alternative C would have similar impacts on the local economy as those described under *Alternative C: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on the Local Economy*, except beneficial impacts would result from development and use of up to two primitive camping areas.

Alternative C would have more beneficial, long-term impacts on the local economy than Alternative A.

Alternative D:

Implementation of Alternative D would have similar impacts on the local economy as those described under *Alternative D: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on the Local Economy*, except that beneficial impacts would result from construction and use of up to one developed campground.

Alternative D would have more beneficial, long-term impacts on the local economy than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar impacts on the local economy as those described under *Alternative E: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on the Local Economy*.

Alternative E would have more beneficial, medium-term impacts on the local economy than Alternative A due to the scale of the restoration effort but less beneficial, long-term impacts due to decreases in recreational access to the area.

Consequences of Implementing Beaver Creek Oil and Gas Unit Management Strategies on Recreation

Indicators:

- Wildlife presence
- Recreation access
- Availability of recreation facilities
- Opportunities for wildlife-dependent recreation activities
- Recreation opportunity setting classification

Assumptions:

- Roads facilitate recreation access but reduce wildlife presence.
- Future discretionary selection of individual roads and facilities for removal and restoration would be aimed at maximizing wildlife benefits while minimizing adverse impacts to recreation.

- Recreation opportunity settings are defined as discrete combinations of physical, biological, social, and managerial conditions that facilitate particular kinds of recreation experiences. Opportunity settings can be inventoried and arrayed along a continuum from wilderness (no roads, limited facilities, dispersed use, and little management presence) to urban-industrial (paved roads, extensive development, dense use, obvious management presence).
- The Beaver Creek Oil and Gas Unit is currently described as a roaded, semi-natural recreation opportunity with industrial developments and activities.

Alternative A (Current Management):

Implementing Alternative A would have similar impacts on recreation as those described under *Alternative A: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Recreation*.

Alternative B:

Implementing Alternative B would have similar impacts on recreation as those described under *Alternative B: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Recreation*.

Alternative B would provide more opportunities for primitive recreation opportunities in a wilderness setting, but those benefits would be available to fewer people than under Alternative A.

Alternative C:

Implementing Alternative C would have similar impacts on recreation as those described under *Alternative C: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Recreation*, except beneficial impacts would result from development of up to two primitive camping areas.

Alternative C would provide more opportunities for primitive recreation opportunities than that provided for under Alternative A.

Alternative D:

Implementing Alternative D would have similar impacts on recreation as those described under *Alternative D: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Recreation*, except beneficial impacts would result from construction of up to one developed campground.

As such, Alternative D would provide more opportunities for developed camping, wildlife-dependent recreation activities, and bicycling than Alternative A.

Alternative E (Preferred Alternative):

Implementing Alternative E would have similar impacts on recreation as those described under *Alternative E: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Recreation*.

Alternative E would provide more opportunities for primitive recreation opportunities in a wilderness setting, but those benefits would be available to fewer people than provided for under Alternative A.

4.4.3.4 Wilderness Values

Consequences of Implementing Beaver Creek Oil and Gas Unit Management Strategies on Wilderness Values

Indicators:

- Untrammeled condition (i.e., free of intentional human manipulation)
- Opportunities for solitude
- Opportunities for primitive and unconfined types of recreation

Assumptions:

- Due to terrain and vegetation, roads, facilities, and public use activities associated with the Beaver Creek Oil and Gas Unit are not visible or audible from other areas of Kenai Refuge.

Alternative A (Current Management):

Implementation of Alternative A would have similar impacts on wilderness values as those described under *Alternative A: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wilderness Values*.

Alternative B:

Implementation of Alternative B would have similar impacts on wilderness values as those described under *Alternative B: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wilderness Values*.

Alternative B would have more beneficial impacts on the untrammeled condition of the unit and more adverse impacts on opportunities for solitude and primitive recreation than Alternative A.

Alternative C:

Implementation of Alternative C would have similar impacts on wilderness values as those described under *Alternative C: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wilderness Values*, except beneficial impacts on opportunities for solitude and primitive recreation opportunities would result from development of two primitive camping areas.

Alternative C would have more beneficial impacts on the untrammeled condition of the unit and opportunities for solitude and primitive recreation than Alternative A.

Alternative D:

Implementation of Alternative D would have similar impacts on wilderness values as those described under section 4.4.2.5 *Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wilderness Values*, Alternative A except adverse impacts would result from construction and use of up to one developed campground.

Alternative D would provide fewer opportunities for solitude and primitive recreation in an untrammeled condition than provided for under Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar impacts on wilderness values as those described under *Alternative E: Consequences of Implementing Swanson River Oil and Gas Unit Management Strategies on Wilderness Values*.

Alternative E would have more beneficial impacts on the untrammeled condition of the unit and more adverse impacts on opportunities for solitude and primitive recreation than Alternative A.

4.4.4 Mystery Creek Access Road and Pipeline Corridor

General Assumptions:

- Vehicle use on the access road and pipeline corridor occurs year-round by industry and Refuge personnel.
- Public vehicle use of the access road and pipeline corridor would increase if/when access is permitted and/or improvements are made.
- ENSTAR is responsible for maintenance consistent with their right-of-way agreement; the Refuge would be responsible for most improvements designed for public use of the area.

4.4.4.1 Physical Environment

Consequences of Implementing Mystery Creek Management Strategies on Soil Resources

Indicators:

- Physical characteristics: compaction, soil permeability, water repellency

Assumptions:

- Current maintenance activities are limited to grading. Grading activities are currently conducted throughout the access road on an "as needed" basis to facilitate pipeline-related project work—not public use access.
- Access road improvements may include adding gravel, rerouting, redesigning, etc., as needed.
- Best management practices would be implemented during restoration efforts to minimize erosion.

Alternative A (Current Management):

Implementation of Alternative A would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect soil resources. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance During the Life of the Project
Conducting maintenance on the 11-mile unimproved access road during the life of the project would have beneficial, short-term impacts on soil resources. Impacts would be minor at site-specific locations when work is conducted by ENSTAR. Soil compaction would decline; soil permeability would increase; and water repellency, sheet runoff, and erosion would diminish as a result of such activities.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile unimproved access road and 23-mile northern portion of the Alaska Pipeline corridor during the life of the project would have adverse, medium-term impacts on soil resources. Impacts would be moderate at site-specific locations and would include increases in soil compaction, decreases in soil permeability, and increases in water repellency. Sheet runoff and erosion would be observed at site-specific locations throughout the road and pipeline corridor. Such effects would increase over time as more vehicles use the area and until ENSTAR conducts road maintenance activities. Sites that remain saturated for extended periods of time would experience more impacts than well-drained sites. Many—if not all—of these sites would ultimately become mud holes.

Restoration Activities After the Life of the Project
Restoring *all* or *some* of the 11-mile unimproved access road and 38-mile northern and southern portions of the Alaska Pipeline corridor—at the Refuge manger's discretion—would have beneficial, long-term impacts on soil resources where restoration work is conducted. Although adverse, short-term impacts would be observed initially due to the use of heavy machinery used to conduct restoration work, overall major beneficial impacts would be observed once vegetation is reestablished and natural processes unfold. Benefits would include declines in soil compaction, increases in soil permeability, and decreases in water repellency. Sheet runoff and erosion would diminish to natural levels, and soil form and function would be enhanced.

Alternative B:

Implementation of Alternative B would consist of access road maintenance with improvements and public use prescriptions that may potentially affect soil resources. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project
Conducting maintenance and improvements on the 11-mile access road during the life of the project would have similar beneficial, short-term impacts on soil resources as those described under Alternative A, except such impacts would be observed more often and potentially at more locations due to a broader range of work conducted at more locations. Alternative B would increase the amount of maintenance and improvement projects to facilitate public access, enhance public safety, and ensure environmental protection.

Alternative B would have more beneficial impacts on soil resources than Alternative A due to increases in access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have similar adverse, medium-term impacts on soil resources as those described under Alternative A, except such impacts would be observed more often and at more locations due to access being permitted for a longer period of time over a larger area. Alternative B would increase the duration of public vehicle use by approximately five weeks on an additional 14 miles of the pipeline corridor (the southern portion).

Alternative B would have more adverse impacts on soil resources than Alternative A due to public use management prescriptions that facilitate increased use.

Alternative C:

Implementation of Alternative C would consist of access road maintenance with some improvements and public use prescriptions that may potentially affect soil resources. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project
Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar beneficial, short-term impacts on soil resources as those described under Alternative A, except such impacts would be observed more often and potentially at more locations due to a broader range of work conducted at more locations. Alternative C would conduct such activities to ensure public safety and environmental protection while providing for a backcountry experience.

Alternative C would have more beneficial impacts on soil resources than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have similar adverse, medium-term impacts on soil resources as those described under Alternative A, except such impacts would be observed at more locations due to access being permitted over a larger area. Alternative C would allow public vehicle use on an additional 14 miles of the pipeline corridor (the southern portion).

Alternative C would have more adverse impacts on soil resources than Alternative A due to public use management prescriptions that facilitate increased use.

Alternative D:

Implementation of Alternative D would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect soil resources. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance During the Life of the Project
Conducting maintenance on the 11-mile unimproved access road during the life of the project would have similar beneficial, short-term impacts on soil resources as those described under Alternative A.

Public Use During the Life of the Project
Closing public vehicle use of the 11-mile access road and 23-mile northern portion of the pipeline corridor would have beneficial, long-term benefits on soil resources. Impacts would be moderate at the local

scale and would result in soil conditions similar to those found along the 14-mile southern portion of the pipeline corridor where access is limited to ENSTAR vehicles. Soil compaction would decline, soil permeability would increase, water repellency would decrease, and sheet runoff and erosion would decline throughout the access road and pipeline corridor.

Alternative D would have more beneficial impacts on soil resources than Alternative A due to public use management prescriptions that prohibit vehicle use.

Restoration Activities After the Life of the Project
Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have similar beneficial long-term and adverse short-term impacts on soil resources as those described under Alternative A, except such impacts would be observed throughout the majority of the corridor. Implementation of restoration efforts would be left at the discretion of the Refuge manager, and more of the corridor would be restored than is proposed under Alternative A.

Alternative D would have more beneficial, long-term and more adverse, short-term impacts on soil resources than Alternative A due to restoration activities conducted after the life of the project.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of access road maintenance with some improvements, public use prescriptions, and restoration activities that may potentially affect soil resources. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project
Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar beneficial, short-term impacts on soil resources as those described under Alternative A, except such impacts would be observed more often and potentially at more locations due to a broader range of work conducted at more locations. Under Alternative E, activities would be conducted to ensure public safety and environmental protection while providing for a backcountry experience.

Alternative E would have more beneficial impacts on soil resources than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the

project would have similar adverse, short-term impacts on soil resources as those described under Alternative A, except such impacts would be observed at more locations due to access being permitted over a larger area. Alternative E would allow public vehicle use on an additional 14 miles of the pipeline corridor (the southern portion).

Alternative E would have more adverse impacts on soil resources than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project
Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have similar beneficial long-term and adverse short-term impacts on soil resources as those described under Alternative A, except such impacts would be observed throughout the majority of the corridor. Implementation of restoration efforts would be left at the discretion of the Refuge manager, and more of the corridor would be restored than is proposed under Alternative A.

Alternative E would have more beneficial, long-term and more adverse, short-term impacts on soil resources than Alternative A due to restoration activities conducted after the life of the project.

Consequences of Implementing Mystery Creek Management Strategies on Water Quality

Indicators:

- Sedimentation

Assumptions:

- Sediment loading affects water quality.
- Sediment loading results from vehicles crossing stream channels.
- The intensity of water quality impacts due to sediment loading varies based on the number and type of vehicles crossing, and the magnitude of stream crossing events.

Alternative A (Current Management):

Implementation of Alternative A would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect water quality. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance During the Life of the Project
Conducting maintenance on the 11-mile unimproved access road during the life of the project would have beneficial, medium-term impacts on water quality due to grading activities designed to minimize soil erosion

and sediment loading at stream crossings. Impacts would be minor at three site-specific stream crossings and would result in declines in sediment loading, which may improve aquatic flora and fauna health.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile unimproved access road and 23-mile northern portion of the Alaska Pipeline corridor during the life of the project would have adverse, short-term impacts on water quality at site-specific locations when and where vehicles cross streams. The intensity of those impacts would vary based on the number and type of vehicles crossing and the magnitude of each stream crossing event. Such impacts would be observed at 15 sites (3 sites along the access road and 12 sites along the northern portion of the pipeline corridor) when and where sediment loading would occur as a result of vehicle crossings. The deposition of sediments into streams could potentially affect water quality, which in turn may affect aquatic flora and fauna health, including salmon species commonly found in six streams bisected by the northern portion of the pipeline corridor. Such effects would increase as more vehicles use the area.

Restoration Activities After the Life of the Project
Restoring *all* or *some* of the 11-mile unimproved access road and 38-mile northern and southern portions of the Alaska Pipeline corridor—at the Refuge manager's discretion—would have beneficial, long-term impacts on water quality if restoration work occurs at stream crossing locations. Such impacts could potentially be observed at 21 sites: 3 sites along the access road, 6 sites along the southern portion of the pipeline corridor, and 12 sites along the northern portion of the pipeline corridor. Impacts would be major at site-specific locations because vehicle use would be prohibited, vegetation would become reestablished, and the deposition of sediments into streams due to vehicle crossings would be eliminated.

Alternative B:

Implementation of Alternative B would consist of access road maintenance and improvements, and public use prescriptions that may potentially affect water quality. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project
Conducting maintenance and improvements on the 11-mile access road during the life of the project would have similar beneficial impacts on water quality as those described under Alternative A, except efforts to ensure environmental protection at three stream crossings would have major and long-term impacts.

Alternative B would have more beneficial impacts on water resources than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have negligible impacts on water quality because road and pipeline corridor maintenance and improvement projects would ensure environmental protection.

Alternative C:

Implementation of Alternative C would consist of access road maintenance with some improvements, and public use prescriptions that may potentially affect water quality. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project
Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar beneficial impacts on water quality as those described under Alternative A, except efforts to ensure environmental protection at three stream crossings while providing for a backcountry experience would have moderate and long-term impacts.

Alternative C would have more beneficial impacts on water resources than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have negligible impacts on water quality due to road and pipeline corridor maintenance and *some* improvement projects conducted to ensure environmental protection while providing for a backcountry experience.

Alternative C would have more beneficial impacts on water resources than Alternative A due to public use management prescriptions.

Alternative D:

Implementation of Alternative D would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect water quality. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance During the Life of the Project
Conducting maintenance on the 11-mile unimproved access road during the life of the project would have similar beneficial, medium-term impacts on water quality as those described under Alternative A.

Public Use During the Life of the Project
Closing public vehicle use of the 11-mile access road and 23-mile northern portion of the pipeline corridor would have beneficial, long-term benefits on water quality. Impacts would be moderate at fifteen sites (3 sites along the access road and 12 sites along the northern portion of the pipeline corridor). Because only industry vehicle use would be allowed, fewer stream crossing events would occur and less sedimentation would be deposited into those streams.

Alternative D would have more beneficial impacts on water quality than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project
Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the Alaska Pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have similar beneficial, long-term impacts on water quality as those described under Alternative A, except such impacts would be observed at 21 sites. Implementation of restoration efforts would be at the discretion of the Refuge manager, and more of the corridor would be restored than is proposed under Alternative A.

Alternative D would have more beneficial impacts on water quality than Alternative A, although some negligible impacts on water quality would result from horse use when such use crosses streams.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of access road maintenance with some improvements, public use prescriptions, and restoration activities that may potentially affect water quality. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project
Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar beneficial impacts on water quality as those described under Alternative A, except efforts to ensure environmental protection at three stream crossings while providing for a backcountry experience would have moderate, long-term impacts.

Alternative E would have more beneficial impacts on water resources than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have negligible impacts on water quality due to road and pipeline corridor maintenance and *some* improvement projects conducted to ensure environmental protection while providing for a backcountry experience.

Alternative E would have more beneficial impacts on water resources than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project
Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the Alaska Pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have similar beneficial, long-term impacts on water quality as those described under Alternative A, except such impacts would be observed at 21 sites. More of the corridor would be restored than is proposed under Alternative A.

Alternative E would have more beneficial impacts on water quality than Alternative A, although some negligible impacts on water quality would result from horse use when such use crosses streams.

4.4.4.2 Biological Environment

Consequences of Implementing Mystery Creek Management Strategies on Wildlife Habitat

Indicators:

- Habitat loss
- Frequency of exotic and/or invasive species

Assumptions:

- Approximately 390 acres (16,988,400 square feet) of forest habitat and 45 acres (1,960,200 square feet) of wetland habitat (i.e., sedge peatlands, alder, and willow shrublands) have been lost due to the Alaska Pipeline project.
- Current maintenance activities are limited to grading. Grading activities are currently conducted throughout the access road on an “as needed” basis to facilitate pipeline-related project work—not public use access.
- Access road improvements may include adding gravel, rerouting, redesigning, etc., as needed.

Alternative A (Current Management):

Implementation of Alternative A would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect wildlife habitat. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance During the Life of the Project
Conducting maintenance on the 11-mile unimproved access road during the life of the project would have adverse, long-term and beneficial, medium-term impacts on wildlife habitat when and where such work is conducted. Adverse, long-term impacts would be moderate at the site-specific scale resulting from grading activities that disturb soils and provide fertile environments for the establishment of new populations of exotic and/or invasive species transported by vehicle use. Conversely, beneficial, medium-term impacts would result from grading activities that reduce road-related mud holes. Such activities indirectly affect wildlife habitat because vehicles no longer inadvertently expand the width of the right-of-way and damage roadside vegetation while trying to avoid the mud holes. These impacts would be minor at the site-specific scale. Additional minor, beneficial, medium-term impacts would result from grading activities designed to minimize sediment loading at three site-specific vehicle stream crossings.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile unimproved access road and 23-mile northern portion of the Alaska Pipeline corridor during the life of the project would have adverse, long-term impacts on wildlife habitat. Impacts would be moderate at site-specific locations and would result in damage to roadside vegetation from vehicles attempting to avoid road-related mud holes, damage from exotic and/or invasive flora being introduced and/or dispersed by such use, and damage to spawning and fish rearing habitats that are degraded by vehicle stream crossings.

Restoration Activities After the Life of the Project
Restoring *all* or *some* of the 11-mile unimproved access road and 38-mile northern and southern portions of the Alaska Pipeline corridor—at the Refuge manager's discretion—would have beneficial, long-term impacts on wildlife habitat where restoration work is conducted. Although minor, adverse, short-term impacts would be observed initially due to the use of heavy machinery used to conduct restoration work, overall major, beneficial impacts would be observed at the local scale once vegetation becomes established and natural processes unfold. Wildlife habitat (including fish habitat) would be enhanced, habitat fragmentation would decline, and the introduction and/or dispersal of exotic and/or invasive species would diminish.

Alternative B:

Implementation of Alternative B would consist of access road maintenance with improvements and public use prescriptions that may potentially affect wildlife habitat. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project

Conducting maintenance and improvements on the 11-mile access road during the life of the project would have similar adverse and beneficial impacts on wildlife habitat as those described under Alternative A, except additional adverse impacts would be expected due to a broader range of road maintenance and improvement work conducted at potentially more locations. Adverse impacts would be major at the site-specific scale if habitat is cleared along the right-of-way to facilitate public access and enhance public safety.

Alternative B would have more adverse impacts than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project

Permitting vehicle use of the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have similar adverse, long-term impacts on wildlife habitat as those described under Alternative A, except such impacts would be observed more often and at more locations due to access being permitted on an additional 14 miles of the pipeline corridor (the southern portion) which crosses six streams (one of which is a salmon stream).

Alternative B would have more adverse impacts on wildlife habitat than Alternative A due to public use management prescriptions.

Alternative C:

Implementation of Alternative C would consist of access road maintenance with some improvements and public use prescriptions that may potentially affect wildlife habitat. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project

Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar adverse and beneficial impacts on wildlife habitat as those described under Alternative A, except additional adverse impacts would be expected due to road maintenance and improvement work conducted at more locations. Adverse impacts would be major at the site-specific scale if habitat is cleared along the right-of-way to enhance public safety.

Conversely, beneficial impacts would be major at three site-specific streams if improvements result in declines in sediment loading.

Alternative C could potentially have more adverse and/or more beneficial impacts than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have similar adverse, long-term impacts on wildlife habitat as those described under Alternative A, except such impacts would be observed at more locations due to access being permitted over a larger area. Alternative C would allow public vehicle use on an additional 14 miles of the pipeline corridor (the southern portion).

Alternative C would have more adverse impacts on wildlife habitat than Alternative A due to public use management prescriptions.

Alternative D:

Implementation of Alternative D would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect wildlife habitat. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance During the Life of the Project
Conducting maintenance on the 11-mile unimproved access road during the life of the project would have similar adverse long-term and beneficial medium-term impacts on wildlife habitat as those described under Alternative A.

Public Use During the Life of the Project
Closing public vehicle use of the 11-mile unimproved access road and 23-mile northern portion of the pipeline corridor would have beneficial, long-term impacts on wildlife habitat. Impacts would be moderate at the local scale and would result in habitat conditions similar to those found along the 14-mile southern portion of the pipeline corridor where access is limited to ENSTAR vehicles. Damage to roadside vegetation would diminish, and opportunities for introduction and/or dispersal of exotic and/or invasive flora and vehicle stream crossings would decline.

Alternative D would have more beneficial, long-term impacts on wildlife habitat than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project
Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have similar beneficial, long-term and adverse, short-term impacts on wildlife habitat as those described

under Alternative A, except such impacts would be observed throughout the majority of the corridor. Implementation of restoration efforts would be at the discretion of the Refuge manager, and more of the corridor would be restored than is proposed under Alternative A.

Alternative D would have more beneficial, long-term impacts and more adverse, short-term impacts on wildlife habitat than Alternative A due to restoration activities conducted after the life of the project.

Alternative E (Preferred Alternative):

Implementation of Alternative C would consist of access road maintenance with some improvements, public use prescriptions, and restoration activities that may potentially affect wildlife habitat. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project

Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar adverse and beneficial impacts on wildlife habitat as those described under Alternative A, except additional impacts would be expected due to road maintenance and improvement work conducted at more locations. Adverse impacts would be major at the site-specific scale if habitat is cleared along the right-of-way to enhance public safety. Conversely, beneficial impacts would be major at three site-specific streams if improvements result in declines in sediment loading.

Alternative E could potentially have more adverse and/or more beneficial impacts than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project

Permitting vehicle use of the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have similar adverse, long-term impacts on wildlife habitat as those described under Alternative A, except such impacts would be observed at more locations due to access being permitted over a larger area. Alternative E would allow public vehicle use on an additional 14 miles of the pipeline corridor (the southern portion).

Alternative E would have more adverse impacts on wildlife habitat than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project

Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have similar beneficial, long-term and adverse, short-term impacts on wildlife habitat as those described

under Alternative A, except such impacts would be observed throughout the majority of the corridor. Implementation of restoration efforts would be at the discretion of the Refuge manager, and more of the corridor would be restored than is proposed under Alternative A.

Alternative E would have more beneficial, long-term impacts and more adverse, short-term impacts on wildlife habitat than Alternative A due to restoration activities conducted after the life of the project.

Consequences of Implementing Mystery Creek Management Strategies on Wildlife

Indicators:

- Wildlife presence

Assumptions:

- Human activity causes disturbance to wildlife at varying degrees depending on the type of activity, intensity of the activity, timing of the activity, number of activities occurring simultaneously, and wildlife species affected.
- Disturbance-related impacts include direct mortality (immediate, on-site death), indirect mortality (eventual, premature death), lowered productivity (reduced fecundity or survival rate), reduced habitat use, and stress.

Alternative A (Current Management):

Implementation of Alternative A would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect wildlife. The impacts associated with these proposed activities are analyzed in the following text.

<u>Access Road Maintenance During the Life of the Project</u>
Conducting maintenance on the 11-mile unimproved access road during the life of the project would have adverse, short-term impacts on wildlife due to disturbance associated with heavy equipment use. Impacts would be moderate at site-specific locations when and where work is conducted, and would result in reduced habitat use, increased stress, and lowered productivity of some species if work is conducted during breeding season for an extended period of time.

<u>Public Use During the Life of the Project</u>
Permitting a variety of public uses along the 11-mile unimproved access road and 23-mile northern portion of the Alaska Pipeline corridor during the life of the project would have adverse, short- to long-term impacts on wildlife due to disturbance associated with such use. Impacts would be moderate to major at site-specific locations and/or at the local scale when and where such use occurs. Direct mortality of some wildlife may result from vehicle-wildlife collisions,

and legal and illegal take of fish and wildlife species. Indirect mortality of fish eggs deposited in gravel downstream of vehicle stream crossing sites could occur at 15 sites due to sediment loading associated with such crossings. Reduced habitat use and avoidance of the road and pipeline corridor, increased stress, and lowered productivity of some species would be expected.

Restoration Activities After the Life of the Project
Restoring *all* or *some* of the 11-mile unimproved access road and 38-mile northern and southern portions of the Alaska Pipeline corridor—at the Refuge manager's discretion—would have beneficial, long-term impacts on wildlife where restoration work is conducted. Although minor, adverse, short-term impacts would be observed initially due to disturbance created by the use of heavy equipment conducting restoration work, overall major, beneficial impacts would be observed at the local scale once habitat is restored to a natural setting and the impacts associated with human use are reduced. Benefits would include declines in vehicle-wildlife collisions and wildlife avoidance of what once was the access road and/or pipeline corridor, and fewer legal and illegal takings of fish and wildlife. Fish egg and fry mortality resulting from vehicles crossing anadromous fish streams would be reduced.

Alternative B:

Implementation of Alternative B would consist of access road maintenance with improvements and public use prescriptions that may potentially affect wildlife. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project
Conducting maintenance and improvements on the 11-mile access road during the life of the project would have similar adverse, short-term impacts on wildlife as those described under Alternative A, except such impacts may be observed more often and potentially at more locations due to an increase in the frequency and type of projects conducted. Conversely, beneficial, long-term impacts would be expected if improvements are conducted to ensure environmental protection (i.e., reduced sediment loading) at three site-specific stream crossings.

Alternative B could potentially have more adverse and/or more beneficial impacts on wildlife than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project
Permitting a variety of public uses along the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have similar adverse, short to long-term impacts on wildlife as those described under Alternative A, except such impacts would be observed more often and at more locations due to vehicle access

being permitted five weeks longer and bicycle access being permitted three months longer on an additional 14 miles of the pipeline corridor (the southern portion). Although road improvement projects would ensure environmental protection, such projects would facilitate an increase in public access and would result in additional disturbance.

Alternative B would have more adverse impacts on wildlife than Alternative A due to public use management prescriptions.

Alternative C:

Implementation of Alternative C would consist of access road maintenance with some improvements and public use prescriptions that may potentially affect wildlife. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project

Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar adverse, short-term impacts on wildlife as those described under Alternative A, except such impacts may be observed more often and potentially at more locations due to an increase in the frequency and number of locations such work is conducted.

Conversely, beneficial, long-term impacts would be expected if improvements are made to ensure environmental protection (i.e., reduced sediment loading) at 21 site-specific stream crossings, including 7 streams where salmon are know to spawn.

Alternative C could potentially have more adverse and/or more beneficial impacts on wildlife than Alternative A due to access road maintenance and improvement projects conducted during the life of the project.

Public Use During the Life of the Project

Permitting a variety of public uses along the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have similar adverse, short to long-term impacts on wildlife as those described under Alternative A, except such impacts would be observed more often and potentially at more locations due to vehicle access being permitted on an additional 14 miles of the pipeline corridor (the southern portion).

Alternative C would have more adverse impacts on wildlife than Alternative A due to public use management prescriptions.

Alternative D:

Implementation of Alternative D would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect wildlife. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance During the Life of the Project
Conducting maintenance on the 11-mile unimproved access road during the life of the project would have similar adverse, short-term impacts on wildlife as those described under Alternative A.

Public Use During the Life of the Project
Closing public vehicle and bicycle use of the 11-mile unimproved access road and 23-mile northern portion of the pipeline corridor would have beneficial, long-term impacts on wildlife. Impacts would be major at the local scale and would result in wildlife conditions similar to those found along the 14-mile southern portion of the pipeline corridor where access is limited to ENSTAR vehicles. Direct and indirect impacts resulting from vehicle-wildlife collisions; legal and illegal take of fish and wildlife species; vehicle stream crossings at 15 sites; reduced habitat use and avoidance of the road and pipeline corridor; stress; and lowered productivity of some species would all decline.

Alternative D would have more beneficial impacts on wildlife than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project
Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have similar beneficial, long-term impacts and adverse, short-term impacts on wildlife resources as those described under Alternative A, except such impacts would be observed throughout the majority of the corridor. Implementation of restoration efforts would be at the discretion of the Refuge manager, and more of the corridor would be restored than is proposed under Alternative A.

Alternative D would have more beneficial, long-term impacts and more adverse, short-term impacts on wildlife than Alternative A due to restoration activities conducted after the life of the project.

Alternative E (Preferred Alternative):

Implementation of Alternative C would consist of access road maintenance with some improvements, public use prescriptions, and restoration activities that may potentially affect wildlife. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project
Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar adverse, short-term impacts on wildlife as those described under Alternative A, except such impacts may be observed more often and potentially at more locations due to an increase in the frequency and number of locations where such work is conducted.

Conversely, beneficial, long-term impacts would be expected if improvements are made to ensure environmental protection (i.e., reduced sediment loading) at 21 site-specific stream crossings, including 7 streams where salmon are know to spawn.

Alternative E could potentially have more adverse and/or more beneficial impacts on wildlife than Alternative A due to access road maintenance and improvement projects conducted during the life of the project.

Public Use During the Life of the Project
Permitting a variety of public uses along the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have similar adverse, short to long-term impacts on wildlife as those described under Alternative A, except such impacts would be observed more often and potentially at more locations due to vehicle access being permitted on an additional 14 miles of the pipeline corridor (the southern portion).

Alternative E would have more adverse impacts on wildlife than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project
Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have similar beneficial, long-term impacts and adverse, short-term impacts on wildlife as those described under Alternative A, except such impacts would be observed throughout the majority of the corridor. Implementation of restoration efforts would be at the discretion of the Refuge manager, and more of the corridor would be restored than is proposed under Alternative A.

Alternative E would have more beneficial, long-term impacts and more adverse, short-term impacts on wildlife than Alternative A due to restoration activities conducted after the life of the project.

4.4.4.3 Human Environment

Consequences of Implementing Mystery Creek Corridor Management Strategies on Recreation

Indicators:

- Recreation access
- Recreation opportunity settings

Assumptions:

- There is unmet public demand for bicycle and motorized vehicle use of the corridor throughout the summer months.
- The presence and use of roads facilitates recreation access but reduces wildlife presence.

- The registration requirement under Alternatives B and C would be implemented by placing a kiosk with a logbook at points of entry.
- Recreation opportunity settings are defined as discrete combinations of physical, biological, social, and managerial conditions that facilitate particular kinds of recreation experiences. Opportunity settings can be inventoried and arrayed along a continuum from wilderness (no roads, limited facilities, dispersed use, and little management presence) to urban-industrial (paved roads, extensive development, dense use, obvious management presence).

Alternative A (Current Management):

Implementation of Alternative A would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect recreation. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance During the Life of the Project
Conducting maintenance activities on the 11-mile unimproved access road during the life of the project would have beneficial, medium-term impacts on recreation due to grading activities that facilitates vehicle use. Impacts would be moderate at site-specific locations when and where work is conducted, and would result in increased recreation access to the area.

Public Use During the Life of the Project
Seasonal prohibitions of public vehicle and bicycle use of the 11-mile unimproved access road and 23-mile northern portion of the Alaska Pipeline corridor during the life of the project would have adverse, long-term impacts on recreation due to access limitations. Impacts would be moderate at the local scale and would occur during three snow-free summer months (May–July) when vehicle and bicycle use is prohibited. Conversely, beneficial, long-term impacts would continue to result during those months as horseback and pedestrian use would be allowed, and a recreation setting that is relatively free of motorized use would be provided. Impacts would be moderate and would result in a more primitive or solitary type of recreation experience during that time period.

Restoration Activities After the Life of the Project
Restoring *all* or *some* of the 11-mile unimproved access road and 38-mile northern and southern portions of the Alaska Pipeline corridor—at the Refuge manager's discretion—would have adverse, long-term impacts on recreation when and where restoration work is conducted. Impacts would be moderate to major at the local scale depending on the amount of restoration work conducted. Vehicle and bicycle access would be reduced or eliminated, and the roaded, natural recreation opportunity setting

would convert to something different depending on the level of restoration conducted (e.g., a primitive, wilderness-like setting).

Alternative B:

Implementation of Alternative B would consist of access road maintenance with improvements and public use prescriptions that may potentially affect recreation. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project

Conducting maintenance and improvements on the 11-mile access road during the life of the project would have similar beneficial, medium-term impacts on recreation as those described under Alternative A, except such impacts would be major due to an increase in the frequency, type, and number of locations where such work is conducted. Alternative B would increase maintenance and improvements throughout the project area to facilitate public access and enhance public safety.

Alternative B would have more beneficial impacts on recreation than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project

Permitting a variety of public uses along the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have adverse and beneficial, long-term impacts on recreation due to access prescriptions. Impacts would be moderate to major at the local scale based on the duration such uses are allowed or not allowed, and the scale of which those impacts would be observed (i.e., on an additional 14 miles of pipeline corridor). Opportunities for unconfined recreation could be affected by a requirement to register at all points of entry. Beneficial impacts would be major at the local scale and would result during a five-month period when public vehicle use would be allowed (or approximately five weeks more than under Alternative A), and during a six-month period when bicycle use would be allowed (or approximately 3.25 months more than under Alternative A). Conversely, horseback and pedestrian users who currently enjoy limited motorized use during those periods would likely suffer moderate to major adverse impacts depending on the amount of additional public vehicle use. The net effect of Alternative B on recreation access would be a substantial increase in public vehicle and bicycle use and a substantial decline in the proportion—as well as the absolute number—of horseback and pedestrian users.

Alternative B would have more beneficial and more adverse impacts on recreation than Alternative A due to public use management prescriptions.

Alternative C:

Implementation of Alternative C would consist of access road maintenance with some improvements and public use prescriptions that may potentially affect recreation. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project

Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar beneficial, medium-term impacts on recreation as those described under Alternative A, except such impacts may be observed more often and potentially at more locations due to an increase in the frequency and number of locations such work is conducted. Alternative C would increase maintenance and conduct *some* improvements throughout the project area to enhance public safety.

Alternative C would have more beneficial impacts on recreation than Alternative A due to access road maintenance and improvements during the life of the project.

Public Use During the Life of the Project

Permitting a variety of public uses along the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have adverse and beneficial, long-term impacts on recreation due to access prescriptions. Although the duration of time public vehicle and bicycle use of the road and pipeline corridor is the same as that described under Alternative A, such users would obtain beneficial impacts from having access to an additional 14 miles of pipeline corridor (the southern portion). Conversely, horseback and pedestrian users who currently enjoy limited motorized use of those areas would likely suffer moderate to major adverse impacts depending on the amount of additional public vehicle use. The net effect of Alternative C on recreation access would be a substantial increase in public vehicle and bicycle use throughout the southern portion of the pipeline corridor and a substantial decline in the proportion and absolute number of horseback and pedestrian users in the area.

Alternative C would have more beneficial and more adverse impacts on recreation than Alternative A due to public use management prescriptions.

Alternative D:

Implementation of Alternative D would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect recreation. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance During the Life of the Project
Conducting maintenance on the 11-mile unimproved access road during the life of the project would have similar beneficial, medium-term impacts on recreation as those described under Alternative A.

Public Use During the Life of the Project
Closing public vehicle and bicycle use of the 11-mile unimproved access road and 23-mile northern portion of the pipeline corridor during the life of the project would have major, adverse impacts on recreation access at the local scale because a large proportion of hunters and other recreation users who seasonally rely on such vehicles to access the area would probably not to visit. Conversely, the use-season would be substantially increased for pedestrian and horse users who, for safety or other reasons, do not use the area when it is open to public vehicle use. The net effect of Alternative D would be to increase opportunities for recreation users who prefer to access the area by foot or horseback while eliminating opportunities for users who prefer to access the area by vehicle or bicycle.

Alternative D would have more adverse and more beneficial impacts on recreation than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project
Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have negligible impacts on recreation because vehicle and bicycle prohibitions would have been implemented during the life of the project. Minor, adverse, short-term impacts would be expected on pedestrian and horse users while restoration work is conducted; however, major, beneficial, long-term impacts would result as access for these users is enhanced by the presence of a dedicated recreation trail and the elimination of all vehicle traffic. The roaded, natural recreation opportunity setting would revert to a primitive, wilderness-like setting once restoration work is completed.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of access road maintenance with some improvements, public use prescriptions, and restoration activities that may potentially affect recreation. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project
Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar beneficial, medium-term impacts on recreation as those described under

Alternative A, except such impacts may be observed more often and potentially at more locations due to an increase in the frequency and number of locations where such work is conducted. Under Alternative E, maintenance would be increased and *some* improvements would be conducted throughout the project area to enhance public safety.

Alternative E would have more beneficial impacts on recreation than Alternative A due to access road maintenance and improvements during the life of the project.

Public Use During the Life of the Project

Permitting a variety of public uses along the 11-mile access road and 38-mile northern and southern portions of the pipeline corridor during the life of the project would have adverse and beneficial, long-term impacts on recreation due to access prescriptions. Opportunities for unconfined recreation could be affected by a requirement to register at all points of entry. Although the duration of time public vehicle and bicycle use of the road and pipeline corridor is the same as that described under Alternative A, such users would obtain beneficial impacts from having access to an additional 14 miles of pipeline corridor (the southern portion). Conversely, horseback and pedestrian users who currently enjoy limited motorized use of those areas would likely suffer moderate to major adverse impacts depending on the amount of additional public vehicle use. The net effect of Alternative E on recreation access would be a substantial increase in public vehicle and bicycle use throughout the southern portion of the pipeline corridor, and a substantial decline in the proportion and absolute number of horseback and pedestrian users in the area.

Alternative E would have more beneficial and more adverse impacts on recreation than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project

Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have negligible impacts on recreation because vehicle and bicycle prohibitions would have been implemented during the life of the project. Minor, adverse, short-term impacts would be expected on pedestrian users while restoration work is conducted; however, major, beneficial, long-term impacts would result as access for these users is enhanced by the presence of a dedicated recreation trail and the elimination of all vehicle traffic. The roaded, natural recreation opportunity setting would revert to a primitive, wilderness-like setting once restoration work is complete.

Consequences of Implementing Mystery Creek Management Strategies on Subsistence

Indicators:

- Presence of subsistence resources in historic and/or natural abundance
- Access to subsistence resources
- Participation in subsistence activities

Assumptions:

- Primary subsistence resources would continue to be moose, hare, grouse, ptarmigan, lynx, coyote, wolf, and wolverine.
- Development and public use of the area has altered the historic distribution and abundance of some wildlife species (e.g., wolf, wolverine).
- Adequate harvest regulations, law enforcement, and speed limits can mitigate impacts associated with overharvesting, poaching, and vehicle-wildlife collisions.
- Numbers of moose in Game Management Unit 15A will continue in a natural decline regardless of any action in the proposed alternatives due to changing environmental conditions.

Alternative A (Current Management):

Implementation of Alternative A would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect subsistence. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance During the Life of the Project
Conducting maintenance on the 11-mile unimproved access road during the life of the project would have beneficial, long-term impacts on subsistence due to enhanced access to subsistence resources; consequently, participation in subsistence activities would increase. Impacts would be moderate at the local scale when and where work is conducted, and would result in facilitated motorized use during key hunting seasons (i.e., moose, wolf, wolverine, lynx, grouse, and ptarmigan). Conversely, conducting maintenance activities would have adverse, short-term impacts on subsistence resources at site-specific locations due to disturbance associated with heavy equipment use.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile unimproved access road and 23-mile northern portion of the Alaska Pipeline corridor during the life of the project would have beneficial, long-term impacts on subsistence because access to subsistence resources (and participation in subsistence activities) would be ensured. Conversely, allowing vehicle

use would have adverse, short- to long-term impacts on subsistence due to declines in the presence of subsistence resources throughout the road and pipeline corridor resulting from disturbance associated with such use. Seasonal and dispersal movements of moose, wolves, wolverines, and lynx—which must cross the access road and pipeline corridor when moving between high elevation summer ranges and lower elevation winter ranges—would be affected, and vehicle-wildlife collisions and wildlife avoidance of the road and pipeline corridor would be expected. Impacts would be moderate at the local scale when public vehicle and bicycle use of access road and pipeline corridor is allowed (i.e., from start of moose hunting season—approximately August 9—until snow cover) and when snowmachine access is granted.

Restoration Activities After the Life of the Project
Restoring *all* or *some* the 11-mile unimproved access road and 38-mile northern and southern portions of the Alaska Pipeline corridor—at the Refuge manager's discretion—would have beneficial and adverse, long-term impacts on subsistence. Beneficial impacts would be moderate to major at the local scale depending on the amount of restoration work conducted and would result in enhanced habitat for subsistence resources. Conversely, major, adverse impacts would be expected due to a reduction or elimination of access to subsistence resources. As a result, participation in subsistence activities would be expected to decline due to restoration activities.

Alternative B:

Implementation of Alternative B would consist of access road maintenance with improvements, and public use prescriptions that may potentially affect subsistence. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project
Conducting maintenance and improvements on the 11-mile access road during the life of the project would have similar beneficial and adverse, long- and short-term impacts on subsistence as those described under Alternative A, except additional impacts would result due to an increase in the frequency, type, and number of locations where such work is conducted.

Alternative B would have more beneficial impacts on subsistence access and more adverse impacts on subsistence resources than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project
Permitting vehicle use of the 11-mile improved access road and 38-mile northern and southern portions of the Alaska Pipeline corridor during the life of the project would have similar beneficial and adverse, short-

to long-term impacts on subsistence as those described under Alternative A, except beneficial impacts due to enhanced vehicle access and participation in subsistence activities would be major. Conversely, increased motorized and non-motorized use prior to and during subsistence hunting seasons would have more adverse impacts on subsistence due to declines in the presence of subsistence resources throughout the road and pipeline corridor.

Alternative B would have more beneficial and more adverse impacts on subsistence than Alternative A due to public use management prescriptions.

Alternative C:

Implementation of Alternative C would consist of access road maintenance with some improvements and public use prescriptions that may potentially affect subsistence. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project

Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar beneficial and adverse, long- and short-term impacts on subsistence as those described under Alternative A, except additional impacts would result due to an increase in the frequency and number of locations where such work is conducted to ensure public safety.

Alternative C would have more beneficial impacts on access and more adverse impacts on subsistence resources than Alternative A due to access maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project

Permitting vehicle use of the 11-mile access road and 38-mile northern and southern portions of the Alaska Pipeline corridor during the life of the project would have similar beneficial and adverse, short- to long-term impacts on subsistence as those described under Alternative A, except additional beneficial impacts on participation in subsistence activities would result from having access to an additional 14 miles of pipeline corridor (the southern portion). Conversely, increased motorized use in the southern portion of the pipeline corridor would have additional adverse impacts on subsistence resources due to disturbance associated with such use.

Alternative C would have more beneficial and more adverse impacts on subsistence than Alternative A due to public use management prescriptions.

Alternative D:

Implementation of Alternative D would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect subsistence. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance During the Life of the Project
Conducting maintenance on the 11-mile access road during the life of the project would have similar beneficial and adverse, long- and short-term impacts on subsistence as those described under Alternative A.

Public Use During the Life of the Project
Closing public vehicle and bicycle use of the 11-mile unimproved access road and 23-mile northern portion of the pipeline corridor would have adverse, long-term impacts on subsistence at the local scale because access to subsistence resources would be limited. Although current access routes would remain open to the public, impacts would be major at the local scale resulting from prescriptions that favor horseback and pedestrian access. As a result, participation in subsistence activities would be expected to decline. Conversely, beneficial, long-term impacts on subsistence resources would occur throughout the corridor. Wildlife conditions would be expected to be similar to those found along the 14-mile southern portion of the pipeline corridor where vehicle access is currently limited to ENSTAR only. Hunters choosing to utilize the area for subsistence activities would likely have a higher probability of success.

Alternative D would have more adverse and more beneficial impacts on subsistence than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project
Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have beneficial, long-term impacts on subsistence because the restoration effort would enhance habitat that would favor subsistence resources.

Alternative D would have more beneficial impacts on subsistence than Alternative A due to restoration activities conducted after the life of the project.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of access road maintenance with some improvements, public use prescriptions, and restoration activities that may potentially affect subsistence. The

impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project

Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar beneficial long-term and adverse short-term impacts on subsistence as those described under Alternative A, except additional impacts would result due to an increase in the frequency and number of locations where such work is conducted to ensure public safety.

Alternative E would have more beneficial impacts on access and more adverse impacts on subsistence resources than Alternative A due to access maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project

Permitting vehicle use of the 11-mile access road and 38-mile northern and southern portions of the Alaska Pipeline corridor during the life of the project would have similar beneficial and adverse, short- to long-term impacts on subsistence as those described under Alternative A, except additional beneficial impacts on participation in subsistence activities would result from having access to an additional 14 miles of pipeline corridor (the southern portion). Conversely, increased motorized use in the southern portion of the pipeline corridor would have additional adverse impacts on subsistence resources due to disturbance associated with such use.

Alternative E would have more beneficial and more adverse impacts on subsistence than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project

Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have beneficial, long-term impacts on subsistence because the restoration effort would enhance habitat that would favor subsistence resources.

Alternative E would have more beneficial impacts on subsistence than Alternative A due to restoration activities conducted after the life of the project.

Consequences of Implementing Mystery Creek Management Strategies on Wilderness Values

Indicators:

- Untrammeled condition (i.e., free of intentional human manipulation)
- Opportunities for solitude
- Opportunities for primitive and unconfined types of recreation
- Ecological and scientific values

Assumptions:

- Management units potentially affected by the alternatives include Two Indians, Chickaloon Flats, Pipeline Lowlands, and Moose River/Mystery Creek.
- With the exception of the existing access road and pipeline corridor, these units currently retain high wilderness values.

Alternative A (Current Management):

Implementation of Alternative A would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect wilderness values. The impacts associated with these proposed activities are analyzed in the following text.

<u>Access Road Maintenance During the Life of the Project</u>
Conducting maintenance on the 11-mile unimproved access road during the life of the project would have adverse, short-term impacts on wilderness values due to heavy equipment used to conduct grading activities. Impacts would be major at site-specific locations when and where work is conducted and would result in diminished opportunities for solitude.

<u>Public Use During the Life of the Project</u>
Permitting vehicle, bicycle, and snowmachine use of the 11-mile unimproved access road and 23-mile northern portion of the Alaska Pipeline corridor during the life of the project would have adverse, long-term impacts on wilderness values at the local scale due to declines in opportunities for solitude, primitive or unconfined types of recreation opportunities, and ecological and scientific values. Impacts would be moderate throughout the majority of the year when and where such use occurs. Conversely, seasonal prohibitions of public vehicle and bicycle use would have beneficial, long-term impacts on wilderness values. Impacts would be moderate at the local scale and would result during the snow-free summer months (May–July) when such use is not allowed, and for a shorter period of time when vehicle use is not allowed due to snow cover but snowmachine use has not been opened due to low snow conditions. The presence and public use of the access road and pipeline corridor would have an adverse, long-term, moderate impact

on ecological and scientific values at the local scale. The road and pipeline corridor and their associated public uses affect the seasonal and dispersal movements of moose, brown bears, black bears, wolves, wolverines, and lynx, which must cross these routes when moving between high elevation summer ranges and lower elevation winter ranges. These impacts have affected the Refuge's ability to study and manage these species in these areas.

Restoration Activities After the Life of the Project

Restoring *all* or *part* of the 11-mile unimproved access road and 38-mile northern and southern portions of the Alaska Pipeline corridor—at the Refuge manager's discretion—would have beneficial, long-term impacts on wilderness values if, when, and where such activities are undertaken. Impacts would be moderate to major at the local scale depending on the scale of the restoration effort and resulting increases in opportunities for solitude, primitive or unconfined types of recreation opportunities, and ecological and scientific values. Seasonal and dispersal movements of moose, brown bears, black bears, wolves, wolverines, and lynx would be enhanced as they move between high elevation summer ranges and low elevation winter ranges if restoration efforts were extensive. As such, the Refuge's ability to study and manage these species in these areas would be facilitated.

Alternative B:

Implementation of Alternative B would consist of access road maintenance with improvements and public use prescriptions that may potentially affect wilderness values. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project

Conducting maintenance and improvements on the 11-mile access road during the life of the project would have similar adverse, short-term impacts on wilderness values as those described under Alternative A, except such impacts may be observed more often and potentially at more locations due to an increase in the frequency and number of locations where such work is conducted. Alternative B would increase the amount of maintenance and improvement projects conducted to facilitate public access, enhance public safety, and ensure environmental protection.

Alternative B would have more adverse impacts on wilderness values than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project

Permitting vehicle, bicycle, and snowmachine use of the 11-mile access road and 38-mile northern and southern portions of the Alaska Pipeline

corridor during the life of the project would have similar adverse, long-term impacts on wilderness values as those described under Alternative A, except impacts would be observed more often and at more locations because the alternative would conduct road improvement projects to facilitate public access, enhance public safety, and ensure environmental protection. Impacts would be major at the local scale and would result in a diminished untrammeled condition. Furthermore, Alternative B would increase the duration of public vehicle use by approximately five weeks and bicycle use by approximately three months on an additional 14 miles of pipeline corridor (the southern portion). Impacts would be major at the local scale and would result from diminished opportunities for solitude during the majority of the year. Increased public use of the access road and pipeline corridor would have additional adverse, long-term impacts on ecological and scientific values. Impacts would be major at the local scale, and would result in affected seasonal and dispersal movements of moose, brown bears, black bears, wolves, wolverines, and lynx, which must cross these routes when moving between high elevation summer ranges and lower elevation winter ranges. Opportunities for unconfined recreation would be adversely affected by a requirement to register at all points of entry.

Alternative B would have more adverse impact on wilderness values than Alternative A due to public use management prescriptions.

Alternative C:

Implementation of Alternative C would consist of access road maintenance with some improvements and public use prescriptions that may potentially affect wilderness values. The impacts associated with these proposed activities are analyzed in the following text.

<u>Access Road Maintenance and Improvements During the Life of the Project</u>
Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar adverse, short-term impacts on wilderness values as those described under Alternative A, except such impacts may be observed more often and potentially at more locations due to an increase in the frequency and number of locations where such work is conducted. Alternative C would increase the amount of maintenance and conduct *some* improvement projects to enhance public safety and ensure environmental protection while providing for a backcountry experience.

Alternative C would have more adverse impacts on wilderness values than Alternative A due to access road maintenance and improvements conducted during the life of the project.

<u>Public Use During the Life of the Project</u>
Permitting vehicle, bicycle, and snowmachine use of the 11-mile access road and 38-mile northern and southern portions of the Alaska Pipeline

corridor during the life of the project would have similar adverse, long-term impacts on wilderness values as those described under Alternative A, except impacts would be observed at more locations because Alternative C would require *some* road improvements to be conducted to enhance public safety and environmental protection. Impacts would be moderate at the local scale, and would result in declines in the untrammeled condition of the corridor. Alternative C would allow public vehicle use on an additional 14 miles of pipeline corridor (the southern portion). Impacts would be moderate at the local scale and would result in diminished opportunities for solitude. Increased public use of the access road and pipeline corridor would have additional adverse, long-term impacts on ecological and scientific values. Impacts would be major at the local scale, and would result in affected seasonal and dispersal movements of moose, brown bears, black bears, wolves, wolverines, and lynx, which must cross these routes when moving between high elevation summer ranges and lower elevation winter ranges. Opportunities for unconfined recreation would be adversely affected by a requirement to register at all points of entry.

Alternative C would have more adverse impact on wilderness values than Alternative A due to public use management prescriptions.

Alternative D:

Implementation of Alternative D would consist of access road maintenance, public use prescriptions, and restoration activities that may potentially affect wilderness values. The impacts associated with these proposed activities are analyzed in the following text.

<u>Access Road Maintenance During the Life of the Project</u>
Conducting maintenance on the 11-mile access road during the life of the project would have similar adverse, short-term impacts on wilderness values as those described under Alternative A.

<u>Public Use During the Life of the Project</u>
Closing public vehicle and bicycle use of the 11-mile unimproved access road and 23-mile northern portion of the pipeline corridor during the life of the project would have beneficial, long-term impacts on wilderness values. Impacts would be major at the local scale and would result in conditions similar to those that exist within the Kenai Wilderness area. The absence of mechanized use and the associated visitation would enhance opportunities for solitude by reducing noise and potential crowding. The presence and use of trails would have some adverse impacts to ecological and scientific values; however, with the relatively low amount of non-motorized use, the disruption of wildlife movements would be minimized.

Alternative D would have more beneficial impacts on wilderness values than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project
Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have similar beneficial impacts as those described under Alternative A, except impacts would be major at the local scale because opportunities for solitude, primitive or unconfined recreation opportunities, and ecological and scientific values would all be enhanced throughout the majority of the corridor. Implementation of the restoration efforts would be at the discretion of the Refuge manager, and more of the corridor would be restored than is proposed under Alternative A.

Alternative D would have more beneficial impacts on wilderness values than Alternative A due to restoration activities conducted after the life of the project.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of access road maintenance with some improvements, public use prescriptions, and restoration activities that may potentially affect wilderness values. The impacts associated with these proposed activities are analyzed in the following text.

Access Road Maintenance and Improvements During the Life of the Project
Conducting maintenance and *some* improvements on the 11-mile access road during the life of the project would have similar adverse, short-term impacts on wilderness values as those described under Alternative A, except such impacts may be observed more often and potentially at more locations due to an increase in the frequency and number of locations where such work is conducted. Alternative E would increase the amount of maintenance and conduct *some* improvement projects to enhance public safety and ensure environmental protection while providing for a backcountry experience.

Alternative E would have more adverse impacts on wilderness values than Alternative A due to access road maintenance and improvements conducted during the life of the project.

Public Use During the Life of the Project
Permitting vehicle, bicycle, and snowmachine use of the 11-mile access road and 38-mile northern and southern portions of the Alaska Pipeline corridor during the life of the project would have similar adverse, long-term impacts on wilderness values as those described under Alternative A, except impacts would be observed at more locations because Alternative E would require *some* road improvements to be conducted to enhance public safety and environmental protection. Impacts would be moderate at the local scale and would result in declines in the

untrammeled condition of the corridor. Alternative E would allow public vehicle use on an additional 14 miles of pipeline corridor (the southern portion). Impacts would be moderate at the local scale and would result in diminished opportunities for solitude. Increased public use of the access road and pipeline corridor would have additional adverse, long-term impacts on ecological and scientific values. Impacts would be major at the local scale and would result in affected seasonal and dispersal movements of moose, brown bears, black bears, wolves, wolverines, and lynx, which must cross these routes when moving between high elevation summer ranges and lower elevation winter ranges. Opportunities for unconfined recreation would be adversely affected by a requirement to register at all points of entry.

Alternative E would have more adverse impact on wilderness values than Alternative A due to public use management prescriptions.

Restoration Activities After the Life of the Project
Restoring *most* of the 11-mile unimproved access road and 38-mile northern and southern portions of the pipeline corridor at the end of operations—except for areas where a trail would be provided for pedestrian and horse use—would have similar beneficial impacts as those described under Alternative A, except impacts would be major at the local scale because opportunities for solitude, primitive or unconfined types of recreation opportunities, and ecological and scientific values would all be enhanced throughout the majority of the corridor. Implementation of the restoration efforts would be at the discretion of the Refuge manager, and more of the corridor would be restored than is proposed under Alternative A.

Alternative E would have more beneficial impacts on wilderness values than Alternative A due to restoration activities conducted after the life of the project.

4.4.5 Ski Hill Road

General Assumptions:

- Ski Hill Road is a popular area for local walkers, cyclists, and cross-country skiers.
- Public use will increase as the local population and tourism increases.
- Action taken to improve the southern portion of the road would include hard-surfacing and realignment of the Sterling Highway entrance.
- Action taken to improve the southern entrance road would facilitate increases in traffic volume and speed.
- Some of the proposed actions will facilitate more use and/or different kinds of use than others.

4.4.5.1 Physical Environment

Consequences of Implementing Ski Hill Road Management Strategies on Air Quality

Indicators:

- Air pollution emissions: fuel exhaust, particulate matter (PM 2.5 and PM 10)

Assumptions:

- Improvements would be limited to grading and/or hard-surfacing (e.g., chip seal, asphalt, etc.).
- The amount of particulate matter emitted into the air varies depending on soil moisture, silt content, wind speed, vehicle use, and other factors.
- The number of grading events would decline along the northern portion of the road if and when it is limited to pedestrians, bicycles, and emergency vehicles only.

Alternative A (Current Management):

Implementation of Alternative A would consist of road maintenance and public use prescriptions that may potentially affect air quality. The impacts associated with these proposed activities are analyzed in the following text.

<u>Maintenance Activities</u>
Conducting maintenance on the 1.85-mile northern and southern portions of the gravel road would have adverse, short-term impacts on air quality due to increases in particulate matter resulting from soil disturbance during grading-related work. Additional adverse, short-term impacts would occur due to an increase in fuel exhaust emissions resulting from diesel powered construction equipment used to conduct the work. Impacts would be major at the local scale when compared to air quality conditions within the road corridor when maintenance is not being conducted.

<u>Public Use</u>
Allowing vehicle use of the 1.85-mile northern and southern portions of the gravel road would have adverse, short-term impacts on air quality due to an increase in particulate matter and fuel exhaust emissions generated from passing vehicles. Impacts would be major at the local scale when compared with air quality conditions in the corridor when vehicles are not present.

Alternative B:

Implementation of Alternative B would have similar adverse impacts as those described under Alternative A, except impacts resulting from

maintenance would be observed more often as a result of regular maintenance by the Refuge.

Alternative B would have more adverse impacts on air quality as a result of maintenance activities than Alternative A and equivalent adverse impacts as a result of public use.

Alternative C:

Implementation of Alternative C would consist of road enhancements and public use prescriptions that may potentially affect air quality. The impacts associated with these proposed activities are analyzed in the following text.

Road Maintenance and Enhancements
Conducting maintenance on the 0.8-mile northern portion of the graveled road would have similar adverse, short-term impacts on air quality as those described under Alternative A, except such impacts would be observed less often because public use would be limited to pedestrians, bicycles, and emergency vehicles only, and grading activities conducted by the Refuge would be less necessary. Additional adverse, short-term impacts would occur due to an increase in fuel exhaust emissions resulting from diesel powered construction equipment used to hard-surface the 1.05-mile southern portion of the road. Impacts would be major at the local scale when compared to air quality conditions within the road corridor when construction is not being conducted.

Alternative C would have less adverse impacts on air quality than Alternative A due to road maintenance and enhancement work provided for under this alternative.

Public Use
Limiting vehicle use on the 0.8-mile northern portion of the gravel road to emergency vehicles only would have beneficial, long-term impacts on air quality due to greatly reduced levels of particulate matter and fuel emissions in that portion of the road corridor. Impacts would be major at the local scale when compared to air quality conditions in the corridor when vehicles are present.

Alternative C would have more beneficial impacts on air quality than Alternative A due to public use management prescriptions.

Alternative D:

Implementing Alternative D would have similar adverse and beneficial impacts on air quality as those described under Alternative C.

Alternative D would have more beneficial and less adverse impacts on air quality than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of road enhancements and public use prescriptions that may potentially affect air quality. The impacts associated with these proposed activities are analyzed in the following text.

Road Maintenance and Enhancements
Conducting maintenance on the 0.8-mile northern portion of the graveled road would have similar adverse, short-term impacts on air quality as those described under Alternative A, except such impacts would be observed less often because public use would be limited to pedestrians, bicycles, and emergency vehicles only, and grading activities conducted by the Refuge would be less necessary. Additional adverse, short-term impacts would occur due to an increase in fuel exhaust emissions resulting from diesel powered construction equipment used to hard-surface the 1.05-mile southern portion of the road. Impacts would be major at the local scale when compared to air quality conditions within the road corridor when construction is not being conducted.

Alternative E would have less adverse impacts on air quality than Alternative A due to road maintenance and enhancement work provided for under this alternative.

Public Use
Limiting vehicle use on the 0.8-mile northern portion of the gravel road to emergency vehicles only would have beneficial, long-term impacts on air quality due to greatly reduced levels of particulate matter and fuel emissions in that portion of the road corridor. Impacts would be major at the local scale when compared to air quality conditions in the corridor when vehicles are present.

Alternative E would have more beneficial impacts on air quality than Alternative A due to public use management prescriptions.

Consequences of Implementing Ski Hill Road Management Strategies on Soils

Indicators:

- Physical characteristics: compaction, soil permeability, water repellency

Assumptions:

- Existing soil characteristics are of a degraded nature due to removal of vegetation, development of the road corridor, and ongoing vehicle use.
- Current maintenance activities are limited to grading.

- Future road improvements may include adding gravel, paving, culverts, realignment, etc.
- The number of grading events would decline along the northern portion of the road if and when it is limited to pedestrians, bicycles, and emergency vehicles.

Alternative A:

Implementation of Alternative A would consist of road maintenance and public use prescriptions that may potentially affect soil resources. The impacts associated with these proposed activities are analyzed in the following text.

Maintenance Activities
Conducting maintenance on the 1.85-mile northern and southern portions of the gravel road would have beneficial, short-term impacts on soil resources due to maintenance activities designed to facilitate vehicle use. Impacts would be minor at site-specific locations when and where grading activities are conducted by the State of Alaska Department of Transportation and Public Facilities (SOA DOTPF). Maintenance currently occurs on an irregular basis. Physical soil characteristics are currently degraded due to removal of vegetation, development of the road corridor, and ongoing vehicle use—and would generally remain so under the alternative. Nevertheless, some degree of compaction would decrease; soil permeability would increase; and water repellency, sheet runoff, and erosion would diminish as a result of maintenance activities.

Public Use
Allowing vehicle use of the 1.85-mile northern and southern portions of the gravel road would have adverse, medium-term impacts on soil resources. Impacts would be moderate at the local scale and would include compaction, decreases in soil permeability, and increases in water repellency. Sheet runoff and erosion would be observed at site-specific locations throughout the road corridor. Such effects would increase over time as more vehicles use the road and until SOA DOTPF conducts maintenance activities. Sites that remain saturated for extended periods of time would experience more impacts than well-drained sites. Many—if not all—of these saturated sites would become mud holes where soil function is diminished.

Alternative B:

Implementation of Alternative B would have similar beneficial and adverse impacts as those described under Alternative A, except beneficial impacts resulting from maintenance would be observed more often, and adverse impacts associated with vehicle use would be observed less often as a result of regular maintenance by the Refuge.

Alternative B would have more beneficial impacts and less adverse impacts on soil resources than Alternative A due to road maintenance work provided for under this alternative.

Alternative C:

Implementation of Alternative C would consist of road enhancements and public use prescriptions that may potentially affect soil resources. The impacts associated with these proposed activities are analyzed in the following text.

Road Maintenance and Enhancements
Conducting maintenance on the 0.8-mile northern portion of the gravel road would have similar beneficial, medium-term impacts on soil resources as those described under Alternative A, except such impacts would be observed less often because public vehicle use would be limited to pedestrians, bicycles, and emergency vehicles only, and grading activities conducted by the Refuge would be less necessary. Conversely, hard-surfacing the 1.05-mile southern portion of the road would have adverse, long-term impacts on soil resources due to compaction occurring beneath the road. Impacts would be moderate at the local scale when compared to existing compacted conditions within the road corridor and would result in complete loss of soil function. Sheet runoff would increase, and increased rates of erosion would be expected at specific sites along the corridor where runoff is directed. Best management practices, including construction of gutters, drainage zones, etc., would be implemented; and the effects of erosion would be less when compared to existing conditions. Additional adverse, long-term impacts of major intensity would be expected if and when the road is realigned to facilitate vehicle ingress and egress from and onto the Sterling Highway, particularly by large recreation vehicles.

Alternative C would have more adverse impacts on soil resources than Alternative A due to road maintenance and enhancement work provided for under this alternative.

Public Use
Limiting vehicle use on the 0.8-mile northern portion of the gravel road to emergency vehicles only would have similar adverse, long-term impacts on soil resources as those described under Alternative A, except impacts would be minor due to less vehicle use over a shorter distance of road.

Alternative C would have less adverse impacts on soil resources than Alternative A due to public use management prescriptions.

Alternative D:

Implementation of Alternative D would have similar beneficial and adverse impacts on soil resources as those described under Alternative

C. No additional adverse impacts would be observed on soil resources as a result of constructing a pedestrian and bicycle trail because the trail would be constructed in the existing road right-of-way.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of road enhancements and public use prescriptions that may potentially affect soil resources. The impacts associated with these proposed activities are analyzed in the following text.

Road Maintenance and Enhancements

Conducting maintenance on the 0.8-mile northern portion of the gravel road would have similar beneficial, medium-term impacts on soil resources as those described under Alternative A, except such impacts would be observed less often because public vehicle use would be limited to pedestrians, bicycles, and emergency vehicles only, and grading activities conducted by the Refuge would be less necessary. Conversely, hard-surfacing the 1.05-mile southern portion of the road would have adverse, long-term impacts on soil resources due to compaction occurring beneath the road. Impacts would be moderate at the local scale when compared to existing compacted conditions within the road corridor and would result in complete loss of soil function. Sheet runoff would increase, and increased rates of erosion would be expected at specific sites along the corridor where runoff is directed. Best management practices, including construction of gutters, drainage zones, etc., would be implemented; and the effects of erosion would be less when compared to existing conditions. Additional adverse, long-term impacts of major intensity would be expected if and when the road is realigned to facilitate vehicle ingress and egress from and onto the Sterling Highway, particularly by large recreation vehicles.

Alternative E would have more adverse impacts on soil resources than Alternative A due to road maintenance and enhancement work provided for under this alternative.

Public Use

Limiting vehicle use on the 0.8-mile northern portion of the gravel road to emergency vehicles only would have similar adverse, long-term impacts on soil resources as those described under Alternative A, except impacts would be minor due to less vehicle use over a shorter distance of road. No additional adverse impacts would be observed on soil resources as a result of constructing a pedestrian and bicycle trail because the trail would be identified as such in the shoulder of the existing road.

Alternative E would have less adverse impacts on soil resources than Alternative A due to public use management prescriptions.

4.4.5.2 Biological Environment

Consequences of Implementing Ski Hill Road Management Strategies on Vegetation

Indicators:

- Vegetation damage and/or loss
- Frequency of exotic and/or invasive species

Assumptions:

- The southern entrance of the road would be realigned to allow for safe ingress and egress of vehicle traffic from and onto the Sterling highway, especially by large recreational vehicles. This action would include removal of vegetation to facilitate construction in previously undeveloped areas.
- The realignment of the road has not been determined and the amount of vegetation to be removed cannot be calculated.
- The northern entrance road would be 24 feet wide whether opened or closed to public vehicle traffic since emergency vehicles and heavy equipment would still use this road for access to the Refuge headquarters area.

Alternative A:

Implementation of Alternative A would consist of road maintenance and public use prescriptions that may potentially affect vegetation. The impacts associated with these proposed activities are analyzed in the following text.

<u>Maintenance Activities</u>
Conducting maintenance on the 1.85-mile northern and southern portions of the gravel road would have no impacts on vegetation at the local scale because the road corridor would not be expanded or reduced in size, and current vegetative conditions would persist.

<u>Public Use</u>
Allowing vehicle use of the 1.85-mile northern and southern portions of the gravel road would have adverse, medium- to long-term impacts on vegetation due to damage and/or loss and dispersal of exotic and/or invasive species. Medium-term impacts would be of minor to major intensity at the site-specific scale when and where vehicles drive off the existing road due to excessive speeds or slippery road conditions, and vegetation damage occurs. Major, long-term impacts at the local scale would be expected due to introduction and dispersal of exotic and/or invasive flora transported by vehicles using the road.

Alternative B:

Implementation of Alternative B would have the similar adverse impacts on vegetation as those described under Alternative A.

Alternative C:

Implementation of Alternative C would consist of road enhancements and public use prescriptions that may potentially affect vegetation. The impacts associated with these proposed activities are analyzed in the following text.

Road Maintenance and Enhancements
Conducting maintenance on the 0.8-mile northern portion of the gravel road would have no impacts on vegetation at the local scale because the road corridor would not be expanded or reduced in size, and current vegetative conditions would persist. Conversely, realigning the southern portion of the road to facilitate ingress and egress of vehicle traffic from and onto the Sterling highway would have adverse, long-term impacts on vegetation. Impacts would be major at the site-specific scale when compared to existing natural conditions because all of the vegetation would be removed to facilitate road construction, and ecological services provided by that vegetation would no longer exist. At the local scale, impacts would be negligible because the forest's ability to continue to provide ecological services would be supported by the surrounding forest community, which is of the same type and age class.

Alternative C would have more adverse impacts on vegetation than Alternative A due to road enhancement projects provided for under this alternative.

Public Use
Allowing public vehicle use of the 1.05-mile southern portion of the road would have similar adverse, medium- to long-term impacts on vegetation as those described under Alternative A, though these impacts would not be expected along the 0.8-mile northern portion of the gravel road because public use would be limited to pedestrians, bicycles, and emergency vehicles only. Beneficial impacts would be expected on vegetation as a result of closing the northern entrance to public vehicle access. Impacts would be moderate at the local scale because fewer vehicles driving off the existing road due to excessive speeds or slippery road conditions would result in less damage to roadside vegetation. Conversely, adverse, long-term impacts on vegetation would be expected along the northern portion of the road and would result from introduction and/or dispersal of exotic and invasive flora by public use. The intensity of the impacts would vary depending on a number of factors, but such impacts would be expected to increase over time as public use of the road increases.

Alternative C would have less adverse impacts on vegetation than Alternative A due to public use management prescriptions that limit vehicle use.

Alternative D:

Implementation of Alternative D would have similar adverse and beneficial impacts on vegetation as those described under Alternative C. No additional adverse impacts would be observed on vegetation as a result of constructing a pedestrian and bicycle trail along the southern portion of the road because the trail would be constructed in the road right-of-way and no additional impacts—other than those associated with the road realignment —would occur.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of road enhancements and public use prescriptions that may potentially affect vegetation. The impacts associated with these proposed activities are analyzed in the following text.

Road Maintenance and Enhancements

Conducting maintenance on the 0.8-mile northern portion of the gravel road would have no impacts on vegetation at the local scale because the road corridor would not be expanded or reduced in size, and current vegetative conditions would persist. Conversely, realigning the southern portion of the road to facilitate ingress and egress of vehicle traffic from and onto the Sterling highway would have adverse, long-term impacts on vegetation. Impacts would be major at the site-specific scale when compared to existing natural conditions because all of the vegetation would be removed to facilitate road construction, and ecological services provided by that vegetation would no longer exist. At the local scale, impacts would be negligible because the forest's ability to continue to provide ecological services would be supported by the surrounding forest community, which is of the same type and age class.

Alternative E would have more adverse impacts on vegetation than Alternative A due to road enhancement projects provided for under this alternative.

Public Use

Allowing public vehicle use of the 1.05-mile southern portion of the road would have similar adverse, medium- to long-term impacts on vegetation as those described under Alternative A, though these impacts would not be expected along the 0.8-mile northern portion of the gravel road because public use would be limited to pedestrians, bicycles, and emergency vehicles only. Beneficial impacts would be expected on vegetation as a result of closing the northern entrance to public vehicle access. Impacts would be moderate at the local scale because fewer vehicles driving off the existing road due to excessive speeds or slippery road conditions would result in less damage to

roadside vegetation. Conversely, adverse, long-term impacts on vegetation would be expected along the northern portion of the road and would result from introduction and/or dispersal of exotic and invasive flora by public use. The intensity of the impacts would vary depending on a number of factors, but such impacts would be expected to increase over time as public use of the road increases. No additional adverse impacts would be observed on vegetation as a result of constructing a pedestrian and bicycle trail along the southern portion of the road because the trail would be constructed in the road right-of-way and no additional impacts—other than those associated with the road realignment—would occur.

Alternative E would have less adverse impacts on vegetation than Alternative A due to public use management prescriptions that limit vehicle use.

Consequences of Implementing Ski Hill Road Management Strategies on Wildlife

Indicators:

- Wildlife presence

Assumptions:

- Human activity causes disturbance to wildlife at varying degrees depending on the type of activity, intensity of the activity, timing of the activity, number of activities occurring simultaneously, and wildlife species affected.
- Disturbance-related impacts include direct mortality (immediate, on-site death), indirect mortality (eventual, premature death), lowered productivity (reduced fecundity or survival rate), reduced habitat use, and stress.
- Realignment of the southern portion of the road would require removal of vegetation to facilitate construction in previously undeveloped areas.

Alternative A:

Implementation of Alternative A would consist of road maintenance and public use prescriptions that may potentially affect wildlife. The impacts associated with these proposed activities are analyzed in the following text.

<u>Maintenance Activities</u>
Conducting maintenance on the 1.85-mile northern and southern portions of the gravel road would have adverse, short-term impacts on wildlife due to disturbance associated with heavy equipment use. Impacts would be moderate at the site-specific scale when and where work is conducted and would result in reduced habitat use and stress on wildlife.

Public Use

Allowing public use of the 1.85-mile northern and southern portions of the gravel road would have adverse, short- to long-term impacts on wildlife due to disturbance associated with use of the road 24-hours per day, 7 days per week. Impacts would be minor to major at the site-specific scale when and where use occurs and depending on the type of encounter that results. Road crossing attempts would result in vehicle-wildlife collisions and direct mortality—particularly during periods of high public use when more vehicles use the road (i.e., summer tourist season). Species particularly susceptible to vehicle-wildlife collisions include moose, red squirrel, and snowshoe hare. Some wildlife species (particularly black and brown bears, wolves, and moose) would avoid the road corridor due to vehicle and human use and associated noise. Some wildlife may forego movement into preferred habitats while others may select different routes or change the timing of their movement based on traffic volume and human activity (i.e., wait for traffic and human presence to subside). Habituation of vehicle use and human activity would be expected of some wildlife species, such as moose, squirrels, and birds. Direct mortality, reduced habitat use, stress, and lowered productivity of some species would result in reduced wildlife presence throughout the corridor.

Alternative B:

Implementation of Alternative B would have similar adverse impacts on wildlife as those described under Alternative A, except more impacts would be expected as a result of regular road maintenance, which would facilitate increased public use, vehicle speed and traffic volume.

Alternative B would have more adverse impacts on wildlife than Alternative A due to road maintenance provided for under this alternative.

Alternative C:

Implementation of Alternative C would consist of road enhancements and public use prescriptions that may potentially affect wildlife. The impacts associated with these proposed activities are analyzed in the following text.

Road Maintenance and Enhancements

Conducting maintenance on the 0.8-mile northern portion graveled road would have similar adverse impacts as those described under Alternative A. Hard-surfacing the southern portion of the road and realigning its entrance to facilitate ingress and egress of vehicle traffic from and onto the Sterling Highway would have adverse, long-term impacts on wildlife. Impacts would be major at the local scale and would result from increased levels in public use, vehicle speed, and traffic volume. Increases in vehicle-wildlife collisions, reduced habitat use, stress, and lowered productivity would be expected throughout this portion of the corridor.

Alternative C would have more adverse impacts on wildlife than Alternative A due to road enhancement projects provided for under this alternative.

Public Use
Allowing public use of the 1.85-mile northern and southern portions of the road would have similar adverse, short- to long-term impacts on wildlife as those described under Alternative A, though fewer incidents of vehicle-wildlife collisions and more incidents associated with public use disturbance would be expected along the northern portion of the road because public vehicle use would be limited, and other forms of public use (i.e., walking, biking, etc.) would increase.

Alternative C would have less adverse impacts on wildlife as a result of vehicle use but more adverse impacts associated with public use than Alternative A.

Alternative D:

Implementation of Alternative D would have similar adverse, short- to long-term impacts as those described under Alternative C, except additional adverse impacts associated with disturbance would be expected as a result of use of a pedestrian and bicycle trail along the southern portion of the road.

Alternative D would have more adverse impacts on wildlife than Alternative A due to public use management prescriptions provided for under this alternative.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of road enhancements and public use prescriptions that may potentially affect wildlife. The impacts associated with these proposed activities are analyzed in the following text.

Road Maintenance and Enhancements
Conducting maintenance on the 0.8-mile northern portion graveled road would have similar adverse impacts as those described under Alternative A. Hard-surfacing the southern portion of the road and realigning its entrance to facilitate ingress and egress of vehicle traffic from and onto the Sterling Highway would have adverse, long-term impacts on wildlife. Impacts would be major at the local scale and would result from increased levels in public use, vehicle speed, and traffic volume. Increases in vehicle-wildlife collisions, reduced habitat use, stress, and lowered productivity would be expected throughout this portion of the corridor.

Alternative E would have more adverse impacts on wildlife than Alternative A due to road enhancement projects provided for under this alternative.

Public Use
Allowing public use of the 1.85-mile northern and southern portions of the road would have similar adverse, short- to long-term impacts on wildlife as those described under Alternative A, though fewer incidents of vehicle-wildlife collisions and more incidents associated with public use disturbance would be expected along the northern portion of the road because public vehicle use would be limited and other forms of public use (i.e., walking, biking, etc.) would increase.

Alternative E would have less adverse impacts on wildlife as a result of vehicle use but more adverse impacts associated with public use than Alternative A.

4.4.5.3 Human Environment

Consequences of Implementing Ski Hill Road Management Strategies on Recreation

Indicators:

- Pedestrian safety
- Amount of recreational use

Assumptions:

- The current design and alignment of Ski Hill Road encourages its use as a Sterling Highway shortcut, which presents a safety threat to drivers and recreational users.

Alternative A:

Implementation of Alternative A would consist of road maintenance and public use prescriptions that may potentially affect recreation activities. The impacts associated with these proposed activities are analyzed in the following text.

Maintenance Activities
Conducting maintenance on the 1.85-mile northern and southern portions of the gravel road would have adverse, short-term impacts on recreation due to the use of heavy equipment and associated noise and dust resulting from grading activities. Impacts would be major at the site-specific scale when and where work is conducted and would result in decreased recreational use in the corridor.

Public Use
Allowing vehicle use of the 1.85-mile northern and southern portions of the gravel road would have adverse, long-term impacts on recreation due to conflicting use patterns. Impacts would be minor at the local scale and would result from those who use the corridor as a non-motorized recreation area (i.e., pedestrians, bicyclists, cross-country skiers, etc.) and those using it as a vehicle shortcut around Sterling

Highway traffic. The existing pattern of vehicle and pedestrian use in the road corridor would continue to present a safety threat to users that increases in proportion to local population increases.

Alternative B:

Implementation of Alternative B would have similar adverse impacts on recreation as those described under Alternative A, except more impacts would be expected as a result of regular road maintenance, which would facilitate increased public use, vehicle speed, and traffic volume.

Alternative B would have more adverse impacts on recreation than Alternative A due to road maintenance provided for under this alternative.

Alternative C:

Implementation of Alternative C would consist of road enhancements and public use prescriptions that may potentially affect recreation. The impacts associated with these proposed activities are analyzed in the following text.

Road Maintenance and Enhancements
Conducting maintenance on the 0.8-mile northern portion graveled road would have similar adverse impacts on recreation as those described under Alternative A. Hard-surfacing the southern portion of the road and realigning its entrance to facilitate ingress and egress of vehicle traffic from and onto the Sterling Highway would have additional adverse, long-term impacts on recreation. Impacts would be major at the local scale and would result from increased levels in vehicle speed and traffic volume, which would further impede recreational use of that portion of the road corridor.

Alternative C would have more adverse impacts on recreation than Alternative A due to road enhancements provided for under this alternative.

Public Use
Limiting public use on the 0.8-mile northern portion gravel road to pedestrians, bicycles, and emergency vehicles only would have beneficial, long-term impacts on recreation due to declines in conflicting use patterns between non-motorized and motorized users. Impacts would be major at the local scale when compared to current conditions and would result in increased pedestrian safety and overall recreational use throughout the northern portion of the road corridor.

Alternative C would have more beneficial impacts on recreation than Alternative A due to public use management prescriptions provided for under the alternative.

Alternative D:

Implementation of Alternative D would have similar adverse and beneficial impacts as those described under Alternative C, except additional beneficial impacts would result from development of a pedestrian and bicycle trail along the southern portion of the road. Impacts would be major and would provide safe non-motorized recreation opportunities throughout the entire north-south length of the road corridor. The net effect of this alternative would be development of a trail network that links downtown Soldotna to Refuge headquarters and Sky View High School.

Alternative D would have more beneficial impacts on recreation than Alternative A due to public use management prescriptions provided for under this alternative.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of road enhancements and public use prescriptions that may potentially affect recreation. The impacts associated with these proposed activities are analyzed in the following text.

Road Maintenance and Enhancements
Conducting maintenance on the 0.8-mile northern portion graveled road would have similar adverse impacts on recreation as those described under Alternative A. Hard-surfacing the southern portion of the road and realigning its entrance to facilitate ingress and egress of vehicle traffic from and onto the Sterling Highway would have additional adverse, long-term impacts on recreation. Impacts would be major at the local scale and would result from increased levels in vehicle speed and traffic volume, which would further impede recreational use of that portion of the road corridor.

Alternative E would have more adverse impacts on recreation than Alternative A due to road enhancements provided for under this alternative.

Public Use
Limiting public use on the 0.8-mile northern portion gravel road to pedestrians, bicycles, and emergency vehicles only would have beneficial, long-term impacts on recreation due to declines in conflicting use patterns between non-motorized and motorized users. Impacts would be major at the local scale when compared to current conditions and would result in increased pedestrian safety and overall recreational use throughout the northern portion of the road corridor. Additional beneficial impacts would result from development of a pedestrian and bicycle trail along the southern portion of the road. Impacts would be major and would provide safe non-motorized recreation opportunities throughout the entire north-south length of

the road corridor. The net effect of this alternative would be development of a trail network that links downtown Soldotna to Refuge headquarters and Sky View High School.

Alternative E would have more beneficial impacts on recreation than Alternative A due to public use management prescriptions provided for under the alternative.

4.4.6 Sterling Highway Pullout

4.4.6.1 Physical Environment

Consequences of Implementing Sterling Highway Pullout Management Strategies on Soils

Indicators:

- Physical characteristics: compaction, soil permeability, water repellency
- Contaminates (e.g., antifreeze, fuel, oil)

Assumptions:

- Existing soil characteristics are of a degraded nature due to removal of vegetation, development of the informal rest stop, and ongoing vehicle use.
- The presence of permanent structures on the landscape degrades physical soil characteristics.
- Development of a formal rest stop would include (but not be limited to) paving the site.

Alternative A:

Implementation of Alternative A would have adverse, long-term impacts on soils due to soil compaction and contamination resulting from vehicle use of the informal rest stop. Impacts would be moderate at the site-specific scale when compared to natural soil conditions. Soil compaction, reduced permeability, increased water repellency, and reduced soil function would continue as a result of vehicle use. Soil contamination resulting from motor vehicle leaks would be expected.

Alternative B:

Implementation of Alternative B would have adverse, long-term impacts on soils due to soil compaction resulting from development of a formal rest stop. Impacts would be major at the site-specific scale when compared to natural soil conditions. Soil compaction and density would increase beyond current conditions, and soil permeability and function would cease to exist once the site is paved. Soil contamination resulting from motor vehicle leaks would be expected and would be more

concentrated as toxic runoff is directed to specific locations along the parameter of the formal rest stop.

Alternative B would have more adverse impacts on soils than Alternative A.

Alternative C:

Implementation of Alternative C would have similar adverse, long-term impacts on soils as those described under Alternative B.

Alternative C would have more adverse impacts on soils than Alternative A.

Alternative D:

Implementation of Alternative D would have similar adverse, long-term impacts on soils as those described under Alternative B.

Alternative D would have more adverse impacts on soils than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have adverse, long-term impacts on soils due to soil compaction resulting from development of a formal rest stop. Impacts would be major at the site-specific scale when compared to natural soil conditions. Soil compaction and density would increase beyond current conditions, and soil permeability and function would cease to exist once the site is paved. Soil contamination resulting from motor vehicle leaks would be expected and would be more concentrated as toxic runoff is directed to specific locations along the parameter of the formal rest stop.

Alternative E would have more adverse impacts on soils than Alternative A.

4.4.6.2 Human Environment

Consequences of Implementing Sterling Highway Pullout Management Strategies on Recreation Opportunity Settings

Indicators:

- Presence of human waste and litter
- Availability of public amenities

Assumptions:

- The majority of use is by commercial vehicles, though recreation vehicles occasionally use the site as well.
- Efforts to formalize the site would include paving and providing public use facilities (e.g., sanitary facilities, bear-proof waste containers, interpretive panels, etc.).

Alternative A:

Implementation of Alternative A would have adverse, long-term impacts on the existing vehicle-based recreation opportunity setting due to an increase in the presence of human waste and litter at the site. Impacts would be minor at the site-specific scale when compared to current conditions because although use of the Sterling Highway is expected to increase, the site would continue to be used primarily by commercial vehicles. Other use would continue to be limited because no public amenities would be offered.

Alternative B:

Implementation of Alternative B would have beneficial, long-term impacts on the existing vehicle-based recreation opportunity setting due to a decrease in the presence of human waste and litter and an increase in opportunities to learn about the Refuge, its resources, and the surrounding area once construction has completed. Impacts would be major at the site-specific scale when compared to current conditions because sanitary facilities and other public amenities (e.g., waste containers, interpretive panels, etc.) would be provided, and the site would be converted from undeveloped to a developed vehicle rest stop.

Alternative B would have more beneficial impacts on recreation than Alternative A.

Alternative C:

Implementation of Alternative C would have similar beneficial impacts on recreation as those described under Alternative B.

Alternative C would have more beneficial impacts on recreation than Alternative A.

Alternative D:

Implementation of Alternative D would have similar beneficial impacts on recreation as those described under Alternative B.

Alternative D would have more beneficial impacts on recreation than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have beneficial, long-term impacts on the existing vehicle-based recreation opportunity setting due to a decrease in the presence of human waste and litter and an increase in opportunities to learn about the Refuge, its resources, and the surrounding area once construction has completed. Impacts would be major at the site-specific scale when compared to current conditions because sanitary facilities and other public amenities (e.g., waste

containers, interpretive panels, etc.) would be provided, and the site would be converted from an undeveloped to a developed vehicle rest stop.

Alternative E would have more beneficial impacts on recreation than Alternative A.

4.4.7 Swanson River and Swan Lake Canoe Systems

General Assumptions:

- Current annual visitation has stabilized and would not increase substantially during the life of this Plan.
- Although public use occurs year-round, the majority of use occurs during the summer.
- The majority of public use would continue to occur at the first four or five lakes of the canoe systems.
- An adequate number of campsites would be available to accommodate use.
- Pioneering new campsites would not increase since most of the areas suitable for camping have already been established.

4.4.7.1 Physical Environment

Consequences of Implementing Canoe System Management Strategies on Soils

Indicators:

- Physical soil characteristics: compaction, soil permeability, water repellency

Alternative A (Current Management):

Implementation of Alternative A would have adverse, long-term impacts on soil resources due to public use prescriptions that facilitate use throughout the Swanson River and Swan Lake canoe systems. Impacts would be minor at site-specific locations when compared to current conditions because soil compaction, declining permeability, and increasing water repellency have led to various degrees of erosion and declines in soil function already due to public use along 17 miles of portage routes and at dispersed campsites. New or additional portages and/or dispersed campsites would not be established due to public use visitation stabilizing and a general lack of suitable terrain for such new facilities. The net result of Alternative A would be that current conditions would generally persist along portage routes and at campsites, though some additional minor impacts would be expected—particularly at canoe put-in and/or take-out locations if use occurs when lake levels are low and vessels are launched and/or landed from muddy shorelines.

Alternative B:

Implementation of Alternative B would have similar adverse impacts on soils as those described under Alternative A, except impacts could be substantially different depending on the results and related management actions derived from the stakeholder-driven Limits-of-Acceptable-Change (LAC) planning process. Under the LAC process, the goal would not be preventing any human-induced impact on soil resources but deciding how much impact would be acceptable and identifying management actions to implement in response to those impacts.

Alternative B could have more adverse or more beneficial impacts than Alternative A.

Alternative C:

Implementation of Alternative C would have similar adverse impacts on soils as those described under Alternative A, except beneficial, medium-term impacts would be expected due to management actions taken to encourage natural rehabilitation of selected sites (e.g., campsites). Impacts would be major at site-specific locations when and where management actions are implemented because public use of such sites would be limited, natural processes would be allowed to unfold, soil compaction would decline, soil permeability would increase, and water repellency would decline.

Alternative C would have more beneficial impacts on soil resources than Alternative A.

Alternative D:

Implementation of Alternative D would have similar adverse impacts on soils as those described under Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse impacts on soils as those described under Alternative A, except beneficial, medium-term impacts would be expected due to management actions taken to encourage natural rehabilitation of selected sites (e.g., campsites). Impacts would be major at site-specific locations when and where management actions are implemented because public use of such sites would be limited, natural processes would be allowed to unfold, soil compaction would decline, soil permeability would increase, and water repellency would decline.

Alternative E would have more beneficial impacts on soil resources than Alternative A.

Consequences of Implementing Canoe System Management Strategies on Water Quality

Indicators:

- Organic matter (e.g., sedimentation, food waste, human waste)
- Inorganic matter (i.e., litter)

Assumptions:

- Organic and inorganic matter affects water quality.
- Sediment loading results primarily from public use at canoe put-in and take-out locations.
- The intensity of water quality impacts due to sediment loading varies based on soil type, soil condition, the number of put-in and/or take-out events at any given site, and the amount of time between loading events.
- Food and human waste results primarily from public use at campsite locations.
- The intensity of water quality impacts due to food and human waste and litter varies based on the amount and type of organic and inorganic waste deposited.
- Under Alternative C, regulations would require appropriate disposal of solid human waste (e.g., cat-hole technique, human waste disposal kits, etc.).

Alternative A (Current Management):

Implementation of Alternative A would have adverse, short-term impacts on water quality due to public use prescriptions that facilitate use throughout Swanson River and Swan Lake canoe systems. The intensity of those impacts would vary due to a number of parameters (e.g., number and timing of vessel put-in and/or take-out events, amount and type of organic and inorganic waste deposited, etc.), but impacts would generally be expected to be negligible or minor at site-specific locations where organic and/or inorganic matter is deposited. Sediment loading occurs at specific locations on specific lakes due to low lake levels and vessels being launched and/or landed from/at shorelines where soils are deposited or stirred up from the lakebed. Food and/or human waste and litter enter the lake system primarily at campsite locations where visitors cook, clean cooking materials, and/or defecate along shorelines or directly into lakes. The deposition of organic and inorganic waste could potentially affect aquatic flora and fauna health, though these indirect effects are expected to be negligible due to the limited amount of use the area gets (particularly lakes deeper within the canoe systems) and the period of time it generally takes for organics to either settle out or be absorbed into the system before another deposition event occurs.

Alternative B:

Implementation of Alternative B would have similar adverse impacts on water quality as those described under Alternative A, except impacts could be substantially different depending on the results and related management actions derived from the stakeholder-driven Limits-of-Acceptable-Change (LAC) planning process. Under the LAC process, the goal would not be preventing any human-induced impact on water quality but deciding how much impact would be acceptable and identifying management actions to implement in response to those impacts.

Alternative B could have more adverse or more beneficial impacts than Alternative A.

Alternative C:

Implementation of Alternative C would have similar adverse impacts on water quality as those described under Alternative A, except less adverse, short-term impacts would be expected due to management action taken to require appropriate disposal of human waste. Impacts would be minor at site-specific locations because other organic and inorganic matter would continue to impact water quality even though solid human waste would be addressed.

Alternative C would have more beneficial impact on water quality than Alternative A due to development of regulations that would require appropriate disposal of human waste.

Alternative D:

Implementation of Alternative D would have similar adverse impacts on water quality as those described under Alternative A, except less adverse, short-term impacts would be expected due to management action taken to require use of outhouses at designated campsites. Impacts would be minor at site-specific locations because other organic and inorganic matter would continue to adversely affect water quality even though most of the impacts associated with human waste would be addressed.

Alternative D would have more beneficial impact on water quality than Alternative A due to required use of outhouses at designated campsites.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse impacts on water quality as those described under Alternative A, except less adverse, short-term impacts would be expected due to management action taken to require appropriate disposal of human waste. Impacts would be negligible at site-specific locations because other organic and inorganic matter would continue to adversely affect water quality even though solid human waste would be addressed.

Alternative E would have more beneficial impact on water quality than Alternative A due to development of regulations that would require appropriate disposal of human waste.

4.4.7.2 Biological Environment

Consequences of Implementing Canoe System Management Strategies on Vegetation

Indicators:

- Vegetation damage or loss
- Frequency of exotic and/or invasive species

Assumptions:

- Use of standing dead and living trees as firewood would increase because down and dead trees are no longer readily available after decades of campfire use in the area.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, short- to long-term impacts on vegetation due to public use prescriptions that facilitate use throughout the Swanson River and Swan Lake canoe systems. Impacts would be minor to major at site-specific locations due to vegetation trampling, damage, and mortality that occurs when canoes are portaged between lakes, vessels are launched and/or landed along lake shorelines, and when some visitor use activities occur at campsites (e.g., firewood collection, construction of amenities, carving into trees, etc.). Pedestrian traffic along 17 miles of portages and at dispersed campsites would provide a vector for the introduction and dispersal of exotic and/or invasive flora. At the local scale, adverse impacts would be negligible when compared to existing conditions because additional trails and campsites would not be pioneered, and larger scale vegetation loss would not occur; but campfire use in the area would increase the potential for accidental human-caused wildfires, which could have adverse and/or beneficial impacts on wildlife habitat depending on when and where the fire occurred, the intensity and size of the fire, and the actions taken to suppress it (if any).

Alternative B:

Implementation of Alternative B would have similar adverse impacts on vegetation as those described under Alternative A, except impacts could be substantially different depending on the results and related management actions derived from the stakeholder-driven Limits-of – Acceptable-Change (LAC) planning process. Under the LAC process, the goal would not be preventing any human-induced impact on vegetation but deciding how much impact would be acceptable and

identifying management actions to implement in response to those impacts.

Alternative B could have more adverse or beneficial impacts than Alternative A.

Alternative C:

Implementation of Alternative C would have similar adverse impacts on vegetation as those described under Alternative A, except beneficial, medium-term impacts would be expected due to management actions taken to encourage natural rehabilitation of selected sites (e.g., campsites). Impacts would be moderate at site-specific locations when and where management actions are implemented because public use of such sites would be limited, natural processes would be allowed to unfold, and vegetation would become reestablished.

Alternative C would have more beneficial impacts on vegetation than Alternative A.

Alternative D:

Implementation of Alternative D would have similar adverse impacts on vegetation as those described under Alternative A, except adverse impacts associated with public use of campsites would occur at designated campsites only. If some existing campsites were closed to public use as part of the management action, beneficial, long-term impacts of major intensity would be expected as vegetation damage and the frequency of exotic and/or invasive flora declines at those sites, and native vegetation becomes reestablished over time.

Alternative D would have more beneficial impacts on vegetation than Alternative A due to campsite management prescriptions.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse impacts on vegetation as those described under Alternative A, except beneficial, medium-term impacts would be expected due to management actions taken to encourage natural rehabilitation of selected sites (e.g., campsites). Impacts would be moderate at site-specific locations when and where management actions are implemented because public use of such sites would be limited, natural processes would be allowed to unfold, and vegetation would become reestablished over time.

Alternative E would have more beneficial impacts on vegetation than Alternative A.

Consequences of Implementing Canoe System Management Strategies on Wildlife

Indicators:

- Wildlife presence

Assumptions:

- Human activity causes disturbance to wildlife at varying degrees depending on the type of activity, timing of the activity, intensity of the activity, number of activities occurring simultaneously, and wildlife species affected.
- Disturbance-related impacts include direct mortality (immediate, on-site death), indirect mortality (eventual, premature death), lowered productivity (reduced fecundity or survival rate), reduced habitat use, and stress.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, short to long-term impacts on wildlife due to disturbance associated with public use of the Swanson River and Swan Lake canoe systems. Minor impacts would occur at the local scale because the majority of public use occurs only within the first four or five lakes of either canoe system. (The majority of the canoe systems do not receive intense levels of human use and wildlife are—for the most part—not affected even during the high public use season.) At the site-specific scale when and where human-wildlife encounters occur, impacts would be minor to major depending on a variety of parameters (e.g., type, timing, and intensity of an activity, wildlife species affected, etc.). In general, human-wildlife encounters along portages and canoe routes would result in a variety of disturbance-related impacts, particularly during the summer months when foot and boat traffic is more frequent. Impacts may include direct and indirect mortality, lowered productivity, reduced habitat use, and increased stress. Direct mortality of some wildlife would result from legal and illegal take of fish and wildlife, and lowered productivity rates would be expected of some wildlife—particularly waterbirds (e.g., loons, trumpeter swans, etc.). Impacts associated with frequent boat traffic and associated nesting waterbird disturbance may result in egg cooling/mortality, nest abandonment, or both. Impacts also would be expected during the “off” and “shoulder” seasons. Although the number of human-wildlife encounters would be much less than that observed during the high public use season, such encounters could potentially be more damaging due to the level of nutritional stress some individual wildlife face during winter months.

Alternative B:

Implementation of Alternative B would have similar adverse impacts on wildlife as those described under Alternative A, except impacts could be substantially different depending on the results and related management actions derived from the stakeholder-driven Limits-of-Acceptable-Change (LAC) planning process. Under the LAC process, the goal would not be preventing any human-induced impact on wildlife but deciding how much impact would be acceptable and identifying management actions to implement in response to those impacts.

Alternative B could have more adverse or more beneficial impacts than Alternative A.

Alternative C:

Implementation of Alternative C would have similar adverse impacts on wildlife as those described under Alternative A, except beneficial, long-term impacts would be expected due to management actions taken to encourage natural rehabilitation of selected sites (e.g., campsites). Impacts would be minor at site-specific locations when and where management actions are implemented because natural processes would be allowed to unfold, vegetation would become reestablished over time, and wildlife would be able to use those areas without human disturbance.

Alternative C would have more beneficial impacts on wildlife than Alternative A.

Alternative D:

Implementation of Alternative D would have similar adverse impacts on wildlife as those described under Alternative A, except adverse impacts associated with public use of campsites would occur at designated campsites only. If some existing campsites were closed to public use as part of the management action, beneficial, long-term impacts of minor intensity would be expected as vegetation becomes reestablished, and wildlife uses those areas without human disturbance.

Alternative D would have more beneficial impacts on wildlife than Alternative A due to campsite management prescriptions.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse impacts on wildlife as those described under Alternative A, except beneficial, long-term impacts would be expected due to management actions taken to encourage natural rehabilitation of selected sites (e.g., campsites). Impacts would be minor at site-specific locations when and where management actions are implemented because natural processes would be allowed to unfold, vegetation would become reestablished, and wildlife would be able to use those areas without human disturbance.

Alternative E would have more beneficial impacts on wildlife than Alternative A.

4.4.7.3 Human Environment

Consequences of Implementing Canoe System Management Strategies on Recreation

Indicators:

- Recreation access
- Recreation opportunity setting classification

Assumptions:

- Under Alternative C, regulations would require appropriate disposal of solid human waste (e.g., cat-hole technique, human waste disposal kits, etc.).
- Recreation opportunity settings are defined as discrete combinations of physical, biological, social, and managerial conditions that facilitate particular kinds of recreation experiences. Opportunity settings can be inventoried and arrayed along a continuum from wilderness (no roads, limited facilities, dispersed use, and little management presence) to urban-industrial (paved roads, extensive development, dense use, obvious management presence).

Alternative A (Current Management):

Implementation of Alternative A would have beneficial, long-term impacts on recreation due to public use prescriptions that facilitate use throughout the Swanson River and Swan Lake canoe systems. Impacts would be negligible at the local scale because recreation access and opportunity settings would not change from current conditions for the foreseeable future as a result of implementing the alternative. Registered visitors would be free to visit, travel, and/or camp where and when they choose for up to 14 days at a time. Summer visitors would experience periodic, localized crowding at popular campsites and on holiday weekends, particularly on the first four or five lakes of either canoe system. Mechanized access would continue to be prohibited, and the area would continue to be a primitive opportunity setting. Management presence would be low, encounters with other visitors would be seasonally likely, public use facilities would largely be absent, and natural processes would dominate.

Alternative B:

Implementation of Alternative B would have similar beneficial impacts on recreation as those described under Alternative A, except impacts could be substantially different depending on the results and related management actions derived from the stakeholder-driven Limits-of-

Acceptable-Change (LAC) planning process. Under the LAC process, the goal would not be preventing any human-induced impact on access or the recreation opportunity setting but deciding how much impact would be acceptable and identifying management actions to implement in response to those impacts.

Alternative B could have more beneficial or adverse impacts than Alternative A.

Alternative C:

Implementation of Alternative C would have similar beneficial impacts on recreation as those described under Alternative A, except additional beneficial, long-term impacts would be expected as a result of management actions taken to allow natural rehabilitation of select campsites. Impacts would be minor at the local scale resulting from improvements to the natural condition of the canoe systems—an important feature of the area's current recreation opportunity setting—most of which is designated as Wilderness. Conversely, adverse, medium-term impacts would be expected on recreation access as a result of management actions taken to temporarily close select campsites. Impacts would be minor at the local scale as some visitors would periodically be prevented from camping in their first-choice location to allow for natural rehabilitation of those sites.

Alternative C would have more beneficial and some adverse impacts on recreation than Alternative A as a result of campsite management prescriptions.

Alternative D:

Implementation of Alternative D would have adverse, long-term impacts on recreation access due to implementation of a reservation system and designated campsite requirements. Impacts would be moderate at the local scale with more impacts occurring during high public use periods when choice of campsites would be most limited. Visitors would not be denied access to the canoe systems, but some would choose not to visit the area if unable to camp where they prefer. Conversely, implementation of the alternative would have both beneficial and adverse impacts on the recreation opportunity setting. Beneficial, long-term impacts would be expected from management actions taken to designate campsites and improve disposal of human waste. Impacts would be minor at the local scale resulting from improvements to the natural condition of the canoe systems—an important feature of the current recreation opportunity setting—most of which is designated as Wilderness. At the same time, constructing outhouses and substantially increasing management presence through a reservation system and designated campsites would move the recreation setting toward the more developed end of the opportunity spectrum.

Alternative D would have some beneficial and more adverse impacts on recreation than Alternative A as a result of public use and campsite management prescriptions.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar beneficial impacts on recreation as those described under Alternative A, except additional beneficial, long-term impacts would be expected as a result of management actions taken to allow natural rehabilitation of select campsites. Impacts would be minor at the local scale and would result from improvements to the natural condition of the canoe systems—an important feature of the area's current recreation opportunity setting—most of which is designated as Wilderness. Conversely, adverse, medium-term impacts would be expected on recreation access as a result of management actions taken to temporarily close select campsites. Impacts would be minor at the local scale as some visitors would periodically be prevented from camping in their first-choice location to allow for natural rehabilitation of those sites.

Alternative E would have more beneficial and some adverse impacts on recreation than Alternative A as a result of campsite management prescriptions.

Consequences of Implementing Canoe System Management Strategies on Wilderness Values

Indicators:

- Untrammeled condition (i.e., free of intentional human manipulation)
- Opportunities for solitude
- Opportunities for primitive and unconfined types of recreation

Assumptions:

- The Swanson River and Swan Lake canoe systems are entirely within the Kenai Wilderness area.
- Appropriate disposal of human waste would include the use of facilities either in the form of dump stations at accessible locations outside the Wilderness Area to support a pack-out program or the use of outhouses.

Alternative A (Current Management):

Implementation of Alternative A would have both beneficial and adverse, long-term impacts on wilderness values due to management prescriptions that facilitate public use of the Swanson River and Swan Lake canoe systems. Beneficial impacts on opportunities for solitude or primitive and unconfined recreation would be negligible at the local scale because visitation levels, recreation access, and the recreation

opportunity setting would not change from current conditions for the foreseeable future as a result of implementing the alternative. Although some summer visitors would experience periodic, localized crowding on the first four or five lakes of the canoe system at trailheads, along portages, and at popular campsites—particularly on holiday weekends—management actions taken to prohibit motorized use throughout the canoe systems would provide opportunities for solitude and/or primitive, unconfined types of recreation throughout most of the system. Such opportunities would be greatest farther from trailheads in more remote portions of the canoe systems where visitors would be isolated from others, and dependence on wilderness skills and abilities would be of paramount importance to ensure safety and survival. Conversely, adverse, long-term impacts on the untrammeled condition or naturalness of the area due to continued public use of the area would be expected. Impacts would be moderate at the local scale and would result from increasing soil compaction and erosion, vegetation damage and loss, improper disposal of human waste, and construction of public use amenities along portages, lakeshores, and at campsites. Declines in water quality at specific sites and wildlife avoidance during periods of high public use would also be expected and provide evidence of previous human use in the area.

Alternative B:

Implementation of Alternative B would have similar beneficial and adverse impacts on wilderness values as those described under Alternative A, except impacts could be substantially different depending on the results and related management actions derived from the stakeholder-driven Limits-of–Acceptable-Change (LAC) planning process. Under the LAC process, the goal would not be preventing any human-induced impact on wilderness values, but deciding how much impact would be acceptable and identifying management actions to implement in response to those impacts.

Alternative B could have more beneficial and/or more adverse impacts than Alternative A.

Alternative C:

Implementation of Alternative C would have similar beneficial and adverse impacts on wilderness values as those described under Alternative A, except additional beneficial and adverse, long-term impacts would be expected as a result of closing select campsites to allow for natural rehabilitation. Adverse impacts would be expected on the unconfined nature of the recreation experience. Impacts would be minor at the local scale and would result from visitors that are less able to independently plan and choose where they would like to camp during their trip. Conversely, beneficial impacts on the untrammeled condition or naturalness of the area would be minor to moderate depending on the scale of management actions undertaken to rehabilitate affected

campsites. Removing the source of adverse impacts (i.e., visitors) and providing the time necessary for soils to recover and vegetation to become reestablished would result in a setting that is more natural appearing with less evidence of other users. Additional beneficial impacts on the untrammeled condition or naturalness of the area would be expected due to management actions taken to require appropriate disposal of human waste. Impacts would be moderate at the site-specific scale, particularly in the vicinity of campsites, where most incidences of solid waste occur.

Alternative C would have more beneficial and some more adverse impacts on wilderness values than Alternative A due to public use and campsite management prescriptions proposed by the alternative.

Alternative D:

Implementation of Alternative D would have similar beneficial and adverse, long-term impacts on wilderness values as those described under Alternative C, except additional adverse impacts on the untrammeled condition or naturalness of the area and primitive and/or unconfined types of recreation would result due to public use and campsite management prescriptions. Impacts would be major at the local scale resulting from implementation of a reservation and designated campsite system that would confine visitors to a limited number of options when planning their trip and few options for independent, free movement throughout the canoe systems. Additional major impacts would occur at the site-specific scale as permanent outhouses are constructed on the landscape. Such structures would provide a constant reminder to visitors of the presence and influence of others in the area. The net result of Alternative D would be a highly structured and semi-developed wilderness experience with few opportunities for free, independent recreation opportunities where visitors make choices about where to camp during their trip.

Alternative D would have more beneficial and more adverse impacts on wilderness values than Alternative A due to public use and campsite management prescriptions proposed by the alternative.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar beneficial and adverse impacts on wilderness values as those described under Alternative A, except additional beneficial and adverse, long-term impacts would be expected as a result of closing select campsites to allow for natural rehabilitation. Adverse impacts would be expected on the unconfined nature of the recreation experience. Impacts would be minor at the local scale and would result from visitors that are less able to independently plan and choose where they would like to camp during their trip. Conversely, beneficial impacts on the untrammeled condition or naturalness of the area would be minor to moderate depending on

the scale of management actions undertaken to rehabilitate affected campsites. Removing the source of adverse impacts (i.e., visitors) and providing the time necessary for soils to recover and vegetation to become reestablished would result in a setting that is more natural appearing with less evidence of other users. Additional beneficial impacts on the untrammeled condition or naturalness of the area would be expected due to management actions taken to require appropriate disposal of human waste. Impacts would be moderate at the site-specific scale, particularly in the vicinity of campsites where most incidences of solid waste occur.

Alternative E would have more beneficial and some more adverse impacts on wilderness values than Alternative A due to public use and campsite management prescriptions proposed by the alternative.

4.4.8 Upper Kenai River (Russian River to Skilak Lake)

General Assumptions:

- Sportfishing season is 84 days (12 weeks) in length.
- Recreation use of the upper Kenai River will increase 2.3 percent per year.
- A recreation "use day" is equivalent to one visitor.
- On the river, 78 guides would operate (20 guides permitted by the Refuge, 58 guided permitted by the State).
- Only 58 guides (78 State licensed guides minus 20 Refuge permitted guides) are eligible for upper Kenai River incidental permits.
- Each boat would contain no more than five people.
- Changes in Refuge visitation equate to changes in visitation for the Kenai Peninsula (Peninsula).

4.4.8.1 Human Environment

Consequences of Implementing Upper Kenai River Management Strategies on Cultural Resources

Indicators:

- Disturbance of documented or undocumented cultural sites and associated resources

Assumptions:

- Although many cultural sites have been documented by archaeologists and/or Refuge staff, many "yet to be discovered" sites exist within the boundaries of the Refuge.
- Newly discovered sites would be documented by archaeologists and appropriate actions taken to protect and/or preserve artifacts.

- The majority of public use currently occurs within 100 yards of the river or within the zone of many documented and yet to be discovered cultural sites.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, long-term impacts on cultural resources due to public use along the upper Kenai River. Unlike many adverse impacts that increase incrementally with increased public use, impacts to the value of cultural sites and associated resources can occur in a single event. As such, impacts would be negligible to major at the site-specific scale depending on the actions of anglers, trail users, and campers that knowingly or unknowingly pass through cultural sites. Impacts would largely be negligible if visitors pass through cultural sites without incident or disturbance to cultural resources, but impacts would be major if resources are damaged or artifacts are removed from the site. Public use patterns are not anticipated to change under the alternative, and current resource conditions would likely persist into the foreseeable future. Consequently, public use would present little potential for disturbance or damage to yet to be discovered cultural sites.

Alternative B:

Implementation of Alternative B would have adverse impacts on cultural resources similar to those described under Alternative A, except additional long-term impacts would be expected due to management actions taken to restrict camping within 100 yards of the river to a single 24-hour period. Impacts would be negligible to major at site-specific locations if, when, and where visitors camp 100 yards or farther from the river. New trails would be cut from the river's edge at various locations in efforts to establish campsites farther from the river; and in the process, unknown or undocumented cultural sites would be encountered. As a result, the total number of campsites, trails, cat-hole toilets, and other groundbreaking activities that could potentially affect cultural resources would increase and would be dispersed over a larger area. Because the distribution, density, and type of cultural sites located 100 yards or more from the river are unknown, it is difficult to predict what the intensity of these impacts would be. However, based on what is known about other areas (i.e., sites near the mouth of the Russian River), the likelihood of adverse impacts occurring is high. Conversely, once new campsites and trails are established 100 yards from the river, few additional areas would be affected by the action.

Alternative B would have more adverse impacts on cultural resources than Alternative A due to campsite management prescriptions proposed under the alternative.

Alternative C:

Implementation of Alternative C would have similar adverse impacts as those described under Alternative B, except long-term impacts would be more intense and would occur at a larger number of locations due to management prescriptions that prohibit *all* camping within 100 yards of the river. More campsites, trails, cat-hole toilets, and other groundbreaking activities would be expected farther from the river than that occurring under Alternative B.

Alternative C would have more adverse impacts on cultural resources than Alternative A due to campsite management prescriptions proposed under the alternative.

Alternative D:

Implementation of Alternative D would have similar adverse impacts as those described under Alternative B.

Alternative D would have more adverse impacts on cultural resources than Alternative A due to campsite management prescriptions proposed under the alternative.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse impacts as those described under Alternative B, except long-term impacts would be more intense and would occur at a larger number of locations due to management prescriptions that prohibit *all* camping within 100 yards of the river. More campsites, trails, cat-hole toilets, and other groundbreaking activities would be expected farther from the river than that occurring under Alternative B.

Alternative E would have more adverse impacts on cultural resources than Alternative A due to campsite management prescriptions proposed under the alternative.

Consequences of Implementing Upper Kenai River Management Strategies on Local Economy

Indicators:

- Number of jobs in the local economy
- Dollars contributed to the local economy

Assumptions:

- The amount spent by anglers and the value of services will remain constant regardless of the number of river users or the level of crowding.

Alternative A (Current Management):

Implementation of Alternative A would consist of non-guided and guided use management prescriptions that could potentially have impacts on the local economy. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Management prescriptions that allow non-guided use along the upper Kenai River without restriction would have beneficial, long-term impacts on the local economy. Impacts would be major at the local scale when compared to current conditions due to an increase in the number of jobs created to provide services to such users. Unpublished data from the U.S. Fish and Wildlife Service Kenai Field Office suggest a 235 percent increase in non-guided boater activity from 1994 to 2004. Similar increases would be expected during the life of the Plan until crowding and/or other social and/or environmental pressures diminish the recreation experience.

Communities would respond to an annual increase in use by providing a range of services required by non-guided sportfishing users (e.g., food, lodging, equipment, etc.). Financial assets would be obtained and ultimately circulated throughout the local economy by businesses and employees of those businesses.

Guided Sportfishing
Management prescriptions limiting guided sportfishing permits to 20 would have beneficial, long-term impacts on the local economy. Impacts would be major at the local scale when compared to current conditions due to an increase in the number of jobs created to provide services and dollars generated by local businesses providing such services. Annual reports required from guides indicate 8,020 user days occurred on the upper Kenai River in 2004. Using the maximum possible number of clients per drift boat as a gauge to measure use (i.e., 1,200 clients per week), a 75 percent increase would be expected over the life of the Plan under this alternative.

Local businesses (i.e., permittees and others) would respond to this increase by providing services required by guided sportfishing users, financial assets would be obtained, and the local economy would benefit through circulation of assets.

Alternative B:

Implementation of Alternative B would consist of guided use management prescriptions that could potentially have impacts on the local economy. The impacts associated with these proposed activities are analyzed in the following text.

Guided Sportfishing
Management prescriptions limiting the timing and starts of guided sportfishing boats would have similar beneficial impacts on the local economy as those described under Alternative A, except impacts would be less under Alternative B due to such actions. The intensity of the impacts would vary depending on the details of the prescription; but in general, if boat starts are more evenly distributed, guides would be less able to concentrate operations during periods of peak demand. If and when guides operating on other sections of the river are able to meet demand on the upper Kenai River, impacts would be negligible.

Financial losses may be offset if clients are more willing to pay higher fees for the opportunity to fish on the river with less boat fishing competition or when catch rates are higher relative to the rest of the river.

Alternative B would have less beneficial impacts on the local economy than Alternative A due to guided sportfishing prescriptions taken to limit the timing and start of boats.

Alternative C:

Implementation of Alternative C would consist of guided use management prescriptions that could potentially have impacts on the local economy. The impacts associated with these proposed activities are analyzed in the following text.

Guided Sportfishing
Management prescriptions that reduce guided sportfishing permits through attrition to 18 would have similar beneficial impacts on the local economy as those described under Alternative A, except impacts would be less under Alternative C due to such actions. The action would allow market forces to determine if and when guided opportunities would be reduced.

Alternative C would have less beneficial impacts on the local economy than Alternative A.

Alternative D:

Implementation of Alternative D would consist of non-guided and guided use management prescriptions that could potentially have impacts on the local economy. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Management prescriptions establishing a limited permit program for non-guided use would have adverse, long-term impacts on the local economy. The intensity of the impacts would vary depending on the details of the permit program, which would be determined through a public rulemaking process. In general, efforts taken to limit visitation at

current or projected use levels would have negligible impacts on the number of jobs created and dollars generated at the local scale because current conditions would not change during the life of the Plan. If management actions cap visitation below current use levels, impacts would be major and would result from declines in services provided, financial assets obtained, and monies circulated in the economy.

Alternative D would have more adverse impacts on the local economy when compared to Alternative A as a result of limiting non-guided use.

Guided Sportfishing
Management prescriptions that reduce the number of guided sportfishing permits through attrition to 15 would have similar beneficial impacts on the local economy as those described under Alternative A, except impacts would be less under Alternative D due to such actions. The action would allow market forces to determine if and when guided opportunities would be reduced.

Alternative D would have less beneficial impacts on the local economy than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of guided use management prescriptions that could potentially have impacts on the local economy. The impacts associated with these proposed activities are analyzed in the following text.

Guided Sportfishing
Management prescriptions that reduce guided sportfishing permits through attrition to 18 would have similar beneficial impacts on the local economy as those described under Alternative A, except impacts would be less under Alternative E due to such actions. The action would allow market forces to determine if and when guided opportunities would be reduced.

Alternative E would have less beneficial impacts on the local economy than Alternative A.

Consequences of Implementing Upper Kenai River Management Strategies on Recreation Activities

Indicators:

- Non-guided and guided sportfishing access and use
- Overnight camping access and use
- Recreation opportunity setting classification

Assumptions:

- Recreation opportunity settings are defined as discrete combinations of physical, biological, social, and managerial

conditions that facilitate particular kinds of recreation experiences. Opportunity settings can be inventoried and arrayed along a continuum from wilderness (no roads, limited facilities, dispersed use, and little management presence) to urban-industrial (paved roads, extensive development, dense use, obvious management presence).

Alternative A (Current Management):

Implementation of Alternative A would consist of non-guided and guided use management prescriptions that could potentially have impacts on recreation. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing

Management prescriptions allowing non-guided use along the upper Kenai River without restrictions would have beneficial and adverse, long-term impacts on recreation. Beneficial impacts would be major at the local scale when compared to current conditions because recreation use would be allowed to increase over time. Unpublished data from the U.S. Fish and Wildlife Service Kenai Field Office suggest a 235 percent increase in non-guided boater activity from 1994 to 2004. Similar increases would be expected during the life of the Plan until crowding and/or other social and/or environmental pressures diminish the recreation experience. As a result, adverse, long-term impacts would be expected as continued growth of non-guided use would have moderate to major impacts on the upper Kenai River recreation opportunity setting. Research conducted by the Alaska Department of Natural Resources in 1993 showed that the upper river was extremely crowed during peak fishing seasons and use has increased substantially since that time. Continued, unchecked growth in visitor use would likely result in even more crowded conditions, increased visitor conflict, and related increases in law enforcement presence.

These changes in combination would produce a setting that—despite limited developments in the river corridor—would result in something closer to the urban rather than the primitive end of the opportunity spectrum.

Guided Sportfishing

Management prescriptions limiting guided sportfishing permits to 20 would have beneficial and adverse, long-term impacts on recreation. Beneficial impacts would be major at the local scale when compared to current conditions because allocations specified in guided sportfishing permits would allow visitor use to increase at projected rates during the life of the Plan. Annual reports required from guides indicate 8,020 user days occurred on the upper Kenai River in 2004. Using the maximum possible number of clients per drift boat as a gauge to

measure use (i.e., 1,200 clients per week), a 75 percent increase would be expected over the life of the Plan under this alternative.

Adverse impacts similar to those of a non-guided sportfishing on the recreation opportunity setting would be expected as a result of increasing visitor use as those described previously (see *Non-Guided Sportfishing*).

Alternative B:
Implementation of Alternative B would consist of guided use management prescriptions that could potentially have impacts on recreation. The impacts associated with these proposed activities are analyzed in the following text.

Guided Sportfishing
Management prescriptions limiting the timing of guided sportfishing starts would have similar beneficial and adverse, long-term impacts on recreation as those described under Alternative A, except beneficial impacts would be less under Alternative B due to actions that affect recreation access. The intensity of the impacts would vary depending on the details of the prescription; but in general, management actions taken to limit the timing of sportfishing boats so that starts are more evenly distributed would have adverse impacts on recreation access. Conversely, more beneficial impacts on the recreation opportunity setting would be expected as a result of the management action because the potential for crowding along the river due to guided use would be reduced.

Alternative B would have less beneficial impacts on recreation access and more beneficial impacts on the recreation opportunity setting than Alternative A.

Alternative C:

Implementation of Alternative C would consist of guided use management prescriptions that could potentially have impacts on recreation. The impacts associated with these proposed activities are analyzed in the following text.

Guided Sportfishing
Management prescriptions that reduce guided sportfishing permits through attrition to 18 would have similar beneficial and adverse impacts on recreation as those described under Alternative A, except beneficial impacts would be less under Alternative C due to such actions. Adverse impacts on recreation access and use would be expected. The action would likely have the effect of slowing the growth of visitor use rather than reducing the current amount of use. Conversely, more beneficial impacts on the recreation opportunity setting would be expected as a result of the management action because

the potential for slowing the rate of crowding due to guided use would be greater.

Alternative C would have less beneficial impacts on recreation access and more beneficial impacts on the recreation opportunity than Alternative A.

Alternative D:

Implementation of Alternative D would consist of non-guided and guided use management prescriptions that could potentially have impacts on recreation. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Management prescriptions establishing a limited permit program for non-guided use would have beneficial and adverse, long-term impacts on recreation. The intensity of the impacts would vary depending on the details of the permit program, which would be determined through a public rulemaking process. In general, efforts taken to limit visitation at current or projected use levels would have negligible impacts on recreation access and the recreation opportunity setting because future conditions would not change much from current conditions. If management actions cap visitation below current use levels, adverse impacts to recreation access and beneficial impacts to the recreation opportunity setting would be major.

Alternative D would have more adverse impacts on recreation access and more beneficial impacts on the recreation opportunity setting when compared to Alternative A as a result of limiting non-guided use.

Guided Sportfishing
Management prescriptions that reduce the number of guided sportfishing permits through attrition to 15 would have similar beneficial and adverse, long-term impacts as those described under Alternative C, except beneficial impacts would be less under Alternative D due to actions that would further reduce recreation access and use. Conversely, more beneficial impacts on the recreation opportunity setting would be expected as a result of the management action because the potential for crowding along the river due to guided use would be reduced.

Alternative D would have less beneficial impacts on recreation access and more beneficial impacts on the recreation opportunity setting than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of guided use management prescriptions that could potentially have impacts on

recreation. The impacts associated with these proposed activities are analyzed in the following text.

Guided Sportfishing
Management prescriptions that reduce guided sportfishing permits through attrition to 18 would have similar beneficial and adverse impacts on recreation as those described under Alternative A, except beneficial impacts would be less under Alternative E due to such actions. Adverse impacts on recreation access and use would be expected. The action would likely have the effect of slowing the growth of visitor use rather than reducing the current amount of use. Conversely, more beneficial impacts on the recreation opportunity setting would be expected as a result of the management action because the potential for slowing the rate of crowding due to guided use would be greater.

Alternative E would have less beneficial impacts on recreation access and more beneficial impacts on the recreation opportunity than Alternative A.

4.4.9 Middle Kenai River (Skilak Lake Downstream to Refuge Boundary)

General Assumptions:

- The sportfishing season is 84 days (12 weeks) in length.
- Although sportfishing between Skilak Lake and the Moose River has been stable or slightly declining for the past 15 years—average annual visitation was 46,024 angler days from 1986 to 1995 compared to 38,085 from 1996 to 2005—overall recreation use of the middle Kenai River is expected to increase 1.3 percent per year.
- A recreation "use day" is equivalent to one visitor.
- As of 2008, 353 sportfishing guides were licensed to operate on the Kenai River. All of them are eligible for commercial sportfishing permits on the middle Kenai River within the Refuge. As of 2008, 114 sportfishing were guides permitted by the Refuge to use the lower Skilak boat launch and operate on the middle Kenai River.
- Each boat would contain no more than five people.
- Changes in Refuge visitation equate to changes in visitation for the Kenai Peninsula.

4.4.9.1 Human Environment

Consequences of Implementing Middle Kenai River Management Strategies on the Local Economy

Indicators:

- Number of jobs in the local economy
- Dollars contributed to the local economy

Assumptions:

- The amount spent by anglers and the value of services will remain constant regardless of the number of river users or the level of crowding.

Alternative A (Current Management):

Implementation of Alternative A would consist of non-guided and guided use management prescriptions that could potentially have impacts on the local economy. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Management prescriptions that allow non-guided use along the middle Kenai River without restriction would have beneficial, long-term impacts on the local economy. Impacts would be major at the local scale when compared to current conditions due to an increase in the number of jobs created to provide services to such users. Communities would respond to an annual increase in use by providing a range of services required by non-guided users (e.g., food, lodging, equipment, etc.). As a result, financial assets would be obtained and ultimately circulated throughout the local economy by businesses and employees of those businesses.

Guided Sportfishing
Management prescriptions that allow guided sportfishing use along the middle Kenai River without restriction would have beneficial, long-term impacts on the local economy. Impacts would be major at the local scale when compared to current conditions due to an increase in the number of jobs created to provide services to such users. Permits would continue to be required for all commercial operators, but the number of permits and the amount of use allowed within each permit would continue to be unrestricted. As a result, financial assets would be obtained and ultimately circulated throughout the local economy by businesses and employees of those businesses.

Alternative B:

Implementation of Alternative B would consist of non-guided use management prescriptions that could potentially have impacts on the

local economy. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Implementation of Alternative B would have similar beneficial, long-term impacts on the local economy as those described under Alternative A.

Guided Sportfishing
Implementation of Alternative B would have similar beneficial, long-term impacts on the local economy as those described under Alternative A. If the State Department of Natural Resources takes action to limit guides on the middle River, the Refuge would then evaluate the need for a Refuge-specific permitting process similar to the system used on the upper Kenai River. If implemented, such a permitting process would have impacts on guided access and use, and the local economy, but it is not possible to predict the type or intensity of those impacts at this time.

Alternative C:

Implementation of Alternative C would consist of non-guided and guided use management prescriptions that could potentially have impacts on the local economy. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Implementation of Alternative C would have similar beneficial, long-term impacts on the local economy as those described under Alternative A.

Guided Sportfishing
Management prescriptions that limit the number of guided sportfishing permits would have beneficial, long-term impacts on the local economy. Although the action would limit the number of sportfishing permits to 114 (i.e., the existing number of permittees), impacts would be major at the local scale when compared to current conditions because such limitations would not affect recreation access or use because the existing number of permits would far exceed current and predicted future demand for guided fishing, communities would respond to an annual increase in use by providing a range of services required by guided users, and jobs would be created. As a result, financial assets would be obtained and ultimately circulated throughout the local economy by businesses and employees of those businesses.

As a result, Alternative C would have similar beneficial impacts on the local economy as Alternative A.

Alternative D:

Implementation of Alternative D would consist of non-guided and guided use management prescriptions that could potentially have impacts on the local economy. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Management prescriptions that establish a limited permitting program for non-guided use would have adverse, long-term impacts on the local economy. The intensity of the impacts would vary depending on the details of the permitting program, which would be determined through a public rulemaking process. In general, efforts taken to limit visitation at current or projected use levels would have negligible impacts on the number of jobs created and dollars generated at the local scale because current conditions would not change during the life of the Plan. If management actions cap visitation below current use levels, impacts would be major resulting from declines in services provided, financial assets obtained, and monies circulated in the economy. Alternative D would have more adverse impacts on the local economy when compared to Alternative A as a result of limiting non-guided use.

Guided Sportfishing
Management prescriptions that limit the number of guided sportfishing permits to 20 through a competitive selection process would have similar beneficial impacts on the local economy as those described under Alternative A, except impacts would be less under Alternative D due to such actions. The action would evenly distribute guided trips throughout the week in a manner similar to permits for the upper Kenai River and would primarily affect the amount of guided use occurring at any given time. While the total amount and timing of guided use would be restricted, opportunities would continue to exceed current and anticipated demand during the life of this Plan.

Alternative D would have less beneficial impacts on the local economy than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of non-guided and guided use management prescriptions that could potentially have impacts on the local economy. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Implementation of Alternative E would have similar beneficial, long-term impacts on the local economy as those described under Alternative A.

Guided Sportfishing
Management prescriptions that limit the number of guided sportfishing permits would have beneficial, long-term impacts on the local economy. Although the action would limit the number of sportfishing permits to 114 (i.e., the existing number of permittees), impacts would be major at the local scale when compared to current conditions. Such limitations would not affect recreation access or use because the existing number of permits would far exceed current and predicted future demand for guided fishing, communities would respond to an annual increase in use by providing a range of services required by guided users, and jobs would be created. As a result, financial assets would be obtained and ultimately circulated throughout the local economy by businesses and employees of those businesses.

As a result, Alternative E would have similar beneficial impacts on the local economy as Alternative A.

Consequences of Implementing Middle Kenai River Management Strategies on Recreation

Indicators:

- Non-guided and guided sportfishing trip recreation access and use
- Overnight camping recreation access and use
- Recreation opportunity setting classification

Assumptions:

- Guided use allocations under all alternatives would be sufficient to meet projected recreation demand for the life of the Plan.
- Recreation opportunity settings are defined as discrete combinations of physical, biological, social, and managerial conditions that facilitate particular kinds of recreation experiences. Opportunity settings can be inventoried and arrayed along a continuum from wilderness (no roads, limited facilities, dispersed use, and little management presence) to urban-industrial (paved roads, extensive development, dense use, obvious management presence).

Alternative A (Current Management):

Implementation of Alternative A would consist of non-guided and guided use management prescriptions that could potentially have impacts on recreation. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Management prescriptions that allow non-guided use along the middle Kenai River without restrictions would have beneficial and adverse,

long-term impacts on recreation. Beneficial impacts would be moderate at the local scale when compared to current conditions because recreation use would be allowed to increase. As a result, adverse, long-term impacts would be expected as continued growth of non-guided use would have moderate impacts on the middle Kenai River recreation opportunity setting. Continued, unchecked growth in visitor use would likely result in even more crowded conditions, increased visitor conflict, and related increases in law enforcement presence. Seasonally heavy use and localized crowded conditions would persist and increase slightly each year. Over the life of the Plan, overall use and evidence of use would likely increase enough to cause a minor shift toward the more developed end of the recreation opportunity spectrum.

Guided Sportfishing
Management prescriptions that allow guided sportfishing use along the middle Kenai River without restrictions would have beneficial and adverse, long-term impacts on recreation. Beneficial impacts would be moderate at the local scale when compared to current conditions because recreation use would be allowed to increase over time. As a result, adverse, long-term impacts would be expected as continued growth of guided use would have moderate impacts on the middle Kenai River recreation opportunity setting. Continued, unchecked growth in visitor use would likely result in even more crowded conditions, increased visitor conflict, and related increases in law enforcement presence. Seasonally heavy use and localized crowded conditions would persist and increase slightly each year. Over the life of the Plan, overall use and evidence of use would likely increase enough to cause a minor shift toward the more developed end of the recreation opportunity spectrum.

Alternative B:

Implementation of Alternative B would consist of non-guided use management prescriptions that could potentially have impacts on recreation. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Implementation of Alternative B would have similar beneficial, long-term impacts on recreation as those described under Alternative A.

Guided Use
Implementation of Alternative B would have similar beneficial, long-term impacts on recreation as those described under Alternative A. If the State Department of Natural Resources takes action to limit guides on the middle Kenai River, the Refuge would then evaluate the need for a Refuge-specific permitting process similar to the system used on the upper Kenai River. If implemented, such a permitting process would have impacts on recreation access and use and the recreation

opportunity setting, but it is not possible to predict the type or intensity of those impacts at this time.

Alternative C:

Implementation of Alternative C would consist of non-guided and guided use management prescriptions that could potentially have impacts on recreation. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Implementation of Alternative C would have similar beneficial, long-term impacts on recreation as those described under Alternative A. A future step-down plan, if completed and implemented in a timely manner, could affect recreation access and use, and the recreation opportunity setting; however, there is not yet any basis for assessing those potential impacts.

Guided Sportfishing
Management prescriptions that limit the number of guided sportfishing permits to the number of existing permittees would have beneficial, long-term impacts on recreation. Although the action would limit the number of sportfishing permits to 114, impacts would be moderate at the local scale when compared to current conditions. Such restrictions would not affect recreation access and use, or the recreation opportunity setting because the existing number of permits would far exceed current and predicted future demand for guided fishing.

As a result, Alternative C would have similar beneficial impacts on recreation as Alternative A.

Alternative D:

Implementation of Alternative D would consist of non-guided and guided use management prescriptions that could potentially have impacts on recreation. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Management prescriptions establishing a limited permit system for non-guided sportfishing would have adverse, long-term impacts on recreation. The intensity of the impacts would vary depending on the standards developed for the proposed system and the effects it would have on recreation access and use, and the recreation opportunity setting. As a result, it is not possible to predict the level of intensity at this time. Nevertheless, Alternative D would have more adverse impacts on recreation than Alternative A.

Guided Sportfishing
Management prescriptions limiting the number of sportfishing guide permits to 20 would have beneficial and adverse impacts on recreation. Adverse impacts would be major at the local scale when compared to the current condition because recreation access and use would be reduced. Conversely, beneficial, long-term impacts on the recreation opportunity setting would be expected as a result of the management action because the potential for crowding along the river due to guided use would be reduced, and users would be less likely to encounter one another— especially during peak-use periods.

As a result, Alternative D would have more adverse impacts on recreation access and more beneficial impacts on the recreation opportunity setting than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would consist of non-guided and guided use management prescriptions that could potentially have impacts on recreation. The impacts associated with these proposed activities are analyzed in the following text.

Non-Guided Sportfishing
Implementation of Alternative E would have similar beneficial, long-term impacts on recreation as those described under Alternative A. A future step-down plan, if completed and implemented in a timely manner, could affect recreation access and use, and the recreation opportunity setting; however, there is not yet any basis for assessing those potential impacts.

Guided Sportfishing
Management prescriptions that limit the number of guided sportfishing permits to the number of existing permittees would have beneficial, long-term impacts on recreation. Although the action would limit the number of sportfishing permits to 114, impacts would be moderate at the local scale when compared to current conditions. Such restrictions would not affect recreation access and use or the recreation opportunity setting because the existing number of permits would far exceed current and predicted future demand for guided fishing.

As a result, Alternative E would have similar beneficial impacts on recreation as Alternative A.

4.4.10 Airplane Access to Lakes in Designated Wilderness

General Assumptions:

- As many as 580 lakes within Kenai National Wildlife Refuge are (and would continue to be) open to and potentially usable by small airplane. (This approximation is based upon standard Piper Super Cub takeoff distance of 1,000 feet or more—equivalent to a lake approximately 16 acres or greater in size).
- Airplane access to any lake within the Refuge would be prohibited from May 1 through September 10 or 30 (depending upon lake-specific regulations) when nesting trumpeter swans and/or their broods are present.
- The majority of airplane landings and operations on the Refuge would occur during the summer and early fall in support of recreational fishing and hunting activities. Camping activities within the localized area around the lake may or may not occur.
- The anticipated increase in population growth for Anchorage and the Kenai Peninsula over the life of the Plan would result in an increase in recreational use within the Refuge.

4.4.10.1 Biological Environment

Consequences of Implementing Airplane Access Strategies on Vegetation Found In and Around Wilderness Lakes

Indicators:

- Vegetation damage or loss
- Frequency of exotic and/or invasive species

Assumptions:

- Floatplanes traveling to and from Anchorage, the Matanunska Valley, and Kenai Peninsula may be vectors for introducing and/or dispersing exotic and/or invasive plants.

Alternative A (Current Management):
Implementation of Alternative A would have adverse, short- to long-term impacts on vegetation due to management prescriptions that allow airplane access to 46 lakes in the Kenai Wilderness. Impacts would be minor to major at site-specific locations due to vegetation trampling, damage, and mortality that occurs when visitors access lake shorelines from airplanes and when some visitor use activities occur at campsites (e.g., firewood collection, construction of amenities, carving into trees, etc.). In Alaska, transport of plant fragments on floatplanes flying between water bodies in urban population centers and those in more remote locations within the State are likely mechanisms of aquatic plant introductions. Pedestrian traffic around lakes would potentially serve as vectors for the introduction and dispersal of exotic and/or invasive

terrestrial plants. Although adverse impacts would be negligible at the local scale when compared to existing conditions because new campsites would probably not be pioneered, campfire use in the area would increase the potential for accidental human-caused wildfires, which could have adverse and/or beneficial impacts on wildlife habitat depending on when and where the fire occurred, the intensity and size of the fire, and the actions taken to suppress it (if any).

Alternative B:

Implementation of Alternative B would have similar adverse impacts on aquatic and terrestrial vegetation as those described under Alternative A, except impacts would be expected at 45 lakes (1 less than Alternative A).

Alternative B would have less adverse impacts on vegetation than Alternative A due to closing airplane access to Bird Lake located in the Dave Spencer Unit of the Kenai Wilderness.

Alternative C:

Implementation of Alternative C would have similar adverse impacts on aquatic and terrestrial vegetation as those described under Alternative A, except impacts would be expected at 50 lakes (4 more than Alternative A). Allowing airplane access to an additional four lakes would have major impacts at site-specific locations when compared to existing conditions because these lakes are pristine and free from the impacts associated with human use. Opening the unnamed lake southwest of Goat Lake in section 28 of the Andy Simons Unit of the Kenai Wilderness would have additional adverse, major impacts at site-specific locations because the action would change the primary method of access to approximately 20 square miles of remote alpine habitat containing highly sensitive vegetation. What is currently a multi-day trek (that few visitors undertake) would become a moderately strenuous day hike for visitors accessing the area via floatplane. High elevation areas would be damaged by newly created, dispersed campsites and associated human use to and from those sites.

Alternative C would have more adverse impacts on vegetation than Alternative A due to management prescriptions that open four additional lakes to airplane access.

Alternative D:

Implementation of Alternative D would have similar adverse impacts on aquatic and terrestrial vegetation as those described under Alternative A, except impacts would be expected at 60 lakes (14 more than Alternative A). Allowing airplane access to an additional 14 lakes would have major impacts at site-specific locations when compared to existing conditions because these lakes are pristine and free from the impacts associated with airplane and human use. Opening the unnamed lake

southwest of Goat Lake in section 28 of the Andy Simons Unit of the Kenai Wilderness would have similar major impacts as those described under Alternative C.

Alternative D would have more adverse impacts on vegetation than Alternative A due to management prescriptions that open 14 additional lakes to airplane access.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have adverse, short- to long-term impacts on vegetation due to management prescriptions that allow airplane access to 46 lakes in the Kenai Wilderness. Impacts would be minor to major at site-specific locations due to vegetation trampling, damage, and mortality that occurs when visitors access lake shorelines from airplanes and when some visitor use activities occur at campsites (e.g., firewood collection, construction of amenities, carving into trees, etc.). In Alaska, transport of plant fragments on floatplanes flying between water bodies in urban population centers and those in more remote locations within the State are likely mechanisms of aquatic plant introductions. Pedestrian traffic around lakes would potentially serve as vectors for the introduction and dispersal of exotic and/or invasive terrestrial flora. Although adverse impacts would be negligible at the local scale when compared to existing conditions because new campsites would probably not be pioneered, campfire use in the area would increase the potential for accidental human-caused wildfires, which could have adverse and/or beneficial impacts on wildlife habitat depending on when and where the fire occurred, the intensity and size of the fire, and the actions taken to suppress it (if any).

Adverse impacts would result at additional lakes, following adoption of the proposed rule change, when special use permits for access are issued to successful applicants in the State's limited drawing hunt program (see 2.1.9.3 Issue 5).

Consequences of Implementing Airplane Access Strategies on Wildlife Found on and Around Wilderness Lakes

Indicators:

- Wildlife presence

Assumptions:

- Human activity causes disturbance to wildlife at varying degrees depending on the type of activity, timing of the activity, intensity of the activity, number of activities occurring simultaneously, and wildlife species affected.
- Disturbance-related impacts include direct mortality (immediate, on-site death), indirect mortality (eventual,

premature death), lowered productivity (reduced fecundity or survival rate), reduced habitat use, and stress.

- Refuge regulations and other airplane related statutes or regulations (e.g., the Airborne Hunting Act, Alaska Department of Fish and Game's Game Management Unit 15A moose hunting related airplane restrictions, and State same-day airborne regulations) would reduce activities that may be illegal and/or contribute to the adverse impacts of airplane operations on wildlife.
- Refuge regulations restricting land-based landings and unauthorized airplane operations in alpine habitats would provide important protection to wildlife species occurring in the area.

Alternative A (Current Management):
Implementation of Alternative A could have adverse, short- to long-term impacts on wildlife due to disturbance associated with airplane landings, taxiing, and takeoffs; low-level flights; and associated human use on and in the vicinity of 46 lakes in the Kenai Wilderness. Impacts could be minor to major at the local scale depending on the type of activity, timing of the activity, intensity of the activity, duration of the activity, and the wildlife species affected. Aquatic and terrestrial wildlife could show signs of disturbance due to airplane and associated human use occurring nearby and/or overhead, and impacts on the presence of wildlife in the area could be expected. At the site-specific scale when and where human-wildlife encounters occur, impacts could be minor to major depending on a variety of parameters (e.g., type of activity, timing of the activity, intensity of the activity, duration of the activity, etc.). In general, human-wildlife encounters at and adjacent to lakes open to airplane access—particularly during the summer and fall when use is more common—could result in a variety of disturbance-related impacts. Impacts may include direct and indirect mortality, lowered productivity, reduced habitat use, and stress. Impacts could also be expected during the "off" and "shoulder" seasons. Although the number of human-wildlife encounters could be much less than that observed during high public use seasons, such encounters could potentially be more damaging due to the level of nutritional stress some individuals face during winter months. Direct mortality of some individuals could result from legal and illegal take of fish and wildlife (e.g., furbearers, etc.), and lowered productivity rates could be expected of some individuals. Waterfowl, waterbirds, and seabirds could be more sensitive to airplane disturbance when they are nesting, brood rearing, molting, and/or congregating on staging areas prior to migration. Some individuals could experience lowered productivity due to nest and/or brood abandonment, and erratic sleeping and/or feeding patterns resulting from disturbance. Molting birds, which are flightless, could be especially intolerant of disturbance and may leave the protection of

lakes by walking overland, making them susceptible to predation. Terrestrial wildlife (e.g., wolves, lynx, moose, caribou, brown bears, etc.) could also be affected by airplane activity. Low-level flights over wildlife could cause physiological and/or behavioral responses that reduce the animals' fitness or ability to survive. Loss of fitness could be manifested as accidental injury, reproductive loss, energy losses (by increasing energy expenditure caused by the disturbance), and habitat avoidance. Moose, caribou, and brown bear are known to react strongly to low-flying airplanes, and adults with young could be more sensitive to such disturbance. Disturbance can be particularly detrimental when animals are under other physiological stress such as during very cold winters with deep snow, pregnancy, birthing, and insect harassment.

Alternative B:

Implementation of Alternative B would have similar adverse impacts on wildlife as those described under Alternative A, except that impacts would be expected at 45 lakes (1 less than Alternative A).

Alternative B would have less adverse impacts on wildlife than Alternative A due to management actions that close airplane access to Bird Lake located in the Dave Spencer Unit of the Kenai Wilderness.

Alternative C:

Implementation of Alternative C would have similar adverse impacts on wildlife as those described under Alternative A, except that impacts would occur on 50 lakes (4 more than Alternative A). Allowing airplane access to an additional four lakes would have moderate impacts on the presence of wildlife at and around those lakes when compared to existing conditions because wildlife in those areas—although affected by low-level flights—have not been disturbed by airplane landings, taxiing and/or takeoffs, and associated human use. Trumpeter swans would not be affected by the action since there are no data suggesting swans use them for breeding and/or nesting purposes. However, waterbodies located adjacent to swan nesting lakes are used by family groups and serve as additional feeding areas and *refugia* for adults and cygnets when "home" lakes are disturbed. Opening these lakes to floatplane access would potentially marginalize them for suitable swan brood habitat. Additionally, opening the unnamed lake southwest of Goat Lake in section 28 of the Andy Simons Unit of the Kenai Wilderness would have additional adverse impacts on wildlife because the action would change the primary method of access to approximately 20 square miles of remote alpine habitat. What is currently a multi-day trek (that few visitors undertake) would become a moderately strenuous day hike for visitors accessing the area via floatplane. Wildlife inhabiting these high elevation areas would be disturbed by visitors recreating in the area.

Alternative C would have more adverse impacts on wildlife than Alternative A due to management actions that open airplane access to four additional lakes.

Alternative D:

Implementation of Alternative D would have similar adverse impacts on wildlife as those described under Alternative A, except impacts would be expected at 60 lakes (14 more than Alternative A). Except for Angler Lake, none of the other proposed lakes to be opened have any record of nesting trumpeter swans. However, four small lakes surrounding and including Round Lake would be in close proximity (less than one mile) to Harvey Lake. Although Harvey Lake would be seasonally open for airplane access, it would be contingent on the absence of swan broods. Swans have nested on Harvey Lake 12 of the past 47 years, making it one of the most productive waterbodies for swans on the Kenai Peninsula. There would be a high probability that low-flying airplanes that are landing, taxiing, and taking off from Round Lake would disturb trumpeter swan nests and broods on Harvey Lake. Beaver, King, Bird, Harvey, and Windy lakes would allow earlier access. Four of these five lakes are among the most productive lakes for swans, with known nest attempts of 25, 1, 6, 11, and 8, respectively, since 1957. Cumulatively, these five lakes are known to have produced at least 145 cygnets. Disturbance associated with earlier airplane access to these lakes in the fall would potentially result in premature brood dispersal and cygnet mortality. Opening these lakes as early as September 10 would affect swan family group cohesiveness and cygnet survivorship. Frozen lakes serve as travel routes for wintering large mammals and furbearers. Opening additional lakes to airplane landing during winter would increase the amount of human-wildlife encounters during the period when many resident species are most influenced by energy-consuming avoidance behavior. Although winter airplane use is minimal, opportunistic trapping or other use would increase and occur with more regularity. Trapper and hunter access to 12 of the 13 newly opened lakes would result in increased localized harvest of beaver and furbearers. Additionally, opening the unnamed lake southwest of Goat Lake in section 28 of the Andy Simons Unit of the Kenai Wilderness would have additional adverse impacts on wildlife because the action would change the primary method of access to approximately 20 square miles of remote alpine habitat. What is currently a multi-day trek (that few visitors undertake) would become a moderately strenuous day hike for visitors accessing the area via floatplane. Wildlife inhabiting these high elevation areas would be disturbed by visitors recreating in the area.

Alternative D would have more adverse impacts on wildlife than Alternative A due to management actions that open airplane access to 18 additional lakes.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have adverse, short- to long-term impacts on wildlife due to disturbance associated with airplane landings, taxiing and takeoffs, low-level flights, and associated human use on and in the vicinity of 46 lakes in the Kenai Wilderness. Impacts to wildlife would be minor to major at the local scale depending on the type of activity, timing of the activity, intensity of the activity, duration of the activity occurring, and the wildlife species affected. Aquatic and terrestrial wildlife would show signs of disturbance due to airplane and associated human use occurring nearby and/or overhead, and impacts on the presence of wildlife in the area would be expected. At the site-specific scale when and where human-wildlife encounters occur, impacts would be minor to major depending on a variety of parameters (e.g., type of activity, timing of the activity, intensity of the activity, duration of the activity occurring, etc.). In general, human-wildlife encounters at and adjacent to lakes open to airplane access, particularly during the summer and fall when use is more common, would result in a variety of disturbance-related impacts. Impacts may include direct and indirect mortality, lowered productivity, reduced habitat use, and stress. Impacts would also be expected during the "off" and "shoulder" seasons. Although the number of human-wildlife encounters would be much less than that observed during high public use seasons, such encounters could potentially be more damaging due to the level of nutritional stress some individuals face during winter months. Direct mortality of some individuals would result from legal and illegal take of fish and wildlife (e.g., furbearers, etc.), and lowered productivity rates would be expected of some individuals. Waterfowl, waterbirds, and seabirds would be more sensitive to airplane disturbance when they are nesting, brood rearing, molting, and/or congregating on staging areas prior to migration. Some individuals would experience lowered productivity due to nest and/or brood abandonment and erratic sleeping and/or feeding patterns resulting from disturbance. Molting birds, which are flightless, would be especially intolerant of disturbance and may leave the protection of lakes by walking overland, making them susceptible to predation. Terrestrial wildlife (e.g., wolves, lynx, moose, caribou, brown bears, etc.) would also be affected by airplane activity. Low-level flights over wildlife would cause physiological and/or behavioral responses that reduce the animals' fitness or ability to survive. Loss of fitness would be manifested as accidental injury, reproductive loss, energy losses (by increasing energy expenditure caused by the disturbance), and habitat avoidance. Moose, caribou, and brown bear are known to react strongly to low-flying airplanes, and adults with young would be more sensitive to such disturbance. Disturbance can be particularly detrimental when animals are under other physiological stress such as during very cold winters with deep snow, pregnancy, birthing, and insect harassment.

Adverse impacts to wildlife would result at additional lakes, following adoption of the proposed rule change, when special use permits for access are issued to successful applicants in the State's limited drawing hunt program (see 2.1.9.3 Issue 5).

4.4.10.2 Human Environment

Consequences of Implementing Airplane Access Strategies on Recreation on Wilderness Lakes

Indicators:

- Recreation access
- Recreation opportunity setting classification

Assumptions:

- The majority of airplane landings and operations on the Refuge would occur during the summer and early fall in support of recreational fishing and hunting activities.
- Recreation opportunity settings are defined as discrete combinations of physical, biological, social, and managerial conditions that facilitate particular kinds of recreation experiences. Opportunity settings can be inventoried and arrayed along a continuum from wilderness (no roads, limited facilities, dispersed use, and little management presence) to urban-industrial (paved roads, extensive development, dense use, obvious management presence).

Alternative A (Current Management):

Implementation of Alternative A would have beneficial, long-term impacts on recreation due to public use prescriptions that facilitate airplane access to 46 lakes located within the Kenai Wilderness except when nesting trumpeter swans and/or their broods are present. However at the refuge-wide scale, impacts would be negligible because hundreds of other lakes on the Refuge would be open to airplane access.

Alternative B:

Implementation of Alternative B would have similar beneficial, long-term impacts on recreation as those described under Alternative A, except impacts would be less due to management prescriptions that facilitate airplane access to 45 lakes located within the Kenai Wilderness (1 less than Alternative A) except when nesting trumpeter swans and/or their broods are present. Adverse impacts of major intensity would be expected on recreation access at the site-specific scale as a result of closing Bird Lake to airplane access; however, at the local scale, impacts would be negligible because hundreds of other lakes on the Refuge would be open to airplane access. Conversely, beneficial, major impacts would be expected on the recreation opportunity setting

at the site-specific scale as a result of closing Bird Lake to airplane access because the relatively few visitors that bushwhack through the Kenai Lowlands to get to the lake would experience a Wilderness setting virtually free of all signs of human use.

Alternative B would have less beneficial impacts on recreation than Alternative A due to management prescriptions that close airplane access at one lake.

Alternative C:

Implementation of Alternative C would have similar beneficial, long-term impacts as those described under Alternative A, except impacts would be greater due to management prescriptions that facilitate airplane access to 50 lakes located in the Kenai Wilderness (four more than Alternative A) except when nesting trumpeter swans and/or their broods are present. Impacts would be minor at the local scale and major at the site-specific scale because more destination choices would be available than provided under Alternative A. Three of the four additional lakes (Falcon, Wren, and Neckshorta) proposed for opening under this alternative are less than one mile from other accessible lakes, although relatively few visitors would attempt to bushwhack from lake to lake through the Kenai Lowlands. The fourth lake—an unnamed lake southwest of Goat Lake in section 28 of the Andy Simons Unit of the Kenai Wilderness—and the surrounding alpine tundra, which currently receives use by the occasional hunter on foot or horseback during multi-day trips, would also become more accessible due to the management prescription. Conversely, adverse, long-term impacts would be expected on the recreation opportunity setting at the site-specific scale as a result of the action. Impacts would vary depending on the amount of use each lake receives; but in general, newly established campsites and associated signs of human presence (e.g., damaged vegetation, human waste, constructed amenities, etc.) would be expected and would increase over time at each lake.

Alternative C would have more beneficial impacts on recreation than Alternative A due to management prescriptions that facilitate recreation access to four additional lakes.

Alternative D:

Implementation of Alternative D would have similar beneficial and adverse, long-term impacts on recreation as those described under Alternative C, except impacts would be expected at 60 lakes (14 more than Alternative A).

Alternative D would have more beneficial impacts on recreation than Alternative A due to management prescriptions that facilitate airplane access to 14 additional lakes.

Alternative E:

Implementation of Alternative E would have similar beneficial and adverse, long-term impacts on recreation as those described under Alternative A, except that beneficial recreational impacts could be expected at lakes in designated Wilderness where airplane access is allowed by special use permit (see 2.1.9.3 Issue 5).

Alternative E would have more beneficial impacts on recreation than Alternative A due to a proposed rule change that would allow the Refuge Manager to issue special permits to successful applicants in the State's limited drawing hunt program (see 2.19.6 Issue 5).

Consequences of Implementing Airplane Access Strategies on Wilderness Values Associated With Wilderness Lakes

Indicators:

- Untrammeled condition (i.e., free of intentional human manipulation)
- Opportunities for solitude
- Opportunities for primitive and unconfined types of recreation

Assumptions:

- Small airplanes are an established and commonly accepted means of transportation to access Wilderness in Alaska. These motorized users have expectations of wilderness solitude and naturalness similar to non-motorized visitors.
- Current airplane activities on lakes within the Kenai Wilderness are not adversely affecting wilderness solitude. The separation of accessible lakes from one another and from other types of uses, and the lack of public comment or complaint seems to support this assumption.

Alternative A (Current Management):

Implementation of Alternative A would have beneficial and adverse, short- and long-term impacts on wilderness values due to management prescriptions that facilitate airplane access to 46 lakes in the Kenai Wilderness except when nesting trumpeter swans and/or their broods are present. Beneficial, long-term impacts would be expected due to management prescriptions that facilitate opportunities for solitude and primitive or unconfined types of recreation. Although the projected increase in visitor use would provide outstanding opportunities for recreation in a wilderness setting, Impacts would be negligible at the local scale because opportunities that are otherwise inaccessible or extremely difficult to access by other means would not change from the current condition as a result of the alternative. Conversely, adverse, short-term impacts on opportunities for solitude would be expected if

and when an increasing number of pilots choose to land their airplanes on or near lakes containing other visitors. Impacts would be major at site-specific locations when and where such actions occur; but in general, most pilots would choose to land on an alternative lake when visitors are observed on their initial choice. Having the ability and means to quickly access alternate lakes would allow pilots to easily and find opportunities for solitude in a remote wilderness setting, even as airplane use increases. Additional adverse, long-term impacts would be expected on the untrammeled condition of the wilderness setting as visitor use and associated activities would continue at established campsites. The intensity of the impacts would vary based on the amount of use—which is projected to increase—and the type of activities conducted at those campsites (e.g., cutting trees, littering, etc.). In general, impacts would be negligible at the local scale since no new campsites are expected to be established during the life of the Plan, and moderate at site-specific locations as evidence of visitors' stays at established campsites increases.

Alternative B:

Implementation of Alternative B would have similar beneficial and adverse, short- and long-term impacts on wilderness values as those described under Alternative A, except adverse impacts would be more due to management prescriptions that close airplane access to one lake located within the Kenai Wilderness. Impacts would be major on opportunities for solitude at the site-specific scale as a result of closing airplane access to Bird Lake and the difficulty associated with accessing the lake by foot. Impacts would be negligible at the local scale because there would be 43 other lakes open to airplane access where opportunities for solitude would be provided. Conversely, beneficial impacts would be expected on the untrammeled condition of the wilderness setting at Bird Lake due to the management action. Impacts would be major at the site-specific scale as the evidence of visitor use declines and campsites recover from use.

Alternative B would have more adverse and more beneficial impacts on wilderness values than Alternative A due to management prescriptions that close airplane access to one lake.

Alternative C:

Implementation of Alternative C would have similar beneficial and adverse long-term, and adverse short-term impacts on wilderness values as those described under Alternative A, except adverse impacts would be greater due to management prescriptions that facilitate airplane access to 50 lakes located in the Kenai Wilderness (4 more than Alternative A) except when nesting trumpeter swans and/or their broods are present. Adverse impacts on opportunities for solitude would be expected because three of the four additional lakes proposed for airplane access under the alternative are within one mile or less from other accessible lakes.

(Neckshorta Lake is less than one mile from Bird and Tangerra lakes. Wren and Falcon lakes are within a mile of each other and within one mile of King, Wilderness, Nekutak, and Snowshoe lakes.) Noise associated with airplane landings and takeoffs at and/or adjacent to these lakes would be expected. Allowing airplane access to the fourth lake, an unnamed lake southwest of Goat Lake in section 28 of the Andy Simons Unit of the Kenai Wilderness, would also have adverse impacts on opportunities for solitude. Impacts would be major at the site-specific scale for the few determined and self-reliant visitors who currently use more primitive means (e.g., foot, horseback) to access this remote area of the Refuge when encounters with airplane users occurs. Additional adverse impacts would be expected on opportunities for solitude for Swanson River and Swan Lake canoe systems visitors who also seek such opportunities but have relatively few options in Alaska for their recreational pursuits. Adverse, long-term impacts on the untrammeled condition of accessible lakes would be expected, although the intensity of the impacts would vary depending on the amount of use each lake receives. In general, newly established campsites and associated signs of human presence (e.g., damaged vegetation, human waste, etc.) would be expected and would increase at each lake.

Alternative C would have more adverse impacts on wilderness values than Alternative A due to management prescriptions that facilitate airplane access to four additional lakes.

Alternative D:

Implementation of Alternative D would have similar beneficial and adverse long-term, and adverse short-term impacts as those described under Alternative C, except adverse impacts would be greater due to management prescriptions that facilitate airplane access to 60 lakes located in the Kenai Wilderness (14 more than Alternative A) except when nesting trumpeter swans and/or their broods are present. Adverse impacts on opportunities for solitude would be expected because 9 of the 12 additional lakes proposed for airplane access under the alternative are within one mile or less from other accessible lakes. (In addition to lakes proposed under Alternative C, Kaknu Lake, Angler Lake, and an unnamed lake west of Kolomin Lake are all within one mile of another accessible lake. The four lakes north of Harvey Lake are all within one mile of each other and Harvey Lake.) Noise associated with airplane landings and takeoffs at and/or adjacent to these lakes would be expected. Additional adverse, long-term impacts on the untrammeled condition of accessible lakes would be expected, although the intensity of the impacts would vary depending on the amount of use each lake receives. In general, newly established campsites and associated signs of human presence (e.g., damaged vegetation, human waste, etc.) would be expected and would increase at each lake.

Alternative D would have more adverse impacts on wilderness values than Alternative A due to management prescriptions that facilitate airplane access to 14 additional lakes.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have beneficial long-term and adverse short- and long-term impacts on wilderness values due to management prescriptions that facilitate airplane access to 46 lakes in the Kenai Wilderness except when nesting trumpeter swans and/or their broods are present. Beneficial, long-term impacts would be expected due to management prescriptions that facilitate opportunities for solitude and primitive or unconfined types of recreation. Although the projected increase in visitor use would provide outstanding opportunities for recreation in a wilderness setting, impacts would be negligible at the local scale because opportunities that are otherwise inaccessible or extremely difficult to access by other means would not change from the current condition as a result of the alternative. Conversely, adverse, short-term impacts on opportunities for solitude would be expected if and when an increasing number of pilots choose to land their airplanes on or near lakes containing other visitors. Impacts would be major at site-specific locations when and where such actions occur; but in general, most pilots would choose to land on an alternative lake when visitors are observed on their initial choice. Having the ability and means to quickly access alternate lakes would allow pilots to easily and independently find opportunities for solitude in a remote wilderness setting, even as airplane use increases. Additional adverse, long-term impacts would be expected on the untrammeled condition of the wilderness setting as visitor use and associated activities would continue at established campsites. The intensity of the impacts would vary based on the amount of use—which is projected to increase—and the type of activities conducted at those campsites (e.g., cutting trees, littering, etc.). In general, impacts would be negligible at the local scale since no new campsites are expected to be established during the life of the Plan, and moderate at site-specific locations as evidence of visitors' stays at established campsites increases.

Adverse impacts on wilderness values could result, following adoption of the proposed rule change, when special use permits for access are issued to successful applicants in the State's limited drawing hunt program (see 2.1.9.3 Issue 5).

Table 4-1. Airplane Access to Lakes in Designated Wilderness Listed By Alternative

Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Dave Spencer Unit (19 lakes)	**Dave Spencer Unit (18 lakes)**	**Dave Spencer Unit (22 lakes)**	**Dave Spencer Unit (25 lakes)**	**Dave Spencer Unit (19 lakes)**
Scenic (early access)	Scenic (early access)	Scenic (early access)	Scenic (early access)	Scenic (early access)
Nekutak	Nekutak	Nekutak	Nekutak	Nekutak
Shoepac	Shoepac	Shoepac	Shoepac	Shoepac
Norak	Norak	Norak	Norak	Norak
Grouse	Grouse	Grouse	Grouse	Grouse
King	King	King	King (early access)	King
Bedlam	Bedlam	Bedlam	Bedlam	Bedlam
Taiga	Taiga	Taiga	Taiga	Taiga
Snowshoe	Snowshoe	Snowshoe	Snowshoe	Snowshoe
Wilderness	Wilderness	Wilderness	Wilderness	Wilderness
Mull	Mull	Mull	Mull	Mull
Tangerra	Tangerra	Tangerra	Tangerra	Tangerra
Bird	n/a	Bird	Bird (early access)	Bird
Cook	Cook	Cook	Cook	Cook
Sandpiper	Sandpiper	Sandpiper	Sandpiper	Sandpiper
Vogel	Vogel	Vogel	Vogel	Vogel
Pepper (*ice only*)	Pepper (*ice only*)	Pepper (*ice only*)	Pepper (*ice only*)	Pepper (*ice only*)
Gene (*ice only*)	Gene (*ice only*)	Gene (*ice only*)	Gene (*ice only*)	Gene (*ice only*)
Swanson (*ice only*)	Swanson (*ice only*)	Swanson (*ice only*)	Swanson (*ice only*)	Swanson (*ice only*)
		Falcon	Falcon	
		Wren	Wren	
		Neckshorta	Neckshorta	
			Rabbit Foot	
			Muskrat	
			Angler (*ice only*)	
Andy Simons Unit (26 lakes)	**Andy Simons Unit (26 lakes)**	**Andy Simons Unit (27 lakes)**	**Andy Simons Unit (33 lakes)**	**Andy Simons Unit (26 lakes)**
Upper Russian	Upper Russian	Upper Russian	Upper Russian	Upper Russian
Twin (east)	Twin (east)	Twin (east)	Twin (east)	Twin (east)
Twin (west)	Twin (west)	Twin (west)	Twin (west)	Twin (west)
Emerald	Emerald	Emerald	Emerald	Emerald
High	High	High	High	High
Dinglestadt	Dinglestadt	Dinglestadt	Dinglestadt	Dinglestadt
Lower Russian	Lower Russian	Lower Russian	Lower Russian	Lower Russian
Iceberg	Iceberg	Iceberg	Iceberg	Iceberg
Green	Green	Green	Green	Green
Kolomin (north)	Kolomin (north)	Kolomin (north)	Kolomin (north)	Kolomin (north)
Kolomin (south)	Kolomin (south)	Kolomin (south)	Kolomin (south)	Kolomin (south)
Wosnesenski	Wosnesenski	Wosnesenski	Wosnesenski	Wosnesenski

Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Pothole	Pothole	Pothole	Pothole	Pothole
Harvey	Harvey	Harvey	Harvey (early access)	Harvey
Martin	Martin	Martin	Martin	Martin
Windy (early access)	Windy (early access)	Windy (early access)	Windy (early access)	Windy (early access)
Tustumena	Tustumena	Tustumena	Tustumena	Tustumena
All Wilderness lakes within one mile of Tustumena shoreline (3 lakes)[1]	All Wilderness lakes within one mile of Tustumena shoreline (3 lakes)	All Wilderness lakes within one mile of Tustumena shoreline (3 lakes)	All Wilderness lakes within one mile of Tustumena shoreline (3 lakes)	All Wilderness lakes within one mile of Tustumena shoreline (3 lakes)
All unnamed lakes in sections 1, 2, 4, 5, 8, and 9 (6 lakes)[1]	All unnamed lakes in sections 1, 2, 4, 5, 8, and 9 (6 lakes)	All unnamed lakes in sections 1, 2, 4, 5, 8, and 9 (6 lakes)	All unnamed lakes in sections 1, 2, 4, 5, 8, and 9 (6 lakes)	All unnamed lakes in sections 1, 2, 4, 5, 8, and 9 (6 lakes)
		Unnamed lake southwest of Goat Lake (section 28)	Unnamed lake southwest of Goat Lake (section 28)	
			Kaknu	
			Unnamed lake west of Koloman (section 31)	
			Four lakes north of Harvey: • Round Lake (section 29) • Unnamed lake northwest of Round Lake (section 30) • Unnamed lake southwest of Round Lake (section 30) • Unnamed lake southwest of Round Lake (section 31)	

[1]Based on "lake criteria" identified as "takeoff distance of 1,000 feet or more—equivalent to a lake approximately 16 acres or greater in size."

Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Mystery Creek Unit (1 lake)	**Mystery Creek Unit (1 lake)**	**Mystery Creek Unit (1 lake)**	**Mystery Creek Unit (1 lake)**	**Mystery Creek Unit (1 lake)**
An unnamed lake in section 11 [1]	An unnamed lake in section 11	An unnamed lake in section 11	An unnamed lake in section 11	An unnamed lake in section 11
			Non-Wilderness Lake (1 lake)	
			Beaver (early access)	
Total	**Total**	**Total**	**Total**	**Total**
46 Lakes	**45 Lakes**	**50 Lakes**	**60 Lakes**	**46 Lakes**

4.4.11 Airplane Access to Chickaloon Flats

General Assumptions:

- The Chickaloon Flats area is approximately 25.8 square miles in size (16,482 acres).
- There are currently six designated landing areas in the Chickaloon Flats area: the unmaintained Big Indian Airstrip, three "upland" areas totaling 1,155 acres, one beach area, and 6.5 miles of the Chickaloon River.
- Airplane pilots prefer to land on "unvegetated" or sparsely vegetated portions of designated landing areas for safety reasons.
- The anticipated increase in population growth for Anchorage and the Kenai Peninsula over the life of the Plan would result in an increase in use.

4.4.11.1 Physical Environment

Consequences of Implementing Airplane Access Management Strategies on Soils in the Chickaloon Flats Area

Indicators:

- Physical soil characteristics: compaction, soil permeability, water repellency

Assumptions:

- Existing physical soil characteristics at three designated "upland" areas are of a degraded nature due to compaction resulting from airplane use.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, medium-term impacts on physical soil characteristics due to management prescriptions that facilitate airplane access at three designated "upland" landing areas within Chickaloon Flats. (Upland areas may be vegetated, sparsely vegetated, and/or barren [i.e., containing mudflats] and may be influenced in total or in part by high tides and/or storm surges. Three upland areas have been designated by regulation for airplane landing, taxiing, and takeoffs in the Chickaloon Flats area.) Impacts would be minor to moderate at the site-specific scale depending on the amount of use the site receives, and negligible at the local scale when compared to current conditions. Soil compaction resulting from airplane landings, taxiing, and takeoffs within designated upland areas would be expected on no more than 400 acres identified as unvegetated, and some portion of 578 acres identified as halophytic wetlands that are sparsely vegetated. Airplane landing conditions would decline beyond current conditions due to an increase

in visitation over the life of the Plan. In addition, some pilots would choose lesser-used sites within designated landing areas, and additional soil compaction would be expected. Opportunities for vegetation growth would diminish at compacted sites.

Alternative B:

Implementation of Alternative B would have similar adverse, medium-term impacts on physical soil characteristics as those described under Alternative A, except impacts would be moderate at the local scale. The management action would give an increasing number of visitors more landing choices over a 13,661 acre area, of which 4,497 acres (or 32.9 percent) are identified as unvegetated. These areas are potentially suitable for airplane landings, taxiing, and takeoffs, and would be subject to impact.

Alternative B would have more adverse impacts on soil resources than Alternative A due to management prescriptions that facilitate airplane access to portions of the Chickaloon Flats area that are currently undisturbed.

Alternative C:

Implementation of Alternative C would have similar adverse, medium-term impacts on physical soil characteristics as those described under Alternative B.

Alternative C would have more adverse impacts on soil resources than Alternative A due to management prescriptions that facilitate airplane access to portions of the Chickaloon Flats area that are currently undisturbed.

Alternative D:

Implementation of Alternative D would have similar adverse, medium-term impacts on physical soil characteristics as those described under Alternative B. Although an additional 6.8-square-mile area (or 4,352 acres) containing 318 acres of unvegetated lands would be opened to airplane access from September 1 through December 15 (or dates that coincide with future waterfowl hunting seasons), negligible impacts on physical soil characteristics would be expected because soils typically begin to harden in September due to cooler autumn temperatures.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse, medium-term impacts on physical soil characteristics as those described under Alternative A, except impacts would be moderate at the local scale. The management action would give an increasing number of visitors more landing choices over a 13,661 acre area, of which 4,497 acres (or 32.9 percent) are identified as unvegetated. These areas are potentially

suitable for airplane landings, taxiing, and takeoffs, and would be subject to impact.

Alternative E would have more adverse impacts on soil resources than Alternative A due to management prescriptions that facilitate airplane access to portions of the Chickaloon Flats area that are currently undisturbed.

4.4.11.2 Biological Environment

Consequences of Implementing Airplane Access Management Strategies on Vegetation in the Chickaloon Flats Area

Indicators:

- Vegetation damage or loss
- Frequency of exotic and/or invasive species

Assumptions:

- Approximately 7,850 acres (47.6 percent of the total Chickaloon Flats area) have been identified as halophytic wetlands containing salt tolerant plants such as seaside arrowgrass (*Triglochin maritimum*), alkaligrass (*Puccinellia grandis*), and sedges (*Carex sps*.). Airplane access is currently allowed on 578 acres of halophytic wetlands or 3.5 percent of the total Chickaloon Flats area under Alternative A but not allowed under any of the action alternatives.
- Existing vegetative conditions at three designated upland areas are of a degraded nature due to airplane use.
- Airplanes traveling to and from approximately 183 landing strips located throughout Anchorage, the Matanunska Valley, and Kenai Peninsula may be vectors for the introduction and/or dispersal of exotic and/or invasive plants.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, medium- to long-term impacts on vegetation due to management prescriptions that facilitate airplane access at three designated upland areas within Chickaloon Flats. Impacts would be moderate to major at the site-specific scale and negligible at the local scale when compared to current conditions. Damage and/or mortality of grasses and sedges; and the possibility of introduced, exotic and/or invasive flora resulting from airplane landings, taxiing, and takeoffs within designated upland areas would be expected to occur on approximately 578 acres (or 3.5 percent of the Chickaloon Flats area) identified as halophytic wetlands consisting of a variety of grasses and sedges. Airplane landing conditions within designated upland areas would decline beyond current conditions due to an increase in visitation over the life of the

Plan. As a result, some pilots would choose lesser-used portions of designated landing areas that are typically vegetated, and some additional damage and/or mortality would be expected.

Alternative B:

Implementation of Alternative B would have similar adverse, medium- to long-term impacts on vegetation as those described under Alternative A, except impacts resulting from damage or loss would be negligible at the site-specific and local scales because only unvegetated portions of 13,661 acres or 4,497 acres (27.3 percent of the total Chickaloon Flats area) would be open to airplanes. Impacts resulting from introduction of exotic and/or invasive species would be major at the site-specific scale when and where such introductions take place.

Alternative B would have more adverse impacts on vegetation due to the potential for introduction of exotic and/or invasive species than Alternative A due to management prescriptions that facilitate airplane access to portions of the Chickaloon Flats area that are currently undisturbed.

Alternative C:

Implementation of Alternative C would have similar adverse, medium- to long-term impacts on vegetation as those described under Alternative B.

Alternative C would have more adverse impacts on vegetation due to the potential for introduction of exotic and/or invasive species than Alternative A due to management prescriptions that facilitate airplane access to portions of the Chickaloon Flats area that are currently undisturbed.

Alternative D:

Implementation of Alternative D would have similar adverse, medium- to long-term impacts on vegetation as those described under Alternative B. Although an additional 6.8-square-mile area (or 4,352 acres) containing 318 acres of unvegetated lands would be opened to airplane access from September 1 through December 15 (or dates that coincide with future waterfowl hunting seasons), negligible impacts on vegetation would be expected as a result of introduction of exotic and/or invasive species because germination and growth of such species would be hampered by cooler autumn temperatures.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse, medium- to long-term impacts on vegetation as those described under Alternative A, except impacts resulting from damage or loss would be negligible at the site-specific and local scales because only unvegetated portions of 13,661 acres or 4,497 acres (32.9 percent of the total

Chickaloon Flats area) would be open to airplanes. Impacts resulting from introduction of exotic and/or invasive species would be major at the site-specific scale when and where such introductions take place.

Alternative E would have more adverse impacts on vegetation due to the potential for introduction of exotic and/or invasive species than Alternative A due to management prescriptions that facilitate airplane access to portions of the Chickaloon Flats area that are currently undisturbed.

Consequences of Implementing Airplane Access Management Strategies on Wildlife in the Chickaloon Flats Area

Indicators:

- Wildlife presence

Assumptions:

- Human activity causes disturbance to wildlife at varying degrees depending on the type of activity, timing of the activity, intensity of the activity, number of activities occurring simultaneously, and wildlife species affected.
- Disturbance-related impacts include direct mortality (immediate, on-site death), indirect mortality (eventual, premature death), lowered productivity (reduced fecundity or survival rate), reduced habitat use, and stress.
- The majority of airplane landings would occur in late summer and early fall in association with recreational coho salmon fishing and waterfowl hunting seasons.
- Refuge regulations and other airplane related statues or regulations (e.g., the Airborne Hunting Act, Alaska Department of Fish and Game's Game Management Unit 15A moose hunting related airplane restrictions, and State same-day airborne regulations) would reduce activities that may be illegal and/or contribute to the adverse impacts of airplane operations on wildlife.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, short- to long-term impacts on wildlife due to disturbance associated with airplane landings, taxiing, takeoffs, and associated human use; and low-level flying airplanes in the vicinity of Chickaloon Flats. Impacts would be major at site-specific locations and minor at the local scale due to management prescriptions that facilitate airplane access at three designated upland areas totaling approximately 1,155 acres (8.5 percent of the Chickaloon Flats area). A variety of wildlife including shorebirds, waterfowl, and mammals would show signs of disturbance due to airplane and associated human use occurring at designated landing

areas and/or overhead. Impacts on the presence of wildlife due to these activities would be expected. In general, airplane-wildlife encounters—particularly those occurring in late summer and early fall when human use of the area is more common—would result in a variety of disturbance-related impacts. Impacts may include direct and indirect mortality, lowered productivity, reduced habitat use, and stress. Direct mortality of some individuals would result from legal and illegal take of fish and wildlife (e.g., waterfowl, moose, etc.). Lowered productivity rates of some individuals would be expected. Shorebirds and waterfowl seeking undisturbed staging areas to feed and build up fat reserves prior to migration would be adversely affected by low-flying airplanes, airplane landings, taxiing, takeoffs, and associated human use of the area—particularly during the months of July through September. Activities that cause birds to flush would be energetically expensive and repeated flushing would ultimately lead to reduced physiological condition and/or site abandonment. Waterfowl (e.g., trumpeter swans, etc.) nest in ponds and streams adjacent to designated landing areas and would be sensitive to airplane disturbance during that time and when rearing broods. Some individuals would experience lowered productivity due to nest and/or brood abandonment, and erratic sleeping and/or feeding patterns resulting from disturbance. Airplane landings, taxiing, and takeoffs in the designated floatplane landing area at the mouth of the Chickaloon River would also cause disturbance to feeding beluga whales. Beluga whale and human use of the area would coincide with coho salmon migration in August and would occur at a time when a large portion of this declining whale population would be congregating in the upper Turnagain Arm, including the Chickaloon River. Terrestrial wildlife (e.g., wolves, etc.) would also be adversely affected by low-flying airplanes, airplane landings, taxiing, takeoffs, and associated human use of the area. Low-level flights over wildlife would cause physiological and/or behavioral responses that reduce the animals' ability to survive and/or its fitness level. Loss of fitness would be manifested as accidental injury, reproductive loss, energy loss (i.e., increasing energy expenditure caused by the disturbance), and habitat avoidance. Brown bears, which feed on coho salmon in the Chickaloon River, would react to low-flying airplanes, and adults with young would be more sensitive to such disturbance. Airplane landings, taxiing, takeoffs, and associated human use of the area (e.g., camping, fishing, hunting, etc.) would result in increased bear-human encounters and an increase in the number of bears killed in defense of life and property.

Alternative B:

Implementation of Alternative B would have similar adverse, short- to long-term impacts on wildlife as those described under Alternative A, except impacts would be moderate at the local scale. The management action would give an increasing number of visitors more landing choices over a 13,661 acre area (82.9 percent of the Chickaloon Flats area), the majority of which currently provides refuge from human

disturbance. The presence of wildlife would be adversely affected wherever airplane landings, taxiing, takeoffs, and associated human use occurs because wildlife would not be able to quickly readjust their distribution and/or behavior to avoid dispersed human activity, interaction, and associated disturbance.

Alternative B would have more adverse impacts on wildlife than Alternative A due to management prescriptions that facilitate airplane access to portions of the Chickaloon Flats area that are currently undisturbed.

Alternative C:

Implementation of Alternative C would have similar adverse, short- to long-term impacts on wildlife as those described under Alternative B, except that airplane use would increase in the vicinity of the Big Indian airstrip as a result of improved maintenance, and associated wildlife disturbance would result in additional impacts on the presence of wildlife.

Alternative C would have more adverse impacts on wildlife than Alternative A due to management prescriptions that facilitate airplane access to portions of the Chickaloon Flats area that are currently undisturbed.

Alternative D:

Implementation of Alternative D would have similar adverse, short- to long-term impacts on wildlife as those described under Alternative B, except impacts would be major at the local scale. The management action would give an increasing number of visitors more landing choices over an additional 6.8 square miles (or 4,352 acres) when these lands are opened to airplane landings, taxing, and takeoffs from September 1 through December 15 (or dates which coincide with future waterfowl hunting seasons). The majority of these lands currently provide refuge from human disturbance. The presence of wildlife would be adversely affected where airplane landings, taxiing, takeoffs, and associated human use occur because wildlife would not be able to quickly readjust their distribution and/or behavior to avoid dispersed human activity, interaction, and associated disturbance.

Alternative D would have more adverse impacts on wildlife than Alternative A due to management prescriptions that facilitate airplane access to portions of the Chickaloon Flats area that are currently undisturbed.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse, short- to long-term impacts on wildlife as those described under Alternative A, except impacts would be moderate at the local scale. The management

action would give an increasing number of visitors more landing choices over 13,661 acres (or 82.9 percent of the total Chickaloon Flats area), the majority of which currently provides refuge from human disturbance. The presence of wildlife would be adversely affected where airplane landings, taxiing, takeoffs, and associated human use occurs because wildlife would not be able to quickly readjust their distribution and/or behavior to avoid dispersed human activity, interaction, and associated disturbance.

Alternative E would have more adverse impacts on wildlife than Alternative A due to management prescriptions that facilitate airplane access to portions of the Chickaloon Flats area that are currently undisturbed.

4.4.11.3 Human Environment

Consequences of Implementing Airplane Access Management Strategies on Recreation in the Chickaloon Flats Area

Indicators:

- Recreation access
- Recreation opportunity setting classification

Assumptions:

- The condition and location of designated upland areas limits current use.
- An estimated 200 airplane landings currently occur per year in the Chickaloon Flats area with most occurring in the late summer and fall in support of day-use salmon fishing and waterfowl hunting.
- The Big Indian airstrip and areas of Chickaloon Flats currently open to airplane access by Federal regulation would remain open under all of the alternatives.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, long-term impacts on recreation due to management prescriptions that limit airplane access to three designated upland areas consisting of approximately 1,155 acres (8.5 percent of the total Chickaloon Flats area). Impacts would be moderate at the local scale because some visitors would choose not to land their airplanes due to the poor physical condition and/or location of designated landing areas. Conversely, beneficial, long-term impacts on the recreation opportunity setting would be expected as use of the area would remain relatively low during the life of the Plan due to the poor physical condition and/or location of designated landing areas. The intensity of the impacts would be negligible at the local scale because the recreation opportunity setting would not change from current conditions. Pilots choosing to

land their airplanes would find a wilderness-like setting with little evidence of human use, non-crowded conditions, and virtually no management presence.

Alternative B:

Implementation of Alternative B would have beneficial, long-term impacts on recreation due to management prescriptions that facilitate airplane access. Impacts would be moderate at the local scale when compared to current conditions because pilots would be able land their airplanes at desired landing locations within a 13,661-acre area (82.9 percent of the total Chickaloon Flats area). Conversely, adverse, long-term impacts on the recreation opportunity setting would be expected as use increases over the life of the Plan due to an increase in use and better landing conditions at desired landing locations. Impacts would be minor at the local scale because the size of the area opened to airplane landings would be able to absorb anticipated increases in use. Visitors would find a wilderness-like setting with slightly more evidence of human use at site-specific locations, and more encounters between visitors would be expected.

Alternative B would have more beneficial impacts on recreation access and more adverse impacts on the recreation opportunity setting than Alternative A due to management prescriptions that facilitate airplane access.

Alternative C:

Implementation of Alternative C would have similar beneficial and adverse, long-term impacts as those described under Alternative B, except impacts would be greater due to management prescriptions that would conduct regular maintenance of the Big Indian airstrip.

Alternative C would have more beneficial impacts on recreation access and more adverse impacts on the recreation opportunity setting than Alternative A due to management prescriptions that facilitate airplane access.

Alternative D:

Implementation of Alternative D would have similar beneficial and adverse, long-term impacts on recreation as those described under Alternative C, except impacts would be greater due to management prescriptions that facilitate airplane access within a 16,546-acre area.

Alternative D would have more beneficial impacts on recreation access and more adverse impacts on the recreation opportunity setting than Alternative A due to management prescriptions that facilitate airplane access.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have beneficial, long-term impacts on recreation due to management prescriptions that facilitate airplane access. Impacts would be moderate at the local scale when compared to current conditions because pilots would be able land their airplanes at desired landing locations within a 13,661-acre area (or 82.9 percent of the total Chickaloon Flats area). Conversely, adverse, long-term impacts on the recreation opportunity setting would be expected as use increases over the life of the Plan due to an increase in use and better landing conditions at desired landing locations. Impacts would be minor at the local scale because the size of the area opened to airplane landings would be able to absorb anticipated increases in use. Visitors would find a wilderness-like setting with slightly more evidence of human use at site-specific locations, and more encounters between visitors would be expected.

Alternative E would have more beneficial impacts on recreation access and more adverse impacts on the recreation opportunity setting than Alternative A due to management prescriptions that facilitate airplane access.

Consequences of Implementing Airplane Access Management Strategies on Wilderness Values in the Chickaloon Flats Area

Indicators:

- Untrammeled condition (i.e., free of intentional human manipulation)
- Opportunities for solitude
- Opportunities for primitive and unconfined types of recreation

Assumptions:

- Small airplanes are an established and commonly accepted means of transportation to access Wilderness in Alaska. These motorized users have expectations of wilderness solitude and naturalness similar to non-motorized visitors.
- An estimated 200 airplane landings currently occur per year in the Chickaloon Flats area with most occurring in the late summer and fall in support of day-use salmon fishing and waterfowl hunting.
- Current airplane activities within designated landing areas of the Chickaloon Flats area are not adversely affecting wilderness solitude. Separation of designated landing areas from one another and from other types of uses, estimations of current and projected use, and the lack of public comment or complaint would support this assumption.
- Airplanes traveling to and from approximately 183 landing strips located throughout Anchorage, the Matanunska Valley,

and Kenai Peninsula will continue to introduce and/or disperse exotic and/or invasive plants.

Alternative A (Current Management):

Implementation of Alternative A would have beneficial and adverse, short-, medium-, and long-term impacts on wilderness values due to management prescriptions that facilitate airplane access at six designated landing areas in the Chickaloon Flats area. Beneficial, long-term impacts would be expected due to management prescriptions that facilitate opportunities for solitude and primitive types of recreation. Although the projected increase in use and related visitor use would provide outstanding opportunities for recreation in a wilderness setting, impacts would be negligible at the local scale because opportunities that are otherwise inaccessible or extremely difficult to access by other means would not change from the current condition as a result of the alternative. Use would remain dispersed and at relatively low levels, with slightly more than the estimated 20–30 airplanes landing during the fall hunting seasons at any single area and some lesser amount of use for recreational fishing. Conversely, adverse, short-term impacts on opportunities for solitude would be expected if and when an increasing number of pilots choose to land their airplanes at sites containing other visitors. Impacts would be major at site-specific locations when and where such actions occur; but in general, most pilots would choose to land at alternative sites when visitors are observed at their initial desired landing location. Adverse, long-term impacts would be expected on the unconfined nature of the recreation experience. Impacts would be moderate at the local scale, and would result from restricting visitors to six designated landing areas. However, it is these very constraints that would ensure visitor experiences are characterized by solitude, a degree of challenge, and little or no interaction with other users in a remote natural setting. Finally, adverse, medium- to long-term impacts would be expected on the untrammeled condition of the area. Impacts would be major at three designated upland areas where damage and/or mortality of grasses and sedges, and the introduction of exotic and/or invasive flora occur as a result of airplane landings, taxiing, and takeoffs.

Alternative B:

Implementation of Alternative B would have similar beneficial and adverse, short- to long-term impacts on wilderness values as those described under Alternative A, except beneficial impacts on opportunities for solitude, and primitive and unconfined types of recreation; and adverse impacts on the untrammeled condition of the area would result from management prescriptions that facilitate airplane access to 13,661 acres (or 82.9 percent of the total Chickaloon Flats area).

Alternative B would have more beneficial and adverse impacts on wilderness values than Alternative A.

Alternative C:

Implementation of Alternative C would have similar impacts; beneficial and adverse, short- and long-term on wilderness values as those described under Alternative B, except impacts would be greater due to management prescriptions that would conduct regular maintenance of the Big Indian airstrip.

Alternative C would have more beneficial and adverse impacts on wilderness values than Alternative A.

Alternative D:

Implementation of Alternative D would have similar impacts; beneficial and adverse, short- and long-term on wilderness values as those described under Alternative C, except beneficial impacts on opportunities for solitude, and primitive and unconfined types of recreation; and adverse impacts on the untrammeled condition of the area would result from management prescriptions that facilitate airplane access to 16,546 acres.

Alternative D would have more beneficial and adverse impacts on wilderness values than Alternative A.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar impacts; beneficial and adverse, short- and long-term on wilderness values as those described under Alternative A, except beneficial impacts on opportunities for solitude, and primitive and unconfined types of recreation; and adverse impacts on the untrammeled condition of the area would result from management prescriptions that facilitate airplane access to 13,661 acres (or 82.9 percent of the total Chickaloon Flats area).

Alternative E would have more beneficial and adverse impacts on wilderness values than Alternative A.

4.4.12 Snowmachine Access

General Assumptions:

- Snowmachine use would continue to be allowed in designated areas (1,250,000 acres or 63 percent of the Refuge) when the Refuge manager determines there is adequate snow cover (typically more than 12 inches) to protect vegetation.
- Snowmachine access to the Refuge is facilitated by more than 1,500 miles of seismic, utility, and transmission lines, and roads.

- Snowmachine access to the Caribou Hills area specifically is facilitated by more than 16 major snowmachine trails located outside the boundaries of the Refuge that are maintained by private organizations.
- Snowmachine use would not be allowed above timberline (except for the Caribou Hills area), in the Refuge headquarters area, the Skilak Wildlife Recreation Area, and parts of the Swanson River and Swan Lake canoe systems (730,000 acres or 37 percent of the Refuge).
- Snowmachines would be used for the following activities: small game hunting, trapping, ice fishing, travel to private cabins, and winter sightseeing; however, the majority of use is expected to be recreational riding.
- The anticipated increase in population growth on the Kenai Peninsula over the life of the Plan combined with an increase in the number of winter recreational cabins on adjacent State lands and increased winter access via logging roads (i.e., roads constructed to conduct spruce bark beetle salvage operations) would result in an increase in snowmachine use on the Refuge.

4.4.12.1 Biological Environment

Consequences of Implementing Snowmachine Access Management Strategies on Vegetation

Indicators:

- Vegetation damage or loss
- Vegetation composition, density, and structure

Assumptions:

- Adequate snow cover does not occur uniformly over the Refuge due to variation in weather patterns, terrain, wind-scouring, and snow pack characteristics (e.g., density).

Alternative A (Current Management):

Implementation of Alternative A would have adverse, medium- to long-term impacts on vegetation due to management prescriptions that allow snowmachine use on 1,250,000 acres (63 percent of the Refuge). Snowmachine use would be prohibited until the Refuge manager determines adequate snow cover exists to protect vegetation, although such cover does not occur uniformly across the Refuge due to variations in weather patterns, terrain, wind-scouring, and snow pack characteristics (e.g., density). The intensity of the impacts would vary based on snow conditions and use; but in general, impacts would be expected at site-specific locations. Vegetation damage and/or mortality would result from snowmachines running over seedlings, saplings, and shrubs exposed above the snow surface; and additional damage and/or

mortality would occur below the snow surface due to snow compaction resulting from snowmachine use. Indirect impacts on the subnivean environment (the zone beneath the snow layer) would be expected resulting from compacted trails that increase the density and reduce the temperature of the snow pack. Such changes would provide moisture to vegetation in the trail area over a longer period of time during the growing season, which would result in changes in vegetation composition, density, and structure in some areas. Snowmachine use in open areas (e.g., grassy-wetlands, treeless areas, open slopes, etc.) would typically result in multiple trails that loop and cross each other. Impacts resulting from such dispersed activity would be less intense, but more widespread, than repeated use along existing trails.

Conversely, major beneficial, long-term impacts on vegetation would be expected due to management prescriptions that do not allow snowmachine use on 730,000 acres (37 percent of the Refuge).

Alternative B:

Implementation of Alternative B would have similar adverse and beneficial, medium- to long-term impacts on vegetation as those described under Alternative A, although the outcome of proposed research studies could lead to management decisions that would affect the duration, intensity, and scale of identified impacts.

Alternative C:

Implementation of Alternative C would have similar adverse and beneficial, medium- to long-term impacts on vegetation as those described under Alternative A, except additional adverse impacts resulting from snow compaction would be expected in zones (e.g., Caribou Hills) that are opened earlier than other portions of designated use areas (from December 1–April 30) depending on local snow conditions, and beneficial impacts would be expected in zones opened later than others or not opened at all due to inadequate snow conditions. Areas without adequate snow cover would remain closed, and damage and/or mortality of seedlings, saplings, and shrubs exposed above the snow surface would be minimized.

Alternative C would have more adverse and more beneficial impacts on vegetation than Alternative A due to management prescriptions that allow for greater flexibility in opening various zones of designated use areas based on local snow conditions.

Alternative D:

Implementation of Alternative D would have similar adverse and beneficial, medium- to long-term impacts on vegetation as those described under Alternative C, except additional adverse impacts resulting from snow compaction would be expected due to management prescriptions that extend the snowmachine season by eliminating the

December 1–April 30 restriction. Although the sole determination for opening zones (e.g., Caribou Hills) would be adequate snow cover, impacts resulting from snow compaction would be increased because extended snowmachine seasons would allow for use beyond current levels in such zones.

Alternative D could have more adverse impacts on vegetation than Alternative A due to management prescriptions that allow for greater flexibility in opening various zones of designated use area if those zones are opened for extended periods of time and more use occurs.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse and beneficial, medium- to long-term impacts as those described under Alternative A, although the outcome of proposed research studies could lead to management decisions that would affect the duration, intensity, and scale of identified impacts.

Consequences of Implementing Snowmachine Access Management Strategies on Wildlife

Indicators:

- Wildlife presence

Assumptions:

- Human activity causes disturbance to wildlife at varying degrees depending on the type of activity, timing of the activity, intensity of the activity, number of activities occurring simultaneously, and wildlife species affected.
- Disturbance-related impacts include direct mortality (immediate, on-site death), indirect mortality (eventual, premature death), lowered productivity (reduced fecundity or survival rate), reduced habitat use, and stress.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, short- to long-term impacts on wildlife due to management prescriptions that allow snowmachine use on the Refuge. Adverse, short- to long-term impacts on wildlife would be expected on 1,250,000 acres (63 percent of the Refuge) when and where snowmachine-wildlife encounters occur. The intensity of the impacts would vary based on the type of activity, timing of the activity, intensity of the activity, duration of the activity, and the wildlife species affected; but in general, impacts would result from intentional harassment and unintentional disturbance due to snowmachine use. At the site-specific scale, impacts would be major on the presence of wildlife when and where snowmachine-wildlife encounters occur. Disturbance-related impacts would include direct and indirect mortality, lowered productivity, reduced habitat use, and stress

resulting in increased energy loss. Direct mortality of some individuals would result from legal and illegal take of wildlife, and small mammals would be crushed or trapped in their tunnels by compacted snow resulting from passing snowmachines. Indirect mortality, lowered productivity, and reduced habitat use would result from stress due to snowmachine-wildlife encounters. Impacts would occur at a critical time when most animals are under extreme stress from winter deprivations, and energy conservation is crucial. Affected wildlife would experience an energy deficit, as more energy would be used to survive than that would be replenished. Disturbance to wintering moose and denning black and brown bears would be of special concern. The availability of carrion, predator rates, winter survival rates, and distribution patterns of some species would also be altered as a result of compacted trails.

Conversely, beneficial, long-term impacts on wildlife would be expected due to management prescriptions that do not allow snowmachine use on 730,000 acres (37 percent of the Refuge). Human-wildlife encounters would be limited to access points and along popular routes. Visitation would remain dispersed and at relatively low levels with overland travel limited to primitive means (e.g., snowshoes, cross-country skis, or dogsleds).

Alternative B:

Implementation of Alternative B would have similar adverse and beneficial, short- to long-term impacts on wildlife as those described under Alternative A, although the outcome of proposed research studies could lead to management decisions that would affect the duration, intensity, and scale of identified impacts.

Alternative C:

Implementation of Alternative C would have similar adverse and beneficial, short- to long-term impacts on wildlife as those described under Alternative A, except additional adverse impacts would be expected in zones (e.g., Caribou Hills) that are opened earlier than others (from December 1–April 30) depending on local snow conditions, and additional beneficial impacts would be expected in zones opened later than others or not opened at all due to inadequate snow conditions.

Alternative C could have more adverse and more beneficial impacts on wildlife than Alternative A due to management prescriptions that allow for greater flexibility in opening various zones within designated use areas depending on adequate snow cover.

Alternative D:

Implementation of Alternative D would have similar adverse and beneficial, short- to long-term impacts on wildlife as those described under Alternative C, except additional adverse impacts would be

expected due to management prescriptions that extend the snowmachine season by eliminating the December 1–April 30 restriction. Although the sole determination for opening zones (e.g., Caribou Hills) would be adequate snow cover, impacts resulting from disturbance would be more in those zones because the extended snowmachine seasons would allow for use beyond current levels. Moose would be particularly vulnerable during early season openings because they gather in open areas—areas that are also used by snowmachines—during the breeding season (late October and early November).

Alternative D would have more adverse and more beneficial impacts on wildlife than Alternative A due to management prescriptions that allow for greater flexibility in opening various zones within designated use areas depending on adequate snow cover.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse and beneficial, short- to long-term impacts on wildlife as those described under Alternative A, although the outcome of proposed research studies could lead to management decisions that would affect the duration, intensity, and scale of identified impacts.

4.4.12.2 Human Environment

Consequences of Implementing Snowmachine Access Management Strategies on Recreation

Indicators:

- Recreation access
- Recreation opportunity setting classification

Assumptions:

- Based on snow course survey data from the Kenai Peninsula (i.e., Kenai Moose Pens, Jean Lake, Eagle Lake, and McNiel Canyon), the Caribou Hills area will have adequate snow cover earlier than December 1 and later than April 30 during the majority of the winter seasons over the life of the Plan.
- Based on snow course survey data from the Kenai Peninsula (i.e., Kenai Moose Pens, Jean Lake, Eagle Lake, and McNiel Canyon), portions of the Refuge below 600 feet in elevation will have adequate snow cover for snowmachine use for 60 days or less in at least 6 of the next 15 winter seasons.
- That portion of the Caribou Hills above 600 feet in elevation is considered a “zone” under Alternatives C and D.
- Recreation opportunity settings are defined as discrete combinations of physical, biological, social, and managerial conditions that facilitate particular kinds of recreation experiences. Opportunity settings can be inventoried and

arrayed along a continuum from wilderness (no roads, limited facilities, dispersed use, and little management presence) to urban-industrial (paved roads, extensive development, dense use, obvious management presence).

Alternative A (Current Management):

Implementation of Alternative A would have adverse, long-term impacts on recreation access due to an "all or nothing" management strategy that uses adequate snow cover to determine when snowmachine use is allowed on 1,250,000 acres (63 percent) of the Refuge. Although the alternative would allow for an open season of 150 days (December 1–April 30) under the best snow conditions, impacts would be moderate at the Refuge-wide scale because the average open season during 1976–2006 was 109 days (73 percent of the potential open season) despite some portions of the designated use areas (e.g., Caribou Hills) frequently having adequate snow cover. Based on historical averages, portions of designated use areas with consistent periods of adequate snow cover (i.e., higher elevations) could be closed for approximately 25 percent of the potential use-season if snowfall at lower elevations is inadequate.

Conversely, beneficial, long-term impacts on the recreation opportunity setting would be expected due to an "all or nothing" management strategy that uses adequate snow cover to determine when snowmachine use is allowed on 1,250,000 acres (63 percent) of the Refuge. The intensity of the impacts would vary depending on snow conditions; but in general, major impacts would be expected at the Refuge-wide scale when inadequate snow conditions exist and snowmachine use is not allowed. Non-motorized visitors would experience a wilderness-like setting with little evidence of human use, non-crowded conditions, and virtually no management presence. Impacts would be negligible when adequate snow conditions exist and snowmachine use is allowed because the recreation opportunity setting would not change from current conditions despite increases in snowmachine ownership and use during the life of the Plan. Visitors would witness evidence of other users (e.g., compacted tracks, noise, exhaust, etc.) and encounter other users at popular use areas (e.g., Caribou Hills). Data obtained from trail counters operating in February and March 2005 indicate that a stationary person on or near an established snowmachine trail in a popular use area would encounter, on average, a snowmachine or group of snowmachines every 20–40 minutes during daylight hours.

Alternative B:

Implementation of Alternative B would have similar adverse and beneficial, long-term impacts on recreation as those described under Alternative A, although the outcome of proposed research studies could

lead to management decisions that would affect the duration, intensity, and scale of identified impacts.

Alternative C:

Implementation of Alternative C would have beneficial, long-term impacts on recreation access due to management prescriptions that would allow greater flexibility in opening snowmachine use. Impacts would be moderate at the Refuge-wide scale resulting from efforts to open specific zones earlier than others (December 1–April 30) depending on adequate snow conditions in those zones. Given past and predicted future snow conditions, some zones (e.g., Caribou Hills) would frequently be opened to snowmachine use for the entire 150-day season, which would be more than a 25 percent increase over current conditions.

Conversely, adverse, long-term impacts on the recreation opportunity setting would be expected due to management prescriptions that allow greater flexibility in opening snowmachine use. The intensity of the impacts would vary based on snow conditions; but in general, major impacts would be expected when snow conditions are adequate and snowmachine use is allowed in specific zones. When snowmachine use is allowed, visitors at popular use areas (e.g., Caribou Hills) would encounter other snowmachine users and evidence of humans in the area (e.g., compacted tracks, noise, exhaust, etc.) throughout the day. These areas would experience a reduction in the number of days without snowmachine use, which would adversely impact the recreation opportunity setting that is otherwise defined by highly natural conditions, primitive recreation activities, and relatively few visitors.

Alternative C could have more beneficial impacts on recreation access and more adverse impacts on the recreation opportunity settings than Alternative A due to management prescriptions that allow for greater flexibility in opening various zones within designated use areas depending on adequate snow cover.

Alternative D:

Implementation of Alternative D would have similar beneficial and adverse, long-term impacts on recreation as those described under Alternative C, except the intensity of impacts would be greater due to management prescriptions that extend the snowmachine season by eliminating the December 1–April 30 restriction. Allowing use to occur any time there is sufficient snow cover could substantially increase the open season in some portions of the Refuge. Past and predicted future snow conditions suggest that some areas (e.g., Caribou Hills) could be open for more than the current maximum 150 days during the life of the Plan.

Alternative D would have more beneficial impacts on recreation access and more adverse impacts on the recreation opportunity setting than Alternative A due to management prescriptions that allow for greater

flexibility in opening various zones within designated use areas depending on adequate snow cover.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse and beneficial, long-term impacts on recreation as those described under Alternative A, although the outcome of proposed research studies could lead to management decisions that would affect the duration, intensity, and scale of identified impacts.

Consequences of Implementing Snowmachine Access Management Strategies on Wilderness Values

Indicators:

- Untrammeled condition (i.e., free of intentional human manipulation)
- Opportunities for solitude
- Opportunities for primitive and unconfined types of recreation

Assumptions:

- Based on snow course survey data from the Kenai Peninsula (i.e., Kenai Moose Pens, Jean Lake, Eagle Lake, and McNiel Canyon), the Caribou Hills area will have adequate snow cover earlier than December 1 and later than April 30 during the majority of the winter seasons over the life of the Plan.
- Based on snow course survey data from the Kenai Peninsula (i.e., Kenai Moose Pens, Jean Lake, Eagle Lake, and McNiel Canyon), portions of the Refuge below 600 feet in elevation will have adequate snow cover for snowmachine use for 60 days or less in at least 6 of the next 15 winter seasons.
- That portion of the Caribou Hills above 600 feet in elevation is considered a “zone” under Alternatives C and D.

Alternative A (Current Management):

Implementation of Alternative A would have adverse, long-term impacts on wilderness values due to management prescriptions that allow snowmachine use on 1,250,000 acres (63 percent) of the Refuge when adequate snow conditions exist. Impacts would be major at site-specific locations and moderate at the local scale (e.g., Caribou Hills) as opportunities for solitude would be limited, especially during peak use periods when more snowmachines or groups of snowmachines would be encountered. Additional impacts on the untrammeled condition, and primitive and unconfined types of recreation would be expected during peak use periods as evidence of human use (i.e., compacted trails, noise, exhaust, etc.) would be observed, and non-motorized users (e.g., snowshoers, cross-country skiers, etc.) seeking a primitive experience

would be affected. At the Refuge-wide scale, adverse impacts on wilderness values would be negligible because the size of the designated use area would be able to absorb projected increases in snowmachine ownership and use during the life of the Plan.

Conversely, beneficial, long-term impacts on wilderness values would be expected on at least 730,000 acres (37 percent) of the Refuge where snowmachine use would not be allowed (i.e., the Skilak Wildlife Recreation Area, portions of the Swanson River and Swan Lake canoe systems, Refuge headquarters area, above treeline) or when such use is not allowed (prior to December 1, after April 30, or when snow cover is not adequate). Impacts would be major at the local scale and moderate at the Refuge-wide scale as outstanding opportunities for solitude and primitive and unconfined types of recreation would be available. Encounters with other groups would occur mostly at access points and popular routes as visitation would remain dispersed and at relatively low levels with overland travel limited to primitive means (e.g. snowshoes, cross-country skis, or dogsleds).

Alternative B:

Implementation of Alternative B would have similar adverse and beneficial, long-term impacts on wilderness values as those described under Alternative A, although the outcome of proposed research studies could lead to management decisions that would affect the duration, intensity, and scale of identified impacts.

Alternative C:

Implementation of Alternative C would have similar adverse and beneficial impacts on wilderness values as those described under Alternative A, except additional adverse impacts would be expected in zones (e.g., Caribou Hills) that are opened earlier than others (December 1–April 30) depending on local snow conditions, and additional beneficial impacts would be expected in zones opened later than others or not opened at all due to inadequate snow conditions.

Alternative C could have more adverse and more beneficial impacts on wilderness values than Alternative A due to management prescriptions that allow for greater flexibility in opening and closing various zones within designated use areas depending on adequate snow cover.

Alternative D:

Implementation of Alternative D would have similar adverse and beneficial impacts on wilderness values as those described under Alternative C, except additional adverse impacts would be expected due to management prescriptions that extend the snowmachine season by eliminating the December 1–April 30 restriction. Allowing use to occur

any time there is adequate snow cover could substantially increase the open season in some portions of the Refuge.

Alternative D could have more adverse impacts on wilderness values than Alternative A due to management prescriptions that allow for greater flexibility in opening various zones within designated use areas depending on adequate snow cover.

Alternative E (Preferred Alternative):

Implementation of Alternative E would have similar adverse and beneficial, long-term impacts on wilderness values as those described under Alternative A, although the outcome of proposed research studies could lead to management decisions that would affect the duration, intensity, and scale of identified impacts.

4.4.13 Cumulative Impacts

4.4.13.1 Introduction

"Cumulative impact" is defined in the Council on Environmental Quality's NEPA regulations as the "impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions" (40 CFR 1508.7). The purpose of the cumulative impact analysis is to identify the direct and indirect effects of the alternatives proposed in this Plan when added to the aggregate effects of past, present, and reasonably foreseeable future actions.

Kenai National Wildlife Refuge has been managed to fulfill Refuge purposes (as identified in the Alaska National Interest Lands Conservation Act of 1980, as amended) for over 20 years as directed by guidance provided in the Kenai National Wildlife Refuge Comprehensive Conservation Plan (1985). Other plans provide specific management direction that "steps down" from and implements the Comprehensive Conservation Plan's general direction. Implementation of these step-down management plans has had direct and indirect, beneficial and adverse impacts on the physical, biological, and socioeconomic environment. Those impacts, combined with those resulting from implementation of this Plan, are analyzed in the following text. No major development actions have been identified within the boundaries of the Refuge for the next 15 years. As a result, an analysis of the impacts associated with "reasonably foreseeable future actions" has been omitted.

4.4.13.2 Physical Environment

Alternative A:

The cumulative effects of implementing management direction proposed under Alternative A, when combined with those associated

with past management actions, would have adverse and beneficial impacts on the physical environment.

Adverse Cumulative Impacts on the Physical Environment
Air quality—which currently exhibits seasonal declines throughout portions of the Refuge due to use of wildland fire on 95 percent of the Refuge and prescribed fire use on 31 percent of the Refuge (when and where such activities occur), and vehicle use and maintenance of 92.5 miles of graveled roads (particularly during periods of high visitation)—would continue to decline under Alternative A. Although air quality would decline for short periods of time at the local scale as a result of fire use and road maintenance and/or public use of the Ski Hill Road as proposed under Alternative A, these impacts would be negligible at the Refuge-wide scale over the long-term. Soil resources—which currently suffer from contamination, compaction, and erosion at site-specific locations throughout the Refuge due to wildland fire and (to a lesser degree) prescribed fire use (when and where such activities occur); construction of anthropogenic features; and other human activities—would continue to experience those impacts under Alternative A. Although soil resources would decline as a result of use of wildland fire on 95 percent of the Refuge and wildland fire suppression activities on 3 percent of the Refuge (when and where such activities occur), and various public use management prescriptions proposed under Alternative A, these impacts would generally be found at the local and site-specific scales. Additional adverse impacts to soil resources would occur when and where new exploration and/or development activities are conducted in the Swanson River and/or Beaver Creek oil and gas units during the life of these projects, and due to airplane access on approximately 978 acres of land in the Chickaloon Flats area. Impacts to soil resources due to oil and gas development would be major in intensity and long-term in duration at site-specific locations, and negligible at the Refuge-wide scale; and minor to moderate in intensity and medium-term in duration due to airplane access in the Chickaloon Flats area. Water quality—which currently suffers declines from inorganic (e.g., litter) and organic (e.g., sediments, human waste) inputs, and toxic contamination at site-specific locations throughout the Refuge due to public use and wildland fire suppression activities—would continue to exhibit declines under Alternative A. Water quality would be adversely effected by toxic contamination associated with wildland fire suppression activities, vehicle use of the Mystery Creek Access Road and pipeline corridor (where 15 stream crossings occur), and public use in the Swanson River and Swan Lake canoe systems. These impacts would vary in intensity and would typically be short-term.

Beneficial Cumulative Impacts on the Physical Environment
Conversely, the cumulative effects of implementing management direction proposed under Alternative A would have beneficial impacts on the physical environment. Soil resources would benefit from

maintenance projects conducted along the 11-mile graveled Mystery Creek Access Road and 1.85-mile graveled Ski Hill Road when and where such activities occur, although these impacts would be minor in intensity and short-term in duration. Additional beneficial impacts would occur as a result of restoration of *most* existing industrial roads and facilities in the Swanson River and Beaver Creek oil and gas units, and in the Mystery Creek area after the life of these projects. These impacts would be major in intensity and long-term in duration. Water quality would benefit from maintenance projects conducted along the 11-mile Mystery Creek Access Road during the life of the pipeline project if those efforts occur at three stream crossings, though these impacts would be minor in intensity and short-term in duration. Additional beneficial impacts would occur on water resources as a result of restoration activities conducted in the Mystery Creek area after the life of the pipeline project. These impacts would be major in intensity and long-term in duration.

Alternative B:

Although the physical environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative B would have additional adverse and beneficial impacts on the physical environment.

<u>Adverse Cumulative Impacts on the Physical Environment</u>
Air quality would be more adversely affected than under Alternative A due to regular maintenance (i.e., grading) of Ski Hill Road, which would generate more air particulates. Declines in air quality would be found throughout the 1.85-mile road corridor for relatively short periods of time when maintenance is conducted. Soil resources would be more adversely affected than under Alternative A due to wildland fire suppression activities conducted on an additional 204,000 acres (when and where such fire occur), road construction activities that hard-surface the Sterling Highway pullout, and public use management prescriptions that allow vehicle and bicycle use in the Mystery Creek area for five additional weeks on an additional 14 miles of the pipeline corridor, and airplane access to an additional 3,519 acres in the Chickaloon Flats area. Additional adverse impacts to soil resources would occur as a result of restoring *all* existing industrial roads, pipelines and associated fixtures, and facilities in the Swanson River and Beaver Creek oil and gas units after the life of the projects, though these impacts are expected to be short-term. Water quality would be more adversely affected than under Alternative A due to wildland fire suppression activities occurring on an additional 204,000 acres where sediment loading and toxic contamination could occur in nearby waterbodies.

<u>Beneficial Cumulative Impacts on the Physical Environment</u>
Conversely, the cumulative effects of implementing management direction proposed under Alternative B would have more beneficial

impacts on the physical environment than under Alternative A. Air quality would benefit from wildland fire suppression activities conducted on an additional 204,000 acres (when and where such activities occur), which would reduce more air quality particulates and emissions resulting from wildland fire events. Soil resources would benefit from an increase in road maintenance conducted along the graveled 11-mile Mystery Creek Access Road and 1.85-mile Ski Hill Road, and additional beneficial impacts would occur when restoration of *all* existing industrial roads, pipelines and associated fixtures, and facilities in the Swanson River and Beaver Creek oil and gas units (or approximately 1,130 acres) is conducted after the life of the projects. Water quality would benefit from road maintenance and improvement projects conducted to ensure environmental protection along the 11-mile Mystery Creek Access Road during the life of the pipeline project. These actions would reduce more sediments at three stream crossings than is proposed under Alternative A.

Alternative C:

Although the physical environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative C would have additional adverse and beneficial impacts on the physical environment.

<u>Adverse Cumulative Impacts on the Physical Environment</u>
Air quality would be more adversely affected than under Alternative A due to using wildland fire as a management tool on an additional 54,500 acres, which would potentially generate more air quality particulates and emissions when and where such events occur because less suppression activity would be conducted. Soil resources would be more adversely affected than under Alternative A due to use of wildland fire prescriptions, road maintenance, and improvement activities that hard-surface 1.05 miles of the southern portion of the Ski Hill Road and the Sterling Highway pullout; and public use management prescriptions that allow vehicle use on an additional 14 miles of the Mystery Creek pipeline corridor and airplane access to an additional 3,519 acres in the Chickaloon Flats area. Additional adverse impacts on soil resources would occur as a result of public use management prescriptions that facilitate pedestrian and horse use on trails and develops up to seven primitive camping areas in the Swanson River and Beaver Creek oil and gas units after the life of the projects. Water quality would be more adversely affected than under Alternative A due to use of wildland fire prescriptions applied to an additional 54,500 acres, which could potentially result in additional sediment loading in nearby waterbodies.

<u>Beneficial Cumulative Impacts on the Physical Environment</u>
Conversely, the cumulative effects of implementing management direction proposed under Alternative C would have more beneficial impacts on the physical environment than Alternative A. Soil resources would benefit from road maintenance and improvement projects

conducted along the 11-mile Mystery Creek Access Road during the life of the pipeline project to ensure environmental protection; and public use management prescriptions that restrict vehicle use on 0.8 miles on the northern portion of the Ski Hill Road and allow natural rehabilitation of select campsites to occur in the Swanson River and Swan Lake canoe systems. Additional beneficial impacts would occur when restoration of *all* pipelines and associated fixtures, and facilities in the Swanson River and Beaver Creek oil and gas units is conducted after the life of the projects. Water quality would benefit from road maintenance and improvement projects conducted to ensure environmental protection of three streams along the 11-mile Mystery Creek Access Road during the life of the pipeline project, and Refuge regulations requiring appropriate disposal of human waste in the Swanson River and Swan Lake canoe systems.

Alternative D:

Although the physical environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative D would have additional adverse and beneficial impacts on the physical environment.

Adverse Cumulative Impacts on the Physical Environment
Air quality would be more adversely affected than under Alternative A due to using wildland fire as a management tool on an additional 54,500 acres, which would potentially generate more air quality particulates and emissions when and where such events occur because less suppression activity would be conducted. Soil resources would be more adversely affected than under Alternative A due to use of wildland fire prescriptions; restoration of *some* existing industrial roads, and *most* pipelines and associated fixtures and facilities in the Swanson River Oil and Gas Unit; road maintenance projects that hard-surface 1.05 miles of the southern portion of the Ski Hill Road and the Sterling Highway pullout; and public use management prescriptions that allow airplane access to an additional 3,837 acres in the Chickaloon Flats area. Additional adverse impacts on soil resources would occur as a result of public use management prescriptions that facilitate vehicle, pedestrian, and horse use on roads and trails; and develops up to three developed campgrounds in the Swanson River and Beaver Creek oil and gas units after the life of these projects. Water quality would be more adversely affected than under Alternative A due to use of wildland fire prescriptions applied to an additional 54,500 acres, which could potentially result in additional sediment loading in nearby waterbodies.

Beneficial Cumulative Impacts on the Physical Environment
Conversely, the cumulative effects of implementing management direction proposed under Alternative D would have more beneficial impacts on the physical environment than under Alternative A. Air quality would benefit from road maintenance and improvement projects that hard-surface the 1.05-mile southern portion of the Ski Hill Road

and reduce air particulates; and public use management prescriptions that prohibit public vehicle use of the graveled 0.8-mile northern portion of the Ski Hill Road. Soil resources would benefit from public use management prescriptions that implement vehicle closures on the 11-mile Mystery Creek Access Road and 23-mile northern portion of the pipeline corridor during the life of the project; and additional beneficial impacts would occur when restoration of *most* pipelines and associated fixtures, and facilities in the Swanson River and Beaver Creek oil and gas units is conducted after the life of the projects. Water quality would benefit from public use management prescriptions that implement vehicle closures on the 11-mile Mystery Creek Access Road and 23-mile northern portion of the pipeline corridor during the life of the project, and require use of outhouses provided at designated campsites located in the Swanson River and Swan Lake canoe systems. Additional beneficial impacts would occur when restoration of the Mystery Creek area occurs after the life of the pipeline project.

Alternative E (Preferred Alternative):

Although the physical environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative E would have additional adverse and beneficial impacts on the physical environment.

<u>Adverse Cumulative Impacts on the Physical Environment</u>
Air quality would be more adversely affected than under Alternative A due to using wildland fire as a management tool on an additional 54,500 acres, which would potentially generate more air quality particulates and emissions when and where such events occur because less suppression activity would be conducted. Soil resources would be more adversely affected than under Alternative A due to use of wildland fire prescriptions; restoration of *some* existing industrial roads, and *most* pipelines and associated fixtures and facilities in the Swanson River Oil and Gas Unit; and restoration of *all* existing industrial roads, pipelines and associated fixtures, and facilities in the Beaver Creek Oil and Gas Unit after the life of the projects, though these impacts are expected to be short-term. Additional adverse impacts to soil resources would occur as a result of road maintenance projects that hard-surface 1.05 miles of the southern portion of the Ski Hill Road and the Sterling Highway pullout; and public use management prescriptions that facilitate vehicle, pedestrian, and horse use on roads and trails, and develops up to two campgrounds in the Swanson River Oil and Gas Unit after the life of the project; vehicle use on an additional 14 miles of the Mystery Creek pipeline corridor; and airplane access to an additional 3,519 acres in the Chickaloon Flats area. Water quality would be more adversely affected than under Alternative A due to use of wildland fire prescriptions applied to an additional 54,500 acres, which could potentially result in additional sediment loading in nearby waterbodies.

Beneficial Cumulative Impacts on the Physical Environment
Conversely, the cumulative effects of implementing management direction proposed under Alternative E would have more beneficial impacts on the physical environment than under Alternative A. Air quality would benefit from road maintenance and improvement projects that hard-surface the 1.05-mile southern portion of the Ski Hill Road and reduces air particulates; and public use management prescriptions that prohibit public vehicle use of the graveled 0.8-mile northern portion of the Ski Hill Road. Soil resources would benefit from restoration of *most* pipelines and associated fixtures, and facilities in the Swanson River Oil and Gas Unit, and *all* industrial roads, pipelines and associated fixtures, and facilities in the Beaver Creek Oil and Gas Unit after the life of the projects; road maintenance and improvement projects conducted along the 11-mile Mystery Creek Access Road during the life of the pipeline project to ensure environmental protection; and natural rehabilitation of select campsites in the Swanson River and Swan Lake canoe systems. Water quality would benefit from road maintenance and improvement projects conducted to ensure environmental protection of three streams along the 11-mile Mystery Creek Access Road during the life of the pipeline project, and when Refuge regulations requiring appropriate disposal of human waste in the Swanson River and Swan Lake canoe systems are implemented.

4.4.13.3 Biological Environment

Alternative A:

The cumulative effects of implementing management direction proposed under Alternative A, when combined with those associated with past management actions, would have adverse and beneficial impacts on the biological environment.

Adverse Cumulative Impacts on the Biological Environment
The health, composition, and structural diversity of vegetation and wildlife habitat, and the presence of wildlife—which has been influenced by natural and human-induced disturbance, construction of anthropogenic features, and other human activities—would continue to be influenced by these factors under Alternative A. Vegetation and wildlife habitat would continue to exhibit declines, and the presence of some wildlife species would continue to be influenced by additional exploration and development activities conducted in the Swanson River and Swan Lake oil and gas units during the life of these projects and road maintenance projects conducted along the 11-mile Mystery Creek Access Road (that provide fertile ground for the introduction of exotic and invasive flora). These impacts would be major in intensity and long-term at site-specific locations. Additional adverse impacts on the biological environment would occur due to public use management prescriptions that facilitate vehicle and bicycle access to the Mystery Creek area, pedestrian access to the Swanson River and Swan Lake

canoe systems, airplane access to 46 lakes in the Dave Spencer Unit of the Kenai Wilderness and three designated upland areas (978 acres) in the Chickaloon Flats area, and snowmachine access to 63 percent of the Refuge when adequate snow cover exists.

Beneficial Cumulative Impacts on the Biological Environment
Conversely, the cumulative effects of implementing management direction proposed under Alternative A would have beneficial impacts on the biological environment. The health, composition, and structural diversity of vegetation and wildlife habitat and the presence of some wildlife would benefit from fire management prescriptions that favor prescribed fire use on 31 percent of the Refuge and use of wildland fire on 95 percent of the Refuge (when and where such activities occur); and public use management prescriptions that seasonally restrict vehicle access to the Mystery Creek area, airplane access to designated lakes and landing areas within the Dave Spencer Unit of the Kenai Wilderness and Chickaloon Flats area, respectively, and snowmachine access Refuge-wide depending on adequate snow cover. Additional beneficial impacts on the biological environment would occur as a result of restoration of *most* existing industrial roads and facilities in the Swanson River and Beaver Creek oil and gas units and the Mystery Creek area after the life of these projects. Increases in habitat acreages, and reductions in habitat fragmentation and human disturbance would have beneficial impacts that are major in intensity and long-term.

Alternative B:

Although the biological environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative B would have additional adverse and beneficial impacts on the biological environment.

Adverse Cumulative Impacts on the Biological Environment
The biological environment would be more adversely affected than under Alternative A due to public use management prescriptions that facilitate vehicle and bicycle access in the Mystery Creek area on an additional 14 miles of the pipeline corridor that crosses six additional streams and allows airplane access to an additional 12,506 acres in the Chickaloon Flats area. The biological environment would benefit less from use of wildland fire prescriptions than under Alternative A due to wildland fire suppression activities conducted on an additional 204,000 acres. Additional adverse impacts to the biological environment would occur as a result of restoring *all* existing industrial roads, pipelines and associated fixtures, and facilities in the Swanson River and Beaver Creek oil and gas units after the life of these projects, though these impacts would be short-term.

Beneficial Cumulative Impacts on the Biological Environment
Conversely, the cumulative effects of implementing management direction proposed under Alternative B would have more beneficial impacts on the biological environment than Alternative A. Vegetation and wildlife habitat and the presence of wildlife would benefit from road maintenance and improvement projects conducted along the 11-mile Mystery Creek Access Road to ensure environmental protection of three streams, and public use management prescriptions that prohibit airplane access to Bird Lake located in the Dave Spencer Unit of the Kenai Wilderness. Additional beneficial impacts would occur when restoration of *all* existing industrial roads, pipelines and associated fixtures, and facilities in the Swanson River and Beaver Creek oil and gas units (approximately 1,130 acres) is conducted after the life of the projects.

Alternative C:

Although the biological environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative C would have additional adverse and beneficial impacts on the biological environment.

Adverse Cumulative Impacts on the Biological Environment
The biological environment would be more adversely affected than under Alternative A due to road construction projects that remove vegetation to realign the Ski Hill Road–Sterling Highway intersection and hard-surfaces the 1.05-mile southern portion of the Ski Hill Road; and public use management prescriptions that facilitate vehicle and bicycle use in the Mystery Creek area on an additional 14 miles of the pipeline corridor that crosses six additional streams, increases pedestrian and bicycle use on the 0.8 mile northern portion of the Ski Hill Road, allows airplane access to four additional lakes in the Dave Spencer Unit of the Kenai Wilderness and on an additional 12,506 acres in the Chickaloon Flats area, and facilitates earlier snowmachine access in specific zones when adequate snow cover exists. Additional adverse impacts on the biological environment would occur as a result of public use management prescriptions that develop up to seven primitive camping areas in the Swanson River and Beaver Creek oil and gas units after the life of the projects.

Beneficial Cumulative Impacts on the Biological Environment
Conversely, the cumulative effects of implementing management direction proposed under Alternative C would have more beneficial impacts on the biological environment than Alternative A. Vegetation and wildlife habitat and the presence of wildlife would benefit from use of wildland fire prescriptions on an additional 54,500 acres; road maintenance and improvement projects conducted along the 11-mile Mystery Creek Access Road to ensure environmental protection of three streams; and public use management prescriptions that close public vehicle use to 0.8 miles of the northern portion of the Ski Hill Road, promote natural rehabilitation of degraded campsites, require

appropriate disposal of human waste in the Swanson River and Swan Lake canoe systems, and prohibit snowmachine access in specific zones due to inadequate snow cover. Additional beneficial impacts would occur as a result of restoration of *all* pipelines and associated fixtures, and facilities in the Swanson River and Beaver Creek oil and gas units after the life of the projects.

Alternative D:

Although the biological environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative D would have additional adverse and beneficial impacts on the biological environment.

Adverse Cumulative Impacts on the Biological Environment
The biological environment would be more adversely affected than under Alternative A due to road construction projects that realign the Ski Hill Road–Sterling Highway intersection and hard-surface the 1.05-mile southern portion of the Ski Hill Road; and public use management prescriptions that increase pedestrian and bicycle use on the 0.8-mile northern portion of the Ski Hill Road, allow airplane access to 14 additional lakes in the Dave Spencer Unit of the Kenai Wilderness and on an additional 15,391 acres in the Chickaloon Flats area, and extend the snowmachine season by eliminating access dates in designated areas when adequate snow cover exists. Additional adverse impacts would occur as a result of public use management prescriptions that facilitate vehicle, pedestrian, and horse use on roads and trails in the Swanson River and Beaver Creek oil and gas units, and construct up to three developed campgrounds after the life of the projects.

Beneficial Cumulative Impacts on the Biological Environment
Conversely, the cumulative effects of implementing management direction proposed under Alternative D would have more beneficial impacts on the biological environment than Alternative A. Vegetation and wildlife habitat and the presence of wildlife would benefit from prescribed fire use on an additional 1,361,500 acres, and public use management prescriptions that closes public vehicle use on the 11-mile Mystery Creek Access Road and 23-mile northern portion of the pipeline corridor during the life of the project and the 0.8-mile northern portion of Ski Hill Road. Additional beneficial impacts would occur as a result of restoration of *most* pipelines and associated fixtures, and facilities in the Swanson River and Beaver Creek oil and gas units, and in the Mystery Creek area after the life of the projects. Increases in habitat acreages, and reductions in habitat fragmentation and human disturbance would have major, long-term impacts on the biological environment when and where such activities occur.

Alternative E (Preferred Alternative):

Although the biological environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative E would have additional adverse and beneficial impacts on the biological environment.

Adverse Cumulative Impacts on the Biological Environment
The biological environment would be more adversely affected than under Alternative A due to public use management prescriptions that facilitates vehicle, pedestrian, and horse use on roads and trails and develops up to two developed campgrounds in the Swanson River Oil and Gas Unit after the life of the project; and facilitates vehicle and bicycle use in the Mystery Creek area on an additional 14 miles of the pipeline corridor that crosses six additional streams, and pedestrian and bicycle use on the 0.8-mile northern portion of the Ski Hill Road. Additional adverse impacts on the biological environment would occur as a result of airplane access to 46 lakes in the Dave Spencer Unit of the Kenai Wilderness and to an additional 12,506 acres in the Chickaloon Flats area. Restoration of *some* existing industrial roads, and *most* pipelines and associated fixtures and facilities in the Swanson River Oil and Gas Unit, and *all* industrial roads, pipelines and associated fixtures and facilities in the Beaver Creek Oil and Gas Unit after the life of these projects would also have adverse impacts, though these impacts would be short-term when restoration work is underway.

Beneficial Cumulative Impacts on the Biological Environment
Conversely, the cumulative effects of implementing management direction proposed under Alternative E would have more beneficial impacts on the biological environment than Alternative A. Vegetation and wildlife habitat and the presence of wildlife would benefit from prescribed fire use on an additional 1,361,500 acres; restoration of *most* pipelines and associated fixtures, and facilities in the Swanson River and Beaver Creek oil and gas units and in the Mystery Creek area after the life of the projects; road maintenance and improvement projects conducted along the 11-mile Mystery Creek Access Road to ensure environmental protection of three streams; and natural rehabilitation of degraded campsites and appropriate disposal of human waste requirements in the Swanson River and Swan Lake canoe systems. Additional beneficial impacts on the biological environment would occur as a result of public use management prescriptions that close public vehicle use on the 11-mile Mystery Creek Access Road and 23-mile northern portion of the pipeline corridor during the life of the project and the 0.8-mile northern portion of Ski Hill Road, and that restricts airplane access to designated lakes within the Dave Spencer Unit of the Kenai Wilderness.

4.4.13.4 Socioeconomic Environment

Alternative A:

The cumulative effects of implementing management direction proposed under Alternative A, when combined with those associated with past management actions, would have adverse and beneficial impacts on the socioeconomic environment.

Adverse Cumulative Impacts on the Socioeconomic Environment
The socioeconomic environment—which has been influenced by public use, industrial use, and past management actions—would continue to be influenced by these activities under Alternative A. Recreation access and opportunity settings would continue to be adversely affected by wildland and prescribed fire events that require access restrictions to be imposed to ensure public safety and road maintenance projects along the Ski Hill Road that generate noise and dust from grading activities. Additional adverse impacts on recreation access and opportunity settings would result from public use management prescriptions that seasonally prohibit vehicle access in the Mystery Creek area; promote user group conflicts along Ski Hill Road; crowded conditions along the Kenai River; and impose aircraft access restrictions at Chickaloon Flats and snowmachine restrictions Refuge-wide. River and wilderness values would decline as a result of additional exploration and development in the Swanson River and Beaver Creek oil and gas units and due to road maintenance projects conducted along the Mystery Creek Access Road when and where such activities occur. Additional adverse impacts to recreation access, and river and wilderness values would occur as a result of restoring *some* existing industrial roads and facilities in the Swanson River and Beaver Creek oil and gas units and in the Mystery Creek area after the life of the projects, though these impacts would typically be short-term.

Beneficial Cumulative Impacts on the Socioeconomic Environment
Conversely, the cumulative effects of implementing management direction proposed under Alternative A would have beneficial impacts on the socioeconomic environment. The local economy would benefit from additional exploration and development in the Swanson River and Beaver Creek oil and gas units during the life of the projects, and public use management prescriptions that facilitate guided sportfishing trips on the upper and middle Kenai River. These impacts would be major in intensity and long-term. Additional beneficial impacts would occur as a result of restoring *some* existing industrial roads and facilities in the Swanson River and Beaver Creek oil and gas units and in the Mystery Creek area after the life of the projects. These impacts would be major in intensity and long-term when and where such activities occur. Recreation and subsistence access would benefit from road maintenance projects that facilitate vehicle access to the Mystery Creek area; and public use management prescriptions that provide for a diversity of experiences in the Mystery Creek area, Swanson River and Swan Lake canoe systems,

the Kenai River, Chickaloon Flats, and other areas of the Refuge that are accessible by airplane, snowmachine, horseback, and foot. Additional beneficial impacts would occur as a result of restoring *some* existing industrial roads and facilities in the Swanson River and Beaver Creek oil and gas units and in the Mystery Creek area after the life of the projects. These impacts would be moderate in intensity and long-term when and where such activities occur.

Alternative B:

Although the socioeconomic environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative B would have additional adverse and beneficial impacts.

Adverse Cumulative Impacts on the Socioeconomic Environment
Cultural resources would be more adversely affected than under Alternative A due to camping restrictions implemented on the upper Kenai River; and the local economy would be more adversely affected due to public use management prescriptions that restrict guided sportfishing and/or float trips on the upper Kenai River. Additional adverse impacts to the local economy would result from restoration of *all* industrial roads within the Swanson River and Beaver Creek oil and gas units after the life of the projects, which would restrict access and limit recreational use in the area. Recreation access would be more adversely affected than under Alternative A by public use management prescriptions that restrict guided use along the Kenai River and airplane access to one lake in the Kenai Wilderness. The recreation opportunity setting would be more adversely affected than under Alternative A due to road maintenance work conducted regularly along Ski Hill Road and resulting increases in public vehicle use, and public use management prescriptions that allow airplane access to an additional 12,506 acres in the Chickaloon Flats area. Subsistence would be more adversely affected than under Alternative A due to more road maintenance and improvement projects conducted on the 11-mile Mystery Creek Access Road to facilitate public access and ensure public safety, which would result in more public use and more impacts on subsistence resources. Additional adverse impacts on subsistence would result from restoration of *all* industrial roads in the Swanson River and Beaver Creek oil and gas units after the life of the project, which would limit subsistence access. Wilderness values would be more adversely affected than under Alternative A due to an increase in wildland fire suppression activity on an additional 204,000 acres; road maintenance and improvement projects conducted on the Mystery Creek Access Road to enhance public access and safety; and public use management prescriptions that require registration in the Mystery Creek area and allow vehicles and bicycles for longer periods of time and in new portions of the pipeline corridor, and close airplane access to Bird Lake in the Kenai Wilderness. Additional adverse impacts on

wilderness values would occur as a result of restoration activities in the Swanson River and Beaver Creek oil and gas units after the life of the projects when and where such activities occur.

Beneficial Cumulative Impacts on the Socioeconomic Environment
Conversely, the cumulative effects of implementing management direction proposed under Alternative B would have more beneficial impacts on the socioeconomic environment than Alternative A. Recreation access—and in some cases, the recreation opportunity setting—would benefit from road maintenance and improvements conducted along the 11-mile Mystery Creek Access Road to ensure public safety, regular maintenance of the Ski Hill Road, and hard-surfacing the Sterling Highway pullout; and public use management prescriptions that increase vehicle and bicycle access to new portions of the Mystery Creek pipeline corridor for longer periods of time and airplane access to an additional 12,506 acres in the Chickaloon Flats area. Additional beneficial impacts to the recreation opportunity setting would result from public use management prescriptions that restrict guide use along the upper Kenai River and airplane access to one lake in the Kenai Wilderness. Subsistence access would benefit from road maintenance and improvement projects conducted along the 11-mile Mystery Creek Access Road during the life of the pipeline project. The local economy, recreation opportunity settings, and river and wilderness values would benefit from restoring *all* existing industrial roads, pipelines and associated fixtures, and facilities in the Swanson River and Beaver Creek oil and gas units and Mystery Creek area after the life of the projects, though benefits to the local economy would diminish once the projects are completed.

Alternative C:

Although the socioeconomic environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative C would have additional adverse and beneficial impacts.

Adverse Cumulative Impacts on the Socioeconomic Environment
Cultural resources would be more adversely affected than under Alternative A due to camping prohibitions implemented on the upper Kenai River; and the local economy would be more adversely affected due to public use management prescriptions that restrict guided sportfishing and/or float trips on the upper Kenai River. Recreation access—and in some cases, the recreation opportunity setting—would be more adversely affected due to road maintenance and construction projects that hard-surface the 1.05-mile southern portion of the Ski Hill Road and realign the Ski Hill–Sterling Highway intersection; and public use management prescriptions that favor additional vehicle and bicycle use over pedestrian and horse use in the Mystery Creek area, and close select campsites within the Swanson River and Swan Lake canoe systems to promote natural rehabilitation of degraded sites.

Additional adverse impacts to the recreation opportunity setting would occur as a result of public use management prescriptions that allow airplane access to four additional lakes in the Kenai Wilderness and 12,506 acres in the Chickaloon Flats area, and when snowmachine access is allowed earlier in specific zones within designated areas due to adequate snow cover. Subsistence would be more adversely affected than under Alternative A due to more road maintenance and improvement projects conducted on the 11-mile Mystery Creek Access Road to ensure public safety, and public use management prescriptions that facilitate vehicle and bicycle use in the Mystery Creek area on an additional 14 miles of the pipeline corridor, which would result in more public use and more impacts on subsistence resources. Additional adverse impacts on subsistence would result from development and use of trails and seven primitive camping areas in the Swanson River and Beaver Creek oil and gas units after the life of the projects, which would facilitate public use and adversely affect subsistence resources. Wilderness values would be more adversely affected than under Alternative A due to road maintenance and improvement projects conducted on the Mystery Creek Access Road to ensure public safety; and public use management prescriptions that require registration of the Mystery Creek area, allow vehicle and bicycle use in new portions of the pipeline corridor, airplane access to four additional lakes in the Kenai Wilderness, snowmachine access in specific zones within designated areas when adequate snow cover exist, and closes selected campsites in the Swanson River and Swan Lake canoe systems to allow for natural rehabilitation. Additional adverse impacts on wilderness values would occur as a result of restoration activities in the Swanson River and Beaver Creek oil and gas units after the life of the projects when and where such activities occur.

Beneficial Cumulative Impacts on the Socioeconomic Environment

Conversely, the cumulative effects of implementing management direction proposed under Alternative C would have more beneficial impacts on the socioeconomic environment than Alternative A. Recreation access would benefit from road maintenance and improvements conducted along the 11-mile Mystery Creek Access Road to ensure public safety and construction projects to formalize a rest stop along the Sterling Highway; and public use management prescriptions that allow vehicle and bicycle use on additional portions of the Mystery Creek pipeline, favor pedestrian and bicycle use on 0.8-miles of the Ski Hill Road, airplane access to four additional lakes in the Kenai Wilderness and an additional 12,300 acres in the Chickaloon Flats area, and earlier snowmachine access in specific zones within designated areas when adequate snow cover exist. The recreation opportunity setting would benefit from public use management prescriptions that allow natural rehabilitation of selected campsites in the Swanson River and Swan Lake canoe systems and restrict guide use along the upper Kenai River. Subsistence access would benefit from road maintenance and improvement projects conducted along

the 11-mile Mystery Creek Access Road to ensure public safety, and subsistence resources would benefit from use of wildland fire prescriptions on an additional 54,500 acres. Wilderness values would benefit more than under Alternative A as a result of less fire suppression activity; and public use management prescriptions that promote natural rehabilitation of degraded campsites in the Swanson River and Swan Lake canoe systems, and allow airplane access to an addition 12,506 acres in the Chickaloon Flats area. The local economy, recreation opportunity settings, subsistence, and river and wilderness values would benefit from restoring *all* existing industrial roads, pipelines and associated fixtures, and facilities in the Swanson River and Beaver Creek oil and gas units after the life of the projects, though benefits to the local economy would diminish once the projects are completed.

Alternative D:

Although the socioeconomic environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative D would have additional adverse and beneficial impacts.

Adverse Cumulative Impacts on the Socioeconomic Environment
Cultural resources would be more adversely affected than under Alternative A due to camping restrictions implemented on the upper Kenai River; and the local economy would be more adversely affected due to public use management prescriptions that implement a limited permit program for non-guided use and restricts guided sportfishing and/or float trips on the upper and middle Kenai River. Recreation access would be more adversely affected than under Alternative A due to public use management prescriptions that prohibit vehicle, snowmachine, and bicycle access in the Mystery Creek area, require registration and designated campsite use in the Swanson River and Swan Lake canoe systems, and restrict guide use on the upper and middle Kenai Rivers and non-guided use on the middle Kenai. The recreation opportunity setting and wilderness values would be more adversely affected than under Alternative A due to increased management presence in the Swanson River and Swan Lake canoe systems, airplane access to 13 additional lakes in the Kenai Wilderness and 15,391 acres in the Chickaloon Flats area, and extended snowmachine access in specific zones within designated areas when adequate snow cover exists. Additional adverse impacts to wilderness values would occur due to retention of *most* roads and *some* facilities, and construction and use of up to three developed campgrounds in the Swanson River and Beaver Creek oil and gas units after the life of the projects.

Beneficial Cumulative Impacts on the Socioeconomic Environment
Conversely, the cumulative effects of implementing management direction proposed under Alternative D would have more beneficial

impacts on the socioeconomic environment than Alternative A. The local economy and recreation access would be enhanced from development and public use of *most* roads, *some* facilities, and up to three developed campgrounds in the Swanson River Oil and Gas Unit after the life of the projects. Recreation and subsistence access—and in some cases, the recreation opportunity setting—would benefit from more prescribed fire use; and road maintenance and construction projects that develop a pedestrian and bicycle trail along Ski Hill Road and hard-surface the Sterling Highway pullout; and public use management prescriptions that facilitate airplane access to 13 additional lakes in the Kenai Wilderness and 15,391 acres in the Chickaloon Flats area, and extend snowmachine access in specific zones within designated areas when adequate snow cover exists. Additional benefits to the recreation opportunity setting would occur due to public use management prescriptions that reduce crowding conditions along the upper and middle Kenai River by restricting guide use. Wilderness values would benefit more than under Alternative A due to less fire suppression activities; and public use management prescriptions that prohibit vehicle, snowmachine, and bicycle use in the Mystery Creek area, campsite rehabilitation and required use of outhouses in the Swanson River and Swan Lake canoe systems, and airplane access to an additional 15,391 acres in the Chickaloon Flats area.

Alternative E (Preferred Alternative):

Although the socioeconomic environment would generally be similar to that under Alternative A, the cumulative effects of implementing management direction proposed under Alternative E would have additional adverse and beneficial impacts.

<u>Adverse Cumulative Impacts on the Socioeconomic Environment</u>
The local economy would be more adversely affected than under Alternative A due to restoration of *all* industrial roads and facilities within Beaver Creek Oil and Gas Unit after the life of the projects, which would restrict access and limit recreational use in the area; and from public use management prescriptions that restrict guided sportfishing and/or float trips on the upper Kenai River. Recreation access—and in some cases, the recreation opportunity setting—would be more adversely affected due to public use management prescriptions that favor additional vehicle and bicycle use over pedestrian and horse use in the Mystery Creek area, and that closes select campsites within the Swanson River and Swan Lake canoe systems to promote natural rehabilitation of degraded sites. The recreation opportunity setting would be more adversely affected due to public use management prescriptions that allow airplane access to an additional 12,506 acres in the Chickaloon Flats area.

<u>Beneficial Cumulative Impacts on the Socioeconomic Environment</u>
Conversely, the cumulative effects of implementing management direction proposed under Alternative E would have more beneficial

impacts on the socioeconomic environment than Alternative A. The local economy would benefit from development and public use of *most* roads, *some* facilities, and up to two developed campgrounds in the Swanson River Oil and Gas Unit and the Mystery Creek area after the life of the projects, though such benefits would diminish once restoration work is completed. Recreation and subsistence access would be enhanced from prescribed fire prescriptions; development and public use of *most* roads, *some* facilities, and up to two developed campgrounds in the Swanson River Oil and Gas Unit after the life of the project; road construction projects that develop a pedestrian and bicycle trail along Ski Hill Road, hard-surface the Sterling Highway pullout, and enhance airplane access to an additional 12,506 acres in the Chickaloon Flats area. The recreation opportunity setting would benefit from public use management prescriptions that allow natural rehabilitation of selected campsites in the Swanson River and Swan Lake canoe systems, and though guide use restrictions along the upper Kenai River. Wilderness values would benefit more than under Alternative A due to less fire suppression activities.

4.5 Mitigation

Adverse impacts resulting from the implementation of this Plan would be mitigated when and where possible, relative to the goals and objectives being implemented. Various means of mitigating impacts would be used, including avoiding the impact altogether, minimizing the impacts by limiting the degree or magnitude of the action, rehabilitating or restoring the affected environment, and compensating for the impact by replacing or providing substitute resources or environments. Mitigation may consist of standard stipulations, such as those attached to oil and gas leases; special stipulations, which may be attached to various types of leases on a site-specific basis; and site-specific, project-specific mitigation identified thorough detailed step-down plans and/or the environmental assessment process. The degree, type, and extent of mitigation undertaken would depend on the site-specific conditions present and the management goals and objectives of the action being implemented.

4.6 Relationship Between Short-Term Use of the Environment and Long-Term Productivity

Under all the alternatives, the primary on-site short-term uses of Kenai National Wildlife Refuge would be recreation (i.e., consumptive and non-consumptive) and utilization of natural resources (i.e., oil and gas development). Monitoring and regulation of fish and wildlife harvests by Alaska Department of Fish and Game and the U. S. Fish and Wildlife Service (Service) would help ensure the long-term productivity of wildlife populations. None of the short-term uses described in any of the alternatives would affect the long-term productivity of the ecosystem.

4.7 Irreversible and Irretrievable Commitment of Resources

The *irreversible* commitment of resources means that nonrenewable resources are consumed or destroyed (e.g., the destruction of cultural resources by other management activities, mineral extraction that consumes nonrenewable minerals). Alternatives A–E provide direction to manage dispersed camping along the upper Kenai River. This direction would alter public use patterns and potentially adversely affect cultural resources. Alternatives A–E would also allow for oil and gas development and production in the Swanson River, Beaver Creek, and Birch Hill oil and gas units on the Refuge during the life of those projects. No additional irreversible commitment of resources is associated with implementation of any of the alternatives proposed in this Plan.

The *irretrievable* commitment of resources represents trade-offs (opportunities forgone) in the use and management of natural resources. Irretrievable commitment of resources includes the expenditure of funds, loss of production, or restriction on resources use. Alternatives A–E would require sportfishing trip guides on the upper Kenai River to have special use permits, with additional limits imposed under Alternatives B–E; and Alternatives A–E would require sportfishing guides on the middle Kenai River to have special use permits, with additional limits imposed under Alternatives B–E. No additional irretrievable commitment of resources is associated with implementation of any of the alternatives proposed in this Plan.

4.8 Environmental Justice

All Federal agencies are required to identify and address, as appropriate, any disproportionately high adverse human health or environmental effects of its programs, policies, and/or activities on minority and low-income populations (U.S. Government 1994). This includes health risks and other impacts for people who rely principally on fish or wildlife for subsistence.

As described in chapter 3, communities associated with the Refuge can be classified (in some cases) as rural. Additionally, many of the residents of these communities have low to moderate incomes and rely on fish and wildlife resources to supplement their diets. The nature of the revision of this Comprehensive Conservation Plan is very different from the proposals often associated with environmental justice issues, such as the siting of pollution-causing facilities. None of the alternatives evaluated in the draft environmental impact statement (EIS) would place a disproportionate weight of any adverse effects on minority or low-income populations. Maintenance of high quality habitat, healthy populations of fish and wildlife, and water quality are purposes of the Refuge. The Service cannot compromise these values and their

associated uses under any management alternative. While the alternatives contain slightly different approaches to meeting the purposes, none would favor activities or projects that would direct negative impacts toward low-income or minority populations.

4.9 Section 810 Evaluation

The Alaska National Interest Lands Conservation Act (ANILCA) section 810 requires an evaluation of the effects on subsistence uses for any action to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands.

This evaluation consists of:

- A finding of whether or not a proposed action would have a significant restriction on subsistence uses
- A notice and hearing of an action is found to have a significant restriction on subsistence uses
- A three-part determination prior to authorization of any action if there is a significant restriction on subsistence uses

Chapter 3 describes the environment of the Refuge, including subsistence and other human uses. Chapter 4 describes anticipated effects of each alternative on the environment, including subsistence and other uses. Because this is a long-range programmatic plan that describes possible changes in management direction for the Refuge, it does not propose any site-specific development or allow any new types of uses or development that would pose risks to subsistence uses of the Refuge.

The preferred alternative (Alternative E) does not contain actions that would significantly reduce subsistence uses because of direct effects on wildlife or habitat resources or that would significantly increase competition for resources.

Similarly, the preferred alternative would not significantly change the availability of resources by altering their distribution or location. The general goal is to maintain habitat and wildlife populations currently occurring on the Refuge.

Finally, the preferred alternative would not significantly reduce subsistence uses because of limitations on access—by physical or legal barriers—to harvestable resources. This evaluation concludes that the actions would not result in significant restrictions of subsistence uses.

4.10 Summary Comparison of Environmental Effects

Table 4-2 provides a summary of the environmental effects described in this chapter.

4.11 References

U.S. Government. 1994. Executive Order 12898. 1994 February 11; amended January 30, 1995, by Executive Order 12998. Available at these two Web sites: http://www.epa.gov/fedrgstr/eo/eo12898.htm. and http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=1995_register&docid=fr01fe95-125.pdf. Accessed July 24, 2007.

Table 4-2. Summary Comparison of the Effects of Implementing the Alternatives

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Air Quality					
Adverse Impacts	Some temporal declines	Similar to Alternative A	Similar to Alternative A; notable differences depend on fire events	Similar to Alternative A; notable differences depend on fire events	Similar to Alternative A; notable differences depend on fire events
Soil Resources					
Adverse Impacts	Some site-specific impacts observed	More impacts observed than Alternative A	More impacts observed than Alternative A	More impacts observed than Alternative A	More impacts observed than Alternative A
Beneficial Impacts	Most benefits obtained after life of energy projects	More benefits obtained than Alternative A after life of energy projects	Benefits obtained after life of energy projects but slightly less than Alternative A	Benefits obtained after life of energy projects but slightly less than Alternative A	More benefits obtained than Alternative A after life of energy projects
Water Quality					
Adverse Impacts	Some short-term impacts observed	Similar to Alternative A; notable differences due to fire events	Similar to Alternative A; notable differences due to fire events	Similar to Alternative A; notable differences due to fire events	Similar to Alternative A; notable differences due to fire events
Beneficial Impacts	Few benefits obtained during life of pipeline project	More benefits obtained during life of pipeline project	More benefits obtained during life of pipeline project	More benefits obtained during and after life of pipeline project	More benefits obtained during and after life of pipeline project
Vegetation / Wildlife Habitat					
Adverse Impacts	Site-specific impacts observed	Similar to Alternative A	More site-specific impacts than Alternative A	More site-specific impacts than Alternative A	More site-specific impacts than Alternative A
Beneficial Impacts	Benefits obtained from fire events and restoration projects	Less benefits from fire events; more from restoration projects	More benefits from fire events; slightly less from restoration projects	More benefits from fire events; slightly less from restoration projects	More benefits obtained from fire events and restoration projects

	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Wildlife					
Adverse Impacts	Some short-term disturbance at site-specific locations	More short-term disturbance at site-specific locations	More short-term disturbance at site-specific locations	More short-term disturbance at site-specific locations	More short-term disturbance at site-specific locations
Beneficial Impacts	Benefits obtained from public use management and restoration projects	Additional benefits obtained from restoration projects	Similar to Alternative A	Less benefits obtained from public use management and restoration projects	Additional benefits obtained from restoration projects
Cultural Resources					
Adverse Impacts	Some site-specific impacts observed	Potentially more site-specific impacts than Alternative A	Potentially more site-specific impacts than Alternative A	Potentially more site-specific impacts than Alternative A	Potentially more site-specific impacts than Alternative A
Local Economy					
Beneficial Impacts	Benefits obtained from public use management prescriptions	Less benefits obtained due to guided use restrictions	Less benefits obtained due to guided use restrictions	Less benefits obtained due to non-guided and guided use restrictions	Less benefits obtained due to guided use restrictions
Recreation					
Adverse Impacts	Some long-term, local scale impacts observed	Similar to Alternative A	Slightly more long-term, local impacts than Alternative A	More long-term, local scale impacts than Alternative A	Slightly more long-term, local impacts than Alternative A
Beneficial Impacts	Benefits obtained from public use management prescriptions	More benefits obtained, largely from additional access prescriptions	More benefits obtained, largely from additional access prescriptions	More benefits obtained, largely from additional access prescriptions	More benefits obtained, largely from additional access prescriptions
Wilderness Values					
Adverse Impacts	Some long-term, local scale impacts observed	More impacts than Alternative A	More impacts than Alternative A	More impacts than Alternative A	More impacts than Alternative A
Beneficial Impacts	Some long-term, local scale benefits observed	More benefits than Alternative A	More benefits than Alternative A	More benefits than Alternative A	More benefits than Alternative A

5. Evaluation of the Alternatives

5.1 Evaluation Criteria

The alternatives described in chapter 2 of the Kenai National Wildlife Refuge (Refuge, Kenai Refuge) Comprehensive Conservation Plan (Plan) were evaluated against six criteria based on existing law and policy. These criteria were selected as being the most important factors for selecting the preferred alternative. Following are the criteria in order of importance.

1. How well does the alternative satisfy the purpose of the Refuge and other provisions of the Alaska National Interest Lands Conservation Act (ANILCA)?
2. How well does the alternative satisfy the mission of the National Wildlife Refuge System (System, Refuge System)?
3. How well does the alternative contribute to meeting the goals of the Refuge?
4. How do the alternatives address the issues and concerns identified during scoping?
5. How well does the alternative maintain biological integrity, diversity, and environmental health at the Refuge and ecosystem scales and contribute to managing the Refuge as part of an ecosystem?
6. How well does the alternative agree with Alaska Department of Fish and Game (ADF&G) management plans for the area?

Differences in how the alternatives would affect Refuge management are relatively small. Therefore, differences in meeting the evaluation criteria are slight. Alternatives that would clearly not meet the purposes of the Refuge or System mission were not developed.

The most important criterion used in evaluating the alternatives is the degree to which the alternatives achieve the purposes of the Refuge as mandated by ANILCA. Chapter 4 describes the physical, biological, and socioeconomic impacts of each of the alternatives and provides a summary of the projected changes.

5.2 Response to Refuge Purposes

All alternatives conserve fish and wildlife populations and habitats in their natural diversity; fulfill international treaty obligations; ensure water quality and necessary water quantity; provide for scientific research, interpretation, environmental education, land management

training, and fish and wildlife-oriented recreation; and protect and preserve the wilderness character of areas within the National Wilderness Preservation System. Alternatives B–E provide higher levels of protection to natural habitats and wildland values on the refuge by increasing the amount of land in the Minimal Management category. Alternative B adds 164,000 acres, Alternative C adds 189,000 acres, and Alternative D and E add 318,550 acres during the life of the Alaska Pipeline project and an additional 49,450 acres after the life of the project. Alternatives D and E would also allow prescribed and wildland fire use on 1,938,000 acres (97.5 percent of the refuge).

5.3 Response to National Wildlife Refuge System Mission

All alternatives were developed with the Refuge System mission in mind, and all contribute to meeting that mission. Each of the alternatives is similar in its contribution to the Refuge System—the national network of lands and waters charged with conserving fish, wildlife, and their habitats. The Refuge provides habitats for moose, caribou, bears, wolves, and other furbearers; salmon and other fish; and waterfowl and other migratory and nonmigratory birds.

5.4 Response to Refuge Goals

Refuge goals reflect the purposes of the refuge and the missions of the National Wildlife Refuge System and the U.S. Fish and Wildlife Service.

All alternatives provide management direction to achieve Refuge goals. Although the alternatives may differ in management strategies and tools used to ensure that fish and wildlife populations, their habitats, and other resources on the Refuge are properly cared for, they are all in conformance with law and policy. The promotion of close working relationships with the State of Alaska, local communities, and other partners is a common theme across all alternatives. Each alternative provides opportunities for compatible uses on the Refuge, including subsistence, wildlife-dependent recreation, and commercial activities. Though all the alternatives would meet resource needs and satisfy public interests, Alternatives B–E provide better options for meeting refuge goals than Alternative A. This is shown through the additional direction for monitoring and evaluation of resources on and public uses of the refuge (goals and objectives of the Refuge are found in chapter 2).

5.5 Response to Issues

This section summarizes the potential management actions that directly address the central planning issues identified in chapter 1 of this document (Table 5-1).

5.5.1 How will the Refuge address large-scale habitat changes and the use of fire?

Under Alternatives A–C, prescribed fire use would be allowed on 618,500 acres (31 percent of the refuge), though such use would be limited under Alternative A on approximately 196,000 acres (10 percent of the refuge) identified as Minimal Management. Alternatives D and E (Alternative E is the Preferred Alternative) would allow prescribed fire use on 1,938,000 acres (97.5 percent of the refuge).

Under Alternative A, wildland fire use would be allowed on 1,883,500 acres (95 percent of the refuge), and Alternative B would allow such use on 1,679,500 acres (84.5 percent of the refuge). Alternatives C–E would allow wildland fire use on 1,938,000 acres (97.5 percent of the refuge)—with wildland fire use only being the default management action in designated Wilderness (1,320,500 acres or 66.4 percent of the refuge) under Alternative C. Under Alternatives D and E, wildland fire use would be the default management action in Minimal and designated Wilderness land management categories (1,883,500 acres or 95 percent of the refuge).

5.5.2 How will the Refuge manage existing facilities for public use while ensuring resource protection?

5.5.2.1 Swanson River and Beaver Creek Oil and Gas Units

Some of the existing industrial roads and facilities in the Swanson River and Beaver Creek oil and gas units would be retained for public use (except bicycle use) under Alternative A, though none would be retained under Alternative B. Most industrial roads would be retained and converted to trails for pedestrian and horse use only under Alternative C; and Alternatives D and E (the Preferred Alternative) would retain and maintain most roads for public use, including bicycle use. No existing facilities would be retained for public use under Alternatives C–E in either oil and gas unit. In the Swanson River Oil and Gas Unit, up to five primitive camping areas would be provided for walk-in use only under Alternative C, and two developed campgrounds would be constructed under Alternatives D and E. In the Beaver Creek Oil and Gas Unit, up to two primitive camping areas would be provided for walk-in use only under Alternative C, one developed campground would be constructed under Alternative D, and no camping facilities would be provided under Alternative E.

5.5.2.2 Mystery Creek Access Road and Pipeline Corridor

Public vehicle use of the unmaintained Mystery Creek Access Road and pipeline corridor north to Chickaloon Bay would be allowed from the start of moose hunting season (approximately August 9) until snow cover under Alternative A. Under Alternative B, the access road would be improved to facilitate public access; and public vehicle use would be allowed July 1–November 30 throughout the area, including southwest access to the East Fork of the Moose River. Alternatives C and E (the Preferred Alternative) would enhance the access road to ensure public safety while providing for a primitive backcountry experience; and public vehicle use would be allowed August 9–November 30 throughout the area, including southwest access to the East Fork of the Moose River. Under Alternative D, public vehicle use of the access road and pipeline corridor would not be allowed. Pedestrian, horse, and snowmachine use would be allowed under all the alternatives. Bicycle use would be allowed from August 9 until snow cover under Alternatives A, C, and E, and May 1–November 30 under Alternative B. Alternative D would not allow bicycle use. Public use registration would not be required under Alternatives A or D, but it would be required under Alternatives B, C, and E.

5.5.2.3 Trail Planning and Development

The development of trails would be allowed in all management categories except designated Wilderness under Alternative A, though maintenance decisions would be driven by the availability of funding alone. Alternatives B–E (the Preferred Alternative) would allow for the development of trails in all management categories except designated Wilderness, but development and maintenance needs would be identified and prioritized through a concerted trail needs assessment that would include construction standards for a wide variety of trails.

5.5.2.4 Ski Hill Road

Maintenance of the graveled Ski Hill Road would be conducted by Alaska Department of Transportation and Public Facilities (ADTPF) under Alternative A and by the U.S. Fish and Wildlife Service (Service) under Alternative B; pedestrian, bicycle, and vehicle use would be allowed throughout the corridor under both alternatives. Maintenance and road improvements would be conducted by the Service under Alternatives C–E (the Preferred Alternative) with the northern portion of the road remaining graveled and open to pedestrian, bicycle, and emergency vehicle use only. The southern section of the road would be improved and hard-surfaced, and open to pedestrian, bicycle, and public vehicle use under Alternatives C–E. A pedestrian and bicycle trail would be constructed in the road right-of-way under Alternatives D and E.

5.5.2.5 Sterling Highway Pullout

Under Alternative A, the Sterling Highway Pullout at milepost 62 would be unmaintained, and public use facilities would not be provided. Under Alternatives B–E (the Preferred Alternative), the site would be developed, and public use facilities would be provided through a cooperative effort with ADTPF.

5.5.3 How will the Refuge enhance wildlife-dependent recreation opportunities?

5.5.3.1 Personal Collection of Natural Resources

Under Alternative A, personal collection of berries, mushrooms, and other edible plants, and/or the collection of shed antlers would not be allowed. Under Alternatives B–E (the Preferred Alternative), personal collection and use of unlimited quantities of berries, mushrooms, and other edible plants; and up to eight naturally shed moose or caribou antlers per person per year would be allowed.

5.5.3.2 Christmas Tree Harvesting

Under Alternative A, harvesting one black or white spruce tree (no larger than 20 feet in height) per family per year between Thanksgiving and Christmas Day for personal use would be allowed upon general announcement. Under Alternatives B–E (the Preferred Alternative), refuge-specific regulations would be drafted to allow for harvesting one black or white spruce tree for personal use.

5.5.4 How will the Refuge manage increasing public use to ensure resource and visitor-experience protection?

5.5.4.1 Swanson River and Swan Lake Canoe Systems

Under all of the alternatives, maximum group size would be limited to 15 individuals without a special use permit, and registration would be required. Alternative B would increase enforcement of the registration requirement, and Alternative D would require visitors to register via a reservation system. Alternatives A–C and E (the Preferred Alternative) would allow dispersed camping, and Alternative D would require camping in designated sites only. Alternative B would conduct a Limits-of-Acceptable-Change framework with stakeholders to guide management actions; Alternatives C and E would monitor and evaluate dispersed campsites using standard protocols, and management actions would be implemented as needed to ensure environmental protection. Alternatives C–E would implement regulations to manage human waste at campsites.

5.5.4.2 Upper Kenai River (Russian River to Skilak Lake)

Under Alternative A, non-guided public use would be allowed without restriction. Alternative B would modify existing management agreements and/or plans cooperatively with stakeholders to address

non-guided public use; and Alternatives C–E (the Preferred Alternative) would implement a limited permit program.

Under all of the Alternatives, sportfishing guides would be required to have special use permits. Permits would be limited to 20 under Alternatives A and B, reduced to 18 under C and E, and reduced to 15 under Alternative D. Reduction in permit numbers would be through attrition. Each permit would allow 10 starts per week with no more than 4 starts per day (although additional restrictions may be imposed if demand for commercial recreational services increases)—except under Alternative B, which would require additional restrictions on the timing and starts of boats beyond such levels.

State-licensed sportfishing guides not having Refuge special use permits may be issued Incidental Use Permits (IUPs) under all the alternatives except Alternative D, which would eliminate the IUP Program. Alternatives A, C, and E would issue up to three IUPs per year subject to quotas and blackout dates (additional quotas and blackout dates beyond current levels would be implemented under Alternative C); and Alternative B would limit the number of IUPs to one per year.

Dispersed camping would be allowed (except within one-quarter mile of the Sterling Highway) under all of the alternatives but would be limited to 14 days in any 30-day period under Alternative A; limited to 24 hours within any 14-day period within 100 yards of the river under Alternative B; not allowed within 100 yards of the river under Alternatives C and E; limited to 48 hours within any 14-day period within 100 yards of the river and within one mile of the Kenai River/Skilak Lake inlet/outlet under Alternative D.

5.5.4.3 Middle Kenai River (Skilak Lake Downstream to the Refuge Boundary)

Non-guided public use would be allowed without restriction under Alternatives A and B. Such use would be allowed without restriction under Alternatives C and E (the Preferred Alternative) until a Limits-of-Acceptable-Change planning process is completed with stakeholders; and Alternative D would implement a limited permit program after a public rulemaking process is conducted.

Sportfishing guides would be required to have special use permits under all of the Alternatives, though such permits would be issued without limit under Alternative A. Under Alternative B, the need to implement a permitting process would be evaluated after the conclusion of the ongoing Kenai River-wide guide process. Under Alternatives C and E, permits would be limited to the number of existing permittees, and existing permittees would be “grandfathered”; under Alternative D, permits would be limited to 20 through a competitive selection process, and management of the timing and starts of boats would be initiated.

5.5.5 How will the Refuge balance motorized access with resource and visitor-experiences protection?

5.5.5.1 Airplane Access to Lakes in Designated Wilderness

Under all the alternatives, airplane access would not be allowed May 1–September 30 on any lake where nesting trumpeter swans and/or their broods are present except on two lakes in designated Wilderness—where the closure would be May 1–September 10 under Alternatives A–C and E—and four lakes in designated Wilderness plus one lake outside of designated Wilderness under Alternative D. Airplane access would be allowed on 46 lakes in designated Wilderness under Alternative A and E (the Preferred Alternative); 45 lakes under Alternative B; 50 lakes under Alternative C; and 59 lakes under Alternative D.

5.5.5.2 Airplane Access to Chickaloon Flats

Under all the alternatives, floatplane access to Chickaloon Flats would be allowed on 6.5 miles of the Chickaloon River. Under Alternative A, wheeled airplane access would be allowed year-round within designated areas of the Chickaloon Flats area, including three upland landing zones, a designated beach zone, and the unmaintained Big Indian Creek airstrip. Under Alternatives B–E (the Preferred Alternative), wheeled airplane access would be allowed on 21 square miles of unvegetated portions of the Chickaloon Flats area. Access would also be allowed on the unmaintained Big Indian Creek airstrip under Alternatives B and E. Under Alternatives C and D, access would be allowed on the Big Indian Creek airstrip, which would be maintained by the Service; and under Alternative D, an additional 6.8 square miles of unvegetated portions of the Chickaloon Flats would be accessible September 1–December 15 (or to coincide with future waterfowl hunting seasons).

5.5.5.3 Snowmachine Access

Under Alternatives A–C and E (the Preferred Alternative), snowmachines would be allowed in designated areas December 1–April 30 when the Refuge manager determines there is adequate snow cover. Under Alternative C, certain zones within designated areas may be opened earlier (than December 1) or later (than April 30) depending on local snow conditions. Under Alternative D, the December 1–April 30 time restriction would be eliminated, and certain zones within designated areas may be opened depending on local snow conditions. Under Alternatives B–E, studies would be conducted with stakeholders to evaluate the effects of snowmachine use on Refuge resources and visitor experiences, and the results of those studies would be used to support future management decisions.

5.6 Response to Biological Integrity and Ecosystem Management

Service policy on maintaining biological integrity, diversity, and environmental health of the Refuge System provides Refuge managers with direction while achieving Refuge purposes. Policy provides a means to evaluate refuges and—through resource assessment, planning, and compatibility processes—set appropriate management direction to maintain and, where appropriate, restore biological integrity, diversity, and environmental health. Consistent with this policy and Refuge purposes, each alternative evaluated in this Plan provides management direction that maintains the biotic and abiotic conditions on the Refuge within historic ranges. Natural processes are the dominant forces at work within the refuge. Prompted by U.S. Fish and Wildlife Service policy and public concerns, all action alternatives, including the preferred alternative would continue, for the most part, longstanding Refuge management practices. Additionally, new objectives designed to improve conservation of biological integrity, diversity, and environmental health through improved environmental monitoring would be implemented.

Hunting, fishing, and wildlife observation would continue to dominate public use of the Refuge. Continued compatibility of these activities would be ensured through effective use of education and management by State and Federal regulatory actions.

Ecosystem management is more a way of thinking than an end product. It embodies the concepts of a constantly changing landscape and recognizes and incorporates the role that humans play in affecting their environment. It compels Refuge staff to examine local, Refuge, and regional scales to improve understanding of the effects of conservation actions. It also requires the manager to consider long-term and cumulative effects of actions over years and decades.

The Service divided Alaska into several broad ecosystems and established interdisciplinary teams to address issues within each of the ecosystems. Kenai Refuge is located within the Cook Inlet Basin Ecoregion, which is bounded by the Alaska Range Ecoregion to the north, the Chugach–St. Elias Mountain Ecoregion to the east, Kachemak Bay to the south, and Cook Inlet to the west. These interdisciplinary teams disbanded in 2004 due to travel and funding restrictions that prevented meetings from occurring. However, the Service continues to apply an ecosystem approach to management of the Refuge. All alternatives maintain the biological integrity, diversity, and environmental health of the Refuge and integrate scientific knowledge into its management.

Table 5-1. Evaluation of the Alternatives Based on Significant Planning Issues

Issue / Concern	Alternative A (Current Management)	Alternative B	Alternative C	Alternative D	Alternative E (Preferred Alternative)
How will the Refuge Address Large-Scale Habitat Changes and the Use of Fire?					
	Habitats managed with prescribed fire use on 618,500 acres and wildland fire use on 1,883,500 acres.	Less management flexibility to address habitat changes.	Slightly more management flexibility to address habitat changes.	Much more management flexibility to address habitat changes.	Much more management flexibility to address habitat changes.
How will the Refuge Manage Existing Facilities for Public Use While Ensuring Resource Protection?					
	Facilities managed for public use include oil and gas units (after the life of the projects), Mystery Creek area, trails, Ski Hill Road, and Sterling Highway pullout.	Slightly more management of facilities for public use; more resource protection.	More management of facilities for public use; slightly less resource protection.	More management of facilities for public use; more resource protection.	Much more management of facilities for public use; slightly less resource protection.
How will the Refuge Enhance Wildlife-Dependent Recreation Opportunities?					
	Opportunities to collect natural resources and harvest Christmas trees for personal use limited.	More opportunities for wildlife-dependent opportunities.	More opportunities for wildlife-dependent opportunities.	More opportunities for wildlife-dependent opportunities.	More opportunities for wildlife-dependent opportunities.
How will the Refuge Manage Increasing Public Use to Ensure Resource and Visitor-Experience Protection?					
	Public use managed at Swanson River and Swan Lake canoe systems and Kenai River.	Slight increases in management of public use to ensure protection of visitor experiences.	Increases in management of public use to ensure protection of visitor experiences.	Additional increases in public use to ensure protection of visitor experiences.	Increases in management of public use to ensure protection of visitor experiences.
How will the Refuge Balance Motorized Access with Resource and Visitor-Experience Protection?					
	Airplane and snowmachine access managed refuge-wide.	Motorized access slightly increased to enhance visitor experience; slightly less resource protection.	Motorized access increased to enhance visitor experience; less resource protection.	Motorized access increased more to enhance visitor experience; less resource protection.	Motorized access slightly increased to enhance visitor experience; slightly less resource protection.

5.7 Response to Area-Related ADF&G Management Plans

This Comprehensive Conservation Plan was developed in consultation with the Alaska Department of Fish and Game (ADF&G). The U.S. Fish and Wildlife Service (Service) routinely consulted with ADF&G personnel during the planning process. ADF&G personnel had the opportunity to participate in all planning team meetings. The Plan attempts to achieve a high level of consistency with ADF&G management plans and objectives for fish and wildlife, as discussed in chapter 2, Section 2.2: Refuge Purposes, Goals, and Objectives. All alternatives acknowledge ADF&G's role in managing fish and wildlife on national wildlife refuges, consistent with the Master Memorandum of Understanding (Volume 2, Appendix B).

6. Implementation and Monitoring

6.1 Introduction

Implementation of the Kenai National Wildlife Refuge Comprehensive Conservation Plan (Plan) will be accomplished, in part, by means of various step-down management plans (section 6.3 and 6.4). Each step-down plan has its own program focus, identifying and directing the implementation of strategies (actions, techniques, and tools) designed to achieve programmatic objectives outlined in the Plan. Part of the implementation process also includes identifying partnership opportunities section 6.5) that result in implementing strategies and that accomplish Refuge objectives, as discussed in chapter 2, section 2.2.

Monitoring the progress of plan implementation is accomplished by a variety of methods, including surveys, inventories, and censuses (section 6.6). Evaluation of monitoring results may lead to amendment or revision of the Plan (section 6.7).

6.2 Regulations

New regulations will be necessary to implement portions of the Final Revised Kenai National Wildlife Refuge Comprehensive Conservation Plan. These regulations will generally supplement existing regulations at 50 CFR 36.39. Some of the proposed regulatory changes will be specific to implement the preferred alternative: others may be necessary to implement specific goals or objectives. Additionally, proposed changes may be desirable to better define or manage uses that have not undergone regulatory review in over 20 years. Finally, some of the regulatory changes proposed for Kenai Refuge could be proposed more broadly to affect all Alaska National Wildlife Refuges. In all cases, the proposed new rules will be published as proposed rules and vetted through a public involvement process. After the public review period is complete, comments will be reviewed and considered. Final regulations will then be published after which they can be implemented.

6.3 Current Step-Down Plans

Step-down management plans deal with specific management subjects. They describe management strategies and implementation schedules and provide details necessary to implement management strategies identified in the Comprehensive Conservation Plan (USFWS 2000). Current step-down plans for the Refuge include the following.

6.3.1 Cabin Management Plan

The Cabin Management Plan provides direction for public use cabins within the Refuge. Any new cabin program must conform to statewide Refuge regulations and be compatible with Refuge purposes. This plan was completed in 2004 and is scheduled to be updated within two years of this Plan's approval.

6.3.2 Caribou Management Plan

The Caribou Management Plan provides direction to manage and maintain caribou populations at levels commensurate with long-term habitat protection. It provides for herds to expand into suitable but unoccupied ranges; provides for multiple uses of herds; and promotes development of scientific research opportunities. This plan was completed in 2003. There are no plans to revise it at this time.

6.3.3 Fire Management Plan

The Fire Management Plan defines wildland fire management objectives and provides appropriate guidelines for fire suppression, fire use, and fuels management activities needed to guide Refuge managers in making land-use decisions to achieve specific resource management objectives. This plan was completed in 2001 and is scheduled to be updated within three years of this Plan's approval.

6.3.4 Fishery Management Plan

The Fishery Management Plan provides management direction necessary to ensure conservation of fishery resources and habitats on the Refuge while maintaining sustainable harvests. Specific goals, objectives, and tasks were identified for completion over a five-year planning window (1995–2000). This plan was completed in 1995 and is scheduled to be updated within two years of this Plan's approval.

6.3.5 Furbearer Management Plan

The Furbearer Management Plan provides specific guidance for furbearer management and uses, including trapping. This plan was completed in 1988. There are no plans to revise it at this time.

6.3.6 Kenai Peninsula Brown Bear Conservation Strategy

The Kenai Peninsula Brown Bear Conservation Strategy identifies the policies and management actions on public lands that will help ensure the future of brown bears and their habitat on the Kenai Peninsula. Stakeholder recommendations are developed for minimizing human-bear interactions; improving land use and management planning; improving public education and outreach; and future research. This plan was completed in 2000 by the Alaska Department of Fish and Game. There are no plans to revise it at this time.

6.3.7 Kenai River Comprehensive Management Plan

The purpose of the Kenai River Management Plan, in part, "is to provide effective direction to the management of the fishery and wildlife resources, sensitive habitat areas, recreational, and development activities in the Kenai River Special Management Area and those areas adjacent to it." The Refuge continues to support this plan and will strive to fulfill its obligations as described. This plan was completed by Alaska Department of Natural Resources and the Kenai Peninsula Borough in 1986 and revised in 1997. There are no plans to revise it at this time.

6.3.8 Kenai River Easement Management Strategy

The Kenai River Easement Management Strategy provides direction to protect streambank habitat on the north and south sides of the Refuge portions of the Kenai River between miles 25.1 and 28.0 (adjacent to the Moose Range Meadows Subdivision and Salamatof Native Association). It seeks to reduce accelerated vegetation trampling, soil erosion, and actual riverbank loss associated with two 25-foot easements that run along the Kenai River. This plan was completed in 1996. There are no plans to revise it at this time.

6.3.9 Moose Management Plan

The Moose Management Plan provides direction for a long-term habitat management program. It defines area-specific objectives and total acreage to be manipulated. It seeks to develop standardized, systematic population assessments that include aerial surveys, habitat evaluations, and direct animal assessments. It identifies area-specific sex and age objectives, recommends harvest strategies, and identifies data needs and research priorities. This plan was completed in 1996 and is scheduled to be updated within two years of this Plan's approval.

6.3.10 Skilak Wildlife Recreation Area Management Plan

The Skilak Wildlife Recreation Area Management Plan provides direction for managing the area, primarily for wildlife viewing and other forms of non-consumptive recreation such as environmental education, interpretation, photography, etc. The plan also provides overall management direction of the area, including facilities management and development. This plan was completed in 2007. There are no plans to revise it at this time.

6.3.11 Swanson River and Swan Lake Road Visitor Facilities Rehabilitation

The Swanson River and Swan Lake Road Visitor Facilities Rehabilitation Environmental Assessment provides direction to improve public access, enjoyment, and safety of the Swanson River and Swan Lake roads, and to help protect wildlife, wildlife habitat, and wilderness values from long-term impacts. It proposes to construct improvements to sections of the roads and adjacent facilities. This plan was completed in 2003. There are no plans to revise it at this time.

6.3.12 Upper Kenai River Commercial Visitor Services Management Strategy

The Upper Kenai River Commercial Visitor Services Management Strategy provides direction to cap the number of Refuge "special use permits" that are authorized to non-angling river float trips on the Refuge section of the upper Kenai River downstream to Skilak Lake at 1996 levels. The plan mitigates existing crowding, prevents future crowding and congestion, meets established Kenai River management objectives, protects the river's wildland character and wildlife resources, and fosters public safety. This plan was completed in 1996. There are no plans to revise it at this time.

6.3.13 Upper Kenai River Cooperative Plan

The Upper Kenai River Cooperative Plan was developed using the Limits-of-Acceptable-Change process and seeks to guide agencies' future management actions in an attempt to reach a collective vision of the river. This plan was completed jointly by Alaska Department of Natural Resources, the Alaska Department of Fish and Game, the U.S. Forest Service, and the U.S. Fish & Wildlife Service in 1997.

6.3.14 Wolf Management Operational Plan

The Wolf Management Operational Plan identifies a wolf management strategy for the Refuge that is jointly implemented by the U.S. Fish & Wildlife Service and Alaska Department of Fish and Game. This plan was completed in 1988 and is scheduled to be updated within two years of this Plan's approval.

6.3.15 Land Protection Plan

The Kenai Refuge Land Protection Plan focuses on the acquisition of private lands located within the external boundaries of the Refuge. This plan was completed in 1994.

6.4 Future Step-Down Plans

6.4.1 Terrestrial and Aquatic Invasive Species Management Plan

The purpose of the Invasive Species Management Plan is to develop an integrated pest management (IPM) approach to managing (including early detection, monitoring, control, or eradication) exotic and invasive plants and animals. This plan will be completed within five years of this Plan's approval.

6.4.2 Sqilantnu Archeological District Management Plan

The purpose of the Sqilantnu Archeological District Management Plan will be to document all cultural resources associated with this archeological district and to develop a comprehensive management plan. This plan will be completed within five years of this Plan's approval.

6.4.3 Stepanka Archeological District Management Plan

The purpose of the Stepanka Archeological District Management Plan will be to document all cultural resources associated with this archeological district and to develop a comprehensive management plan. This plan will be completed within three years of this Plan's approval.

6.4.4 Kenai Law Enforcement Operations Plan

The purpose of the Kenai National Wildlife Refuge Law Enforcement Operations Plan is to provide the Service, Region 7 administrators, and Refuge employees with the standard operating procedures and policies concerning law enforcement operations on the Kenai Refuge. This plan will be completed immediately upon this Plan's approval.

6.4.5 Kenai Trails Needs Assessment and Management Plan

The purpose of the Kenai Trail Needs Assessment and Management Plan will be to document all trails located on the Refuge; identify maintenance needs and construction standards; and propose development of a wide variety of trails. This plan will be completed within three years of this Plan's approval.

6.4.6 Kenai Refuge Sign Plan

The purpose of the Kenai Refuge Sign Plan will be to document all signs located on the Kenai Refuge and to complete an assessment of all maintenance, replacement, and development needs. This plan will be completed within three years of this Plan's approval.

6.4.7 Kenai Wilderness Stewardship Plan

The purpose of the Kenai National Wildlife Refuge Wilderness Stewardship Plan will be to provide the Service, Region 7 administrators, and Refuge employees with the standard operating procedures and policies concerning Wilderness management on the Kenai Refuge. This plan will be completed immediately upon this Plan's approval.

6.4.8 Wildland Fire Monitoring Plan

The purpose of the Wildland Fire Monitoring Plan will be to help fire managers improve the coordination and effectiveness of project implementation. It will allow for the use of National Fire Plan funds to accomplish long-term fire monitoring activities. This plan will be completed within three years of this Plan's approval.

6.4.9 Wildlife Inventory and Monitoring Plan

The purpose of the Inventory and Monitoring Plan will be to consolidate related tasks that were identified in (or are derived from) this Revised Comprehensive Conservation Plan. These plans will adhere to the new Region 7 inventorying and monitoring template. This plan will be completed within two years of this Plan's approval.

6.4.10 Research Natural Areas Management Plan

The plan will include discussions of related policy and law and identify goals and objectives to incorporate the designated areas on the refuge into an integrated ecological monitoring and research program.

6.5 Partnership Opportunities

Because the Refuge exists within a dynamic ecosystem and many of its resources are of national and international importance, members of the public, organizations, and other government agencies have interests in the Refuge and the work the U.S. Fish & Wildlife Service does. Successful implementation of many Refuge programs requires active community participation, support, and assistance. Partnerships are among the best ways for the Refuge to accomplish its work and fulfill its mission, and it seeks opportunities with others to do that work, including but not limited to the following:

- Cook Inlet Regional, Inc. (the regional Native corporation)
- Local village corporations
- Local village councils
- Kenai Peninsula Borough
- Local municipalities and cities
- State of Alaska

- Other Federal agencies
- Universities and museums
- Nongovernmental organizations
- Local businesses
- South Central Federal Subsistence Regional Advisory Council
- Friends of Kenai National Wildlife Refuge

6.5.1 Existing Partnerships

6.5.1.1 Biological Partnerships

Refuge biologists and the Alaska Department of Fish and Game (ADF&G) routinely collaborate to assess status and trends of brown bear, moose, mountain goat, caribou, and Dall sheep populations. They also coordinate fisheries activities with the Kenai Fish and Wildlife Field Office and ADF&G. These activities range from management and research to gathering baseline data on fishery use on waters within the Refuge.

6.5.1.2 Sterling Highway Partnership

The Sterling Highway near mileposts 70 and 72 have some of the highest moose-vehicle collision rates for a rural road in the State. The Alaska Department of Transportation and Public Facilities proposed reconstructing the highway between mileposts 58 and 79, of which 18 miles occur within the Kenai Refuge. There is a growing national concern for reducing wildlife-vehicle collisions through wildlife crossing structures, signs, fencing, lighting, and other techniques.

Wildlife-vehicle collisions result in major financial costs in property damage, human injuries and/or fatalities, and wildlife losses. Moose—as the largest member of the deer family—cause the highest cost per accident. While moose make up 85 percent of the wildlife-vehicle collisions on this 21-mile stretch of highway, black and brown bears and caribou are also killed. The Refuge is working in partnership with the Federal Highway Administration, Alaska Department of Transportation and Public Facilities, Alaska Department of Fish and Game, Alaska Department of Public Safety, and the Alaska Moose Federation to reduce the number of wildlife-vehicle collisions while maintaining the permeability of the highway and enhancing habitat connectivity.

The Refuge is collecting three sets of data: movement data of GPS collared moose, wildlife-vehicle collision data and road kill reports, and data collected from a call-in wildlife hotline. These data, collected two years preconstruction, will be used to identify “hot spots” where significant crossings of the highway occur and use that

to aid in the design and placement of wildlife crossing structures and other methods and techniques to reduce wildlife-vehicle collisions while maintaining wildlife corridors across the Sterling Highway. A postconstruction phase of the study will help determine the success of our cooperative effort.

6.5.1.3 Christmas Bird Count Partnership

Refuge staff assists with the annual Audubon Christmas Bird Count.

6.5.1.4 Long Term Ecological Monitoring Partnership

The Long Term Ecological Monitoring Program (LTEMP) continues to be developed. The goal of LTEMP is to inventory and monitor biota on permanent points systematically distributed across the Refuge at five-kilometer intervals. Through a 2004 Memorandum of Understanding (MOU), LTEMP is formally linked with the U.S. Department of Agriculture Forest Inventory and Analysis program as an adjunct inventory.

6.5.1.5 Alaska Landscape Cumulative Effects Partnership

The Refuge continues to sponsor development of the Alaska Landscape Cumulative Effects Simulator (ALCES) through the nonprofit Kenai Watershed Forum (http://www.kenaiwatershed.org/effectsmodel.html). ALCES models the cumulative effects of natural processes and anthropogenic disturbances on the Kenai Peninsula (Peninsula). As a planning tool, ALCES can be used to evaluate future scenarios of management alternatives at the strategic level. An ALCES consortium was formally established among 11 partners with the signing of an MOU in 2005.

6.5.1.6 Invasive Species Partnership

The Refuge continues to expand its invasive species work through a collaborative effort with the National Wildlife Refuge System Invasive Species Program, U.S. Geological Survey-Biological Resources Division (USGS-BRD), National Institute of Invasive Species Science, and Burned Area Emergency Rehabilitation (BAER).

6.5.1.7 University Partnerships

Refuge biologists serve as adjunct faculty at the University of Alaska Fairbanks, Colorado State University, and the Alaska Pacific University, which furthers opportunities for graduate research in such topics as ecological constraints on marten distribution, climate change, arthropod taxonomy and distribution, rising tree line, and shrub invasion of drying wetlands.

6.5.1.8 Visitor Contact Partnerships

The Refuge Visitor Center, located in the headquarters area and operated in conjunction with the Alaska Natural History Association (ANHA), provides information and education services highlighting natural and cultural resources and recreation opportunities on the Kenai Peninsula. In addition, the Visitor Contact Station located in the Skilak Wildlife Recreation Area—which is operated seasonally by volunteer Student Conservation Association interns—provides information and education services to travelers along the Sterling Highway.

6.5.1.9 Environmental Education and Outreach Partnerships

Environmental education and outreach programs are conducted in coordination with the Kenai Peninsula School District, local homeschool groups, Scout groups, State agencies, other Federal agencies, local libraries, and other community organizations.

6.6 Monitoring and Evaluation

Monitoring helps the Refuge track the progress of implementing the Plan. The results of monitoring show how objectives are being achieved and measure progress towards accomplishing goals. Table 6-1 displays proposed inventory and monitoring projects that would concern wildlife, fisheries, and their habitats. Table 6-2 displays proposed monitoring indicators for public use. Proposed monitoring will be refined as the wildlife and habitat inventory and monitoring, fisheries management, and public-use management step-down plans are prepared or revised.

6.7 Plan Amendment and Revision

Periodic review and change of this Comprehensive Conservation Plan will be necessary. As knowledge of Refuge resources, users, and uses improves, changes in management may be identified. Fish and wildlife populations, user groups, adjacent land users, and other management considerations change with time—often in unforeseen ways. Challenges also may be encountered in trying to implement the Plan.

Revisions are a necessary part of the adaptive management approach used by the Service. This means that objectives and strategies to reach goals can be adjusted. Most of the resulting changes will fine-tune the Plan. These changes will not require modification of this document because minor changes will be addressed in the more detailed Refuge step-down and annual work plans. Only a major change in management of the Refuge will make it necessary to revise this Plan with a new environmental impact statement.

To enable Refuge users; adjacent landowners; local, State, and Federal agencies; and other interested parties to express their views on how the Refuge is being managed, the Refuge will periodically hold meetings or use other techniques (e.g., comment cards and surveys) to solicit comments for evaluation purposes. By encouraging continuing public input, the Refuge will be better able to serve the public, to determine potential problems before they occur, and to take immediate action to resolve existing problems.

Every three to five years, Refuge staff will review public comments, local and State government recommendations, staff recommendations, research studies, and other sources to determine if revisions to the Plan are necessary. If major changes are proposed, public meetings may be held, and new environmental assessments and environmental impact statements may be necessary. Full review and updating of the Plan will occur every 15 years.

6.8 Acronyms

The following acronyms are specific to Table 6-1 and Table 6-2.

AAQS	Ambient Air Quality Standard
ADOT	Alaska Department of Transportation and Public Facilities
AIC	Akaike's Information Criterion
AKEPIC	Alaska Exotic Plant Information Clearinghouse
ALMS	Alaska Landbird Monitoring System
AWFCG	Alaska Wildland Fire Coordinating Group
BBS	Breeding Bird Survey
BP	Before Present
CBC	Christmas Bird Count
CNIPM	Committee for Noxious and Invasive Plants Management
DEC	(Alaska) Department of Environmental Conservation
DEM	Digital Elevation Model
DLP	Defense of Life or Property
EE	Environmental Education
EPA	(U.S.) Environmental Protection Agency
FAA	Federal Aviation Administration
FIA	Forest Inventory and Analysis
FMH	Fire Monitoring Handbook
FPA	Fire Program Analysis
FRCC	Fire Regime Condition Class

IMPROVE	Interagency Monitoring of Protected Visual Environments
LAC	Limits-of-Acceptable-Change
LE	law enforcement
LTEMP	Long-Term Ecological Monitoring Program
NGO	Non-governmental organization
NOTAM	Notice to Airmen
NRCS	National Resource Conservation Service
NWRS	National Wildlife Refuge System
OMB	Office of Management and Budget
PM	Particles of Mass
PET	Potential Evaportranspiration
PSD	Prevention of Significant Deterioration
RAWS	Remote Automated Weather Stations
RNA	Research National Area
SE	Standard Error
SUPE	Sample Unit Probability Estimator
USGS	U.S. Geological Survey
UV	Ultra Violet
WA	Wilderness Act
WUI	Wildland/Urban Interface

Table 6-1. Biological Inventorying and Monitoring Plan

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
Objectives:					
1.1 Continue long-term monitoring of vegetative responses to fire on 3 sets of permanent plots: Hakala, Fire Monitoring Handbook (FMH), and Forest Inventory and Analysis (FIA)	How does vegetation respond to wildfire?	Evaluate variation in species composition and structure at different time intervals post fire	Statistically significant change in density (stem density), dominance (basal area), or frequency (occurrence) of plant species	Modify fire prescriptions for moose habitat enhancement, WUI or other habitat modifications	Resample Hakala plots every 5 years, FMH every 3–5 years, and FIA plots every 10 years
1.3 Continue annual monitoring of snowshoe hare populations on five established sites	Where are we in the snowshoe hare-lynx cycle?	Evaluate annual variation in hare pellet counts at five sites	Periodicity of cycle (not amplitude)	Critical data for considering translocation or reintroduction efforts, and for interpreting variation in harvest of furbearer populations (particularly lynx); recommend changes in hunting/trapping regulations to State Board of Game	Resample 5 sites annually

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
1.4 Host at least one funded, cooperative fire research project every 3–5 years on the Refuge to maintain established working relationships with the fire science community and to improve the working knowledge of Refuge fire managers and ecologists in boreal ecosystems	What are the interagency, prioritized information and research needs of the Refuge, the Refuge System in Alaska, and other land and fire managers in the Northern Hemisphere?	Research project proposals	AWFCG Research and Monitoring Committee prioritized fire research needs list and Joint Fire Science Committee	Re-establish working relationships with interagency fire research committees and others in the fire science community	Review lists annually and collaborate with cooperators on selected projects
1.5 Complete the ongoing population assessment of steelhead trout in the Kasilof River watershed	What is the current status of steelhead trout in the Kasilof River watershed?	Timing and size of runs from video weirs	Compare future returns with baseline escapement (2005, 2006)	Recommend changes in the fishing regulations to State Board of Fisheries; special protection for Crooked and Nikolai creeks	Repeat as need arises
1.6 Establish 5 permanent stations in peatlands to measure the annual accumulation rate of peat moss	How quickly are wetlands drying?	mm/year accumulation	Compare current rate of accumulation with historic rates (~6000 years BC) of accumulation as determined from peat cores	Critical data for determining strategic response to drying wetlands including loss of carbon sequestration	Sample annually for >3 years to establish baseline

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
1.7 Develop a supervised classification of vegetation communities on the Kenai Peninsula from LANDSAT imagery (30m resolution)	What is the current distribution of vegetation communities?	Classification accuracy >80% at all resolutions	None	Critical data for developing wildlife-habitat models and for monitoring landscape-level changes in vegetation and physical features (lakes, glaciers)	Once to establish baseline
1.8 Complete the archiving of all historical fisheries and limnological information in a database that will be compatible with the Refuge's GIS	What are the baseline conditions of the Refuge's waterbodies?	Conductivity, pH, depth, turbidity		Critical data for evaluating system changes in water quality and/or fisheries communities	Need to better establish baseline conditions (multiple sampling within year); more rigorous monitoring is needed; consider re-surveying selected lakes every 10 years
1.9 Enhance the Peninsula-wide meteorological station network by increasing the number and quality of stations in cooperation with interagency partners	How is local climate changing?	Currently have 10 RAWS on the Peninsula that record hourly values of air temperature, dew point, relative humidity, wind speed, wind direction, precipitation, fuel temperature, fuel moisture	Additional sensors would measure soil temperature at several depths, soil heat flow, soil moisture, and duff moisture; additional stations would be established on the western Peninsula for better coverage	Better estimates of fire behavior and fuels; develop estimates of potential evapotranspiration (PET) and hence the daily water and energy budgets	Continuous monitoring

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
1.11 Complete fuels classification mapping to meet national fire plan goals for the LANDFIRE, FRCC and FPA projects	What is the distribution of fuels classes?	Fuel models (40 American, Canadian, or other classification system)	AWFCG fuels crosswalk	Critical data for use of accepted fire behavior prediction models	As needed in response to landscape level vegetation disturbances
1.12 Complete a population assessment of rainbow trout in the Kenai River below Skilak Lake	What is the current status of the rainbow trout fisheries below Skilak Lake?	Estimate sex, age, and size of extant population by netting and electroshocking; estimate take by legal harvest from creel surveys	Compare with 1999 abundance estimate	Recommend changes in the fishing regulations (daily bag and size limits) to State Board of Fisheries; reallocate recreational fishing access between guided and unguided users	Repeat as need arises
1.13 Improve precision by 25% on estimates of historical wildfire rates in black and white spruce	Are historical rates of wildfire changing?	Mean fire return interval in black and white spruce at the landscape level	Reduce current estimates of precision on mean fire return interval by 25% for the purpose of detecting change due to climate change and/or suppression	Critical data for determining if current fire regime has deviated from historic rates; could result in suppression or increased WUI depending on interpretation of "natural"	Record fire polygons (shape and acreage) as they burn to monitor current rates; continue to date charcoal from historic burns

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
1.14 Improve precision by 25% on estimates of historical bark beetle outbreaks in white/Lutz spruce	Are historical rates of spruce bark beetle outbreaks changing?	An outbreak is defined as a "release" as determined with dendrochronology. A "release" is the doubling of the mean ring width in any 10-year interval from the previous 10-year interval	Reduce current estimates of precision on spruce bark beetle outbreaks by 25% for the purpose of detecting change due to climate change	Critical data for determining if current frequency of beetle outbreaks has deviated from historic rates; could result in changes to fuel types/loads for estimating fire risk, pesticide application, and/or other silvicultural treatments in non-wilderness areas	Record spruce bark beetle outbreaks from aerial surveys as they occur to monitor current rates; continue to date stands to improve on spatial extent of historic outbreaks
1.15 Complete a high-resolution DEM of the Refuge	What is the distribution of elevational relief?	Meters above sea level	None	Critical data for developing watershed models and for inclusion as a covariate in vegetation classification and species models	Once to establish baseline; consider repeating if new technology improves resolution significantly
1.16 Re-establish a remote-sensing, lightning detection capability for the Kenai Peninsula	Is the rate of natural ignitions (lightning) changing in response to climate change?	Number and coordinates of positive and negative lightning strikes daily and annually	Statistically significant deviation of number of lightning strikes from long-term average (to be determined)	Although lightning-caused fires are considered "natural," this definition may (or may not) be reasonable given that climate change is at least partially anthropogenic; fire management response may vary based on policy determination	Continuous monitoring

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
1.17 Complete a population assessment of lake trout in Hidden Lake	What is the sustainable level of lake trout harvest in Hidden Lake?	Estimate sex, age, and size of extant population by netting and electroshocking; estimate take by legal harvest from creel surveys	No previous estimates	Recommend changes in fishing regulations to State Board of Fisheries	Once to establish baseline
1.18 Complete a comprehensive inventory of vascular flora, vertebrate fauna, and selected invertebrate taxa as part of the Long Term Ecological Monitoring Program (LTEMP)	What is the current status of biodiversity?	Model species distributions and/or empirically estimate the frequency of occurrence of species	Taxonomic identification of species; genetic bar coding	Federal listing of new species/subspecies found to be endemic; re-examine management actions if listed species not known to occur on the Refuge is found	Once to establish baseline
1.21 Complete a spatially-explicit soil survey	What is the distribution of soils?	Soil types as determined by National Resource Conservation Service (NRCS)	None	Critical data for understanding floral distribution, invasive species risk, potential for erosion	Once to complete mapping
1.22 Initiate research to estimate annual variation in marine-derived nutrient input, and assess effects on terrestrial wildlife and habitat	What is the contribution of marine input to terrestrial nutrient cycling?	d ^{15}N and d^{13}C, and lipophilic contaminants such as PCBs	None	Critical data for evaluating impacts of variation in salmon runs on the terrestrial system	Sample 3 years to establish baseline

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
1.23 Enter into cooperative studies with ADF&G to assess populations of Chinook salmon on two rivers within the Refuge	How do Chinook salmon use riverine (and associated wetland) systems?	Evaluate temporal and spatial distributions of early run Chinook in the Kenai River and late-run Chinook in the Kasilof River from telemetry data and weir counts	Maintain annual escapement goal for early-run Chinook in Kenai River; establish and maintain an escapement goal for late-run Chinook on Kasilof River	Recommend changes in fishing regulations to State Board of Fisheries, particularly for early-run Chinook	Establish baseline; repeat as needed
1.24 Initiate 4 weir projects to enumerate anadromous fish populations returning to the Swanson River, Chickaloon River, Big Indian Creek, and Little Indian Creek	What is the current status of anadromous fish populations in the four largest river systems north of the Kenai River?	Creel surveys; timing and size of runs from video weirs	No previous escapement estimates	Recommend changes in fishing regulations to State Board of Fisheries	Once to establish baseline
1.25 Estimate new rate trajectories for the wildfire regime, spruce bark beetle outbreaks, wetland drying, water budget, carbon budget, and biota re-distribution in response to global climate change during the next 50–200 years	How will the landscape change in response to accelerated climate change?	Wildfire and beetle outbreaks (see 1.9 and 1.10); water budget (PET=inches of water per year); wetland drying (changing peat accumulation and wetland acreage); biota shifts (spatially explicit statistical models from LTEMP)	Compare historic rates of change with estimated trajectories of rates in response to climate change	Critical data for evaluating climate change impacts on resources; management response depends on whether these changes are considered outside range of natural diversity	Ongoing sampling

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
2.4 Continue contributions to regional and national monitoring efforts including but not limited to CBC, ALMS and BBS	How well do local bird population trends correspond to regional and national trends?	ALMS = density estimates from program distance; CBC/BBS = relative abundance	Significant deviation from both long-term regional trends and locally-estimated benchmark	Consider research to understand deviation	CBC, BBS annually surveyed; ALMS every other year
2.6 At 5-year intervals or after a significant natural perturbation, monitor landscape changes of both vegetation and physical features using pixel-by-pixel change analysis (30m resolution) from supervised classification of LANDSAT imagery	How is the landscape changing in response to climate change, natural perturbations, and other anthropogenic drivers?	Pixel-by-pixel change in land cover type	Statistically significant deviation in the frequency and/or distribution of pixels within land cover types	Research potential causes; evaluate management response to apparent trends in land cover conversion rates (e.g., softwood to hardwood)	Repeat after large scale vegetation changes due to fires or insect outbreaks; consider repeating as remote-sensed data and/or analytical software improve
2.7 At 5-year intervals, assess and report fire occurrence, fire cause, fire behavior, and fire effects trends (using the best available technology) to provide the information necessary to revise the Refuge's Fire Management Plan	Is the Refuge fire management plan contemporary and responsive to the Refuge Plan, habitat management plans, the National Fire Plan and interagency emergency response plans?	Plan, National Fire Plan, habitat management and fire management objectives	Dependent upon measurable standards identified in selected management objectives	Revise Fire Management Plan objectives and/or planned management responses to mitigate deficiencies and improve plan responsiveness	Once every 5 years or as necessary to respond to changes in the Plan, habitat management plans, interagency emergency response plans or the National Fire Plan

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
2.8 Caribou populations will be maintained at or below 2 caribou per square kilometer until 2014	Are caribou populations exceeding the carrying capacity?	Density derived from home range and population estimates based on radio telemetry	Populations exceed 2 caribou per square km	Recommend liberalizing harvest to State Board of Game	Counts occur annually but may be less frequent
2.9 Dall sheep and mountain goat populations (subadults + adults) will be maintained within 1 SE of the 20-year average for 3 count areas within Refuge boundaries, and the percentage of young-of-the-year in the counts will not drop below 20% for 3 consecutive years	What is the trend in Dall sheep and mountain goats?	Aerial counts of sheep and goats (by adults, subadults, and young-of-the-year) within 3 count areas (Twin Lakes 355, Indian Creek 356, and Tustumena Glacier 357)	Subadult/adult sheep and goats will be maintained within 1 SE of the 20-year average for 3 count areas; percentage of young-of-the-year in the counts will not drop < 20% for 3 consecutive years	Consider more intensive surveying and/or research into causes; recommend changes in hunting/trapping regulations to State Board of Game	3 count areas sampled annually; Peninsula-wide survey completed every 3 years

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
2.11 Develop an interagency program to monitor population trends and/or health of wolves, wolverines, and brown and black bears on the Peninsula	What is the trend in large carnivore populations?	• Wolverines (SUPE estimate of density) • Wolves (radio telemetry estimate of # packs) • Black bears (harvest estimate of sex-age class distribution) • Brown bears (mark-recap estimate of population)	Significant deviation from mean metric	Recommend changes in hunting and trapping regulations to State Board of Game	To be determined
2.14 Evaluate historical, current, and potential distributions of marten and red fox populations in the absence of active management, and identify restoration actions	What are the trends in marten and red fox populations—two species that were historically more common?	• Winter track distribution and frequency of occurrence from aerial videography; sex-age ratios of harvested fox and marten	Occupation estimates demonstrate population stability or increase, and do not project species extirpation from the Refuge	Consider translocation as a means to expand distributions; consider more liberal coyote harvest to reduce competitive interactions; consider additional restrictions on marten and/or red fox harvests	Once baseline distribution is established, re-sample at 5-year intervals

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
2.15 Complete a Wildfire Monitoring Plan that will include monitoring purposes, goals, objectives, and proposed activities for wildland fire, urban interface projects, wildland fire use, hazard fuels and WUI projects	Are Refuge fire management and monitoring projects effective?	• Plan, National Fire Plan, habitat management plan(s), and interagency collaborative management plan(s) objectives	Local/USFWS/national standards for monitoring and evaluation of fire management activities	Revise management practices to meet objectives	Once to establish, then review and update at least as often as the Refuge fire management plan
2.17 Complete the development of a Terrestrial and Aquatic Invasive Species Management Plan	How will the Refuge detect, control, and/or eradicate invasive species populations on the Refuge?	• Plant invasiveness (consistent with AKEPIC rankings)	Plant management will be consistent with CNIPM recommendations; all chemicals used for treatments will be registered for use in Alaska	Strategic approach will be to protect the remote interior of the Refuge (particularly Wilderness) by eradicating incipient populations and preventing well-established populations from expanding	Plan will be updated every 5 years or as needed
2.18 Prescribed fire will be used to maintain (Condition Class I) or improve (Condition Class 2 or 3) the condition class on 2,000–4,000 acres of non-wilderness per year in at least 3 out of 5 years	How does condition class change as a result of prescribed fire?	• Acres burned; fire regime condition class (FRCC)	National FRCC classification methods and standards	Revise prescriptions and prescribed fire plans to accomplish prescribed fire plan objectives	Monitor annually and maintain 5-year averages

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
2.19 Expand LTEMP to detect spatial and temporal changes in selected biota, including but not limited to vascular plants, breeding landbirds, mesocarnivores, selected insect assemblages, and exotic, invasive and injurious species	How is biodiversity changing?	Probability of occurrence as monitored in program presence; evaluate local rates of colonization and extinction	Statistically significant change in either species occurrence or distribution	Research potential causes; evaluate management response in the context of ANILCA mandate to conserve natural diversity; for increases in invasive species, more aggressive management may be required, including pesticide use, public use restrictions, and changes in how Refuge maintenance and biological activities are carried out	In cooperation with USDA-FIA, resample 20% of LTEMP sites every other year such that all points are re-sampled every decade
3.1 Continue and expand research on wood frogs until the cause of their abnormalities is identified	Do current wood frog abnormality rates signify environmental degradation?	% abnormal	Understand why extant levels (>10%) exceed ambient levels elsewhere in North America (1–3%)	Monitor long range transport of air contaminants, UV, viral and bacterial populations	Continue until cause(s) can be identified
3.2 Continue and expand research on local bird populations until the cause of bill abnormalities is identified	Do current bill abnormality rates signify environmental degradation?	% abnormal	Understand why extant levels appear to be increasing but are generally restricted to primarily resident bird species	Monitor long range transport of air contaminants, UV, viral and bacterial population	Continue until cause(s) can be identified

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
3.3 Continue to work with ADEC and industry to monitor, assess, and remediate contaminated sites in the existing oil and gas units	Is the existing industry footprint contaminated?	ppm, ppb in soil and/or water	Exceed EPA standards	Assess need for remediation; consider research to assess uptake and subsequent impacts on wildlife	Continue as sites are found, as sites are restored, as accidents occur
3.4 Evaluate current management practices and infrastructure improvements to ensure that the ecological integrity of the five designated RNAs on the Refuge are not compromised	Are RNAs adequately protected to answer the questions they are designed to address?	Mean fire return interval; snow machine traffic; invasive species; trails	Undisturbed, natural system (e.g., consistent with historic fire rates)	Enforce public use restrictions; post signs	N/A
3.5 Complete the development of landscape models at two scales to evaluate the cumulative effects of natural processes and anthropogenic perturbations on wildlife habitat	What are the key drivers of future landscape change?	Indicators: coho habitat, brown bear habitat, moose habitat, forest composition and age, land cover types, footprint types	Relative contribution of input variable to change in indicator variables as determined from sensitivity analyses	Evaluate efficacy of managing anthropogenic drivers in the context of natural processes and climate change	Periodic updating of models as new input data become available

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
3.7 Develop statistical models to explain how biotic and abiotic factors affect the distribution of species and communities at the landscape level	What factors determine floral and fauna distributions?	Frequency of occurrence; relative abundance	AIC model selection criteria	Critical for understanding how natural processes and climate change are affecting biota; provide informational platform from which to consider more aggressive habitat management	Update as necessary
3.9 Establish one air quality monitoring site within designated Wilderness to measure the concentration of fine particles for mass, optical absorption, major and trace elements, organic and elemental carbon, and nitrates	What are the trends in our air quality (including visibility)?	Concentration of fine ($PM_{2.5}$) particles for mass, optical absorption, major and trace elements, organic and elemental carbon, and nitrate and of PM_{10} particles for mass (consistent with IMPROVE)	Exceed AAQS or PSD Class II increments	Petition EPA and/or DEC to further restrict local point sources	3 consecutive years of monitoring to determine annual variation in baseline values; subsequent monitoring could be done at 10-year intervals
3.10 Initiate research to determine the effects of roads within and/or adjacent to the Refuge on local moose, caribou, and brown bear movements and survival, specifically to identify important crossings and/or high collision areas	How are roads impacting wildlife?	Mortality rates, survival rates, population distribution	To be determined	To be determined	To be determined

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
3.11 Determine baseline levels of selected contaminants, specifically organochlorines, organophosphates, and heavy metals that may have originated from nonrenewable resource extraction, long range atmospheric deposition, and/or past management practices	What are our current (baseline) levels of contaminants and pesticides?	ppm, ppb; media/substrate to be determined	Exceed EPA standards or literature values known to cause physiological impacts to wildlife	Assess need for remediation; consider research to assess uptake and subsequent impacts on wildlife	Once to establish baseline; long range air transport may require 2–3 years to estimate annual variation
3.12 Initiate research to evaluate uptake of identified contaminants by selected indicator species	Are ambient contaminant loads affecting wildlife populations?	Tissue and organ concentrations (e.g., liver, lipids, brain)	Compare with literature values to assess impacts	Notify public of health concern; consider research to asses specific physiological effects on impacted species	N/A

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
5.1 Evaluate the need to increase the number of USGS stream gauge stations in cooperation with interagency partners	What are the baseline stream flows of major rivers on the Refuge?	USGS monitors stream flow on the Kenai River at Cooper Lake, mouth of the Killey River, Skilak Lake outlet, and Soldotna. At the very least, monitoring should be expanded to include Killey, Funny and Moose rivers (sites that were previously sampled for 3 years by USFWS)	Significant deviation from 10-year average of stage, water temperature, and discharge	Water quality and quantity are expected to respond to climate change impacts on snow pack, precipitation, glacial melt, and air temperature	Monitor continuously for 10 years to establish baseline
5.2 Develop a prioritized list of culverts, bridges, and other river/stream structures that need to be replaced or modified to restore fish passage and normal stream function	Which streams have compromised hydrology and/or anadromous fisheries as a results of road infrastructure?	Stream flow is either reduced downstream of the culvert or made discontinuous as result of the culvert becoming overhanging	Fish passage is obstructed	Unilaterally fund culvert replacement and/or work with other partners (e.g., Kenai Watershed Forum, ADOT) to mitigate	As needed
5.3 Design and implement a ground water monitoring program	What is the baseline level of ground water flow and quality?	Recharge rate, contaminant load	N/A	N/A	Establish baseline; monitoring frequency to be determined

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
5.4 Design and initiate a water quality monitoring program for waters within the refuge, including the Kenai and Swanson River watersheds	What are the long-term trends in water quality given accelerated climate change and increasing commercial/recreational activities?	Water quality will include standard metrics (e.g., temperature, turbidity, pH, conductivity, DO, TSS, BOD, E. coli), nutrients (e.g., nitrates, phosphates), and selected contaminants (e.g., PAHs, PCBs)	Significant deviation from benchmark (average to be determined)	Recommend changes to DEC if contaminant levels exceed EPA standards; consider reducing visitation rates; conduct research to identify sources of high contaminant levels	To be determined
5.5 Develop a water budget and hydrologic models for the Refuge's 10 major watersheds	How is hydrology changing in response to climate change?	Stochastic parameter estimation	N/A	Significant change from historical flows would affect fisheries, recreational and commercial use of the Kenai, Swanson, Chickaloon and Kasilof rivers and tributaries, which would have to be addressed in subsequent planning efforts	N/A

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
9.3 Initiate a program to assess and model the natural soundscape of designated Wilderness and other areas	Is wilderness quality being degraded by anthropogenic noise?	dBA (peak values, integrated averages)	Significant deviation from benchmark values and/or spatial distribution of noise	Prohibit floatplane access to lakes in wilderness; petition FAA to issue NOTAMs of minimum altitude over wilderness; further restrict snowmachine access to wilderness	To be determined
9.4 Initiate research to assess and model motorized and non-motorized human-wildlife interactions as a result of recreational activities, including snowmachines, boats, road traffic, campgrounds, and trail use in Wilderness	Are recreational uses currently allowed compatible with Refuge purposes?	Changes in fitness as measured by body mass, productivity and/or survivorship; spatial redistribution of wildlife; reduced populations; bear DLPs, moose-vehicle collisions, or other measures of mortality; invasive species distributions	To be determined	Revise compatibility determinations; reduce current levels of use, and/or eliminate activities via seasonal, temporal and spatial restrictions; expand educational outreach to voluntarily reduce conflict; reduce traffic speeds; invasive species management	To be determined

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
Preferred Alternative:					
Swanson River Oil and Gas Unit					
1.1 After the life of the project, most of the existing oil and gas related industrial roads would be retained for public and administrative uses.	How will it be determined which industrial roads will be retained?	Habitat fragmentation; road and trail densities; proximity to other natural and/or human resources; invasive species risk	Policy on biological integrity, diversity, and environmental health	Restore roads to surrounding habitat	Initiate evaluations within 5 years of projected abandonment of oil and gas unit.
1.2 After the life of the project, up to two developed campgrounds would be constructed.	Where will campgrounds be located, and what will be the level of development?	Proximity to other natural and/or human resources	None	Not Applicable	Not Applicable
Beaver Creek Oil and Gas Unit					
2.1 After the life of the project, all oil and gas related roads, pipelines, and facilities would be removed and the sites restored to match the surrounding landscape.	1) Have sources of environmental contaminants been removed? 2) Are habitat restoration activities effective?	1) EPA priority pollutants 2) Acceptable plant regrowth, minimal erosion, no invasive species	Policy on biological integrity, diversity, and environmental health; surrounding vegetation type; AKDEC and EPA pollutant standards	Additional remediation as necessary	Site visits annually until results acceptable

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
Mystery Creek Access Road and Pipeline Corridor					
3.1 Access road improvements would be limited to those necessary for environmental protection.	Does vehicle use of the road and corridor result in increasing environmental damage?	1) Widening of the road or corridor 2) Stream turbidity and/or settleable solids	No increase in vegetation loss; no increase in vehicle-caused siltation in anadromous fish streams	Road improvements to address deficiencies	Annual road measurements at stream crossings, inclines, and wet areas; sample sites and procedures for water quality to be determined
3.2 Public vehicle use of the improved access road and pipeline corridor north to Chickaloon Bay and southwest to the East Fork of the Moose River would be allowed August 9–November 30.	How will vehicle use be administered and monitored?	Number of vehicles; waterfowl and big game harvest; brown and black bear DLPs; damage to riparian habitat at stream crossings	Required registration to enter area	Reduce use levels seasonally to meet objectives	Ongoing
Personal Collection of Natural Resources					
4.1 Personal collection and use of unlimited quantities of berries, mushrooms, other edible plants, and up to 8 naturally shed moose or caribou antlers per person per year would be authorized.	How will personal collection of natural resources be monitored?	To be determined	To be determined	To be determined	Review program and potential impacts every 5 years

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
Christmas Tree Harvesting					
5.1 Harvesting 1 black or white spruce tree no larger than 20 feet in height per family per year would be authorized.	How will Christmas tree harvests be monitored?	To be determined	To be determined	To be determined	Review program and potential impacts every 5 years
Airplane Access to Lakes in Designated Wilderness					
6.1 Airplane access would be allowed on 46 lakes in designated Wilderness.	How will airplane access on lakes in designated Wilderness be monitored and evaluated?	Distribution of trumpeter swan nests and broods; trumpeter swan population demographics; noise levels	Significant change in current swan breeding population and/or distribution; discovery of incipient population of invasive aquatic plant species	Increase or decrease restrictions on airplane access	Conduct swan aerial surveys every 5 years in cooperation with FWS, Division of Migratory Birds; annual brood surveys
Airplane Access to Chickaloon Flats					
7.1 Wheeled airplane access would be allowed year-round on 21 square miles of the Chickaloon Flats area that are unvegetated.	What impact(s) will increased aircraft access have on staging waterfowl and shorebird populations in the spring and fall?	Aerial and ground counts of staging waterfowl and shorebird populations and distributions	Baseline data must be acquired	Restrict aircraft access spatially and/or temporally	Minimum 2-year study to establish baseline; conduct annual aerial surveys

Management Direction	Inventory and Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
Snowmachine Access					
8.1 Conduct studies with the State of Alaska and other stakeholders to evaluate the effects of use on Refuge resources.	How will snowmachine activity and access be monitored and evaluated; and when will the results of the designated studies begin to influence management actions?	Snow depth and compaction; noise levels; vegetation trampling and damage; wildlife disturbance and/or redistribution; spatial distribution and volume of snowmachine traffic; noise levels	Baseline data must be acquired	To be determined	Minimum 2-year study to establish baseline conditions; subsequent monitoring to be based on study design

Table 6-2. Public Use Inventorying and Monitoring Plan

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
Goals/Objectives:					
1.1 Natural resource professionals, students, and the visiting public value opportunities to increase their knowledge of Refuge ecosystems, issues, and management practices.	What is the level of knowledge of Refuge ecosystems, issues, and management practices?	Conduct surveys of subject users	No Service standard; propose that initially, 50% of users demonstrate a basic knowledge of subject areas	Comprehensive review of EE curricula, natural resource training, and outreach efforts to insure adequate opportunities are available	Baseline surveys (OMB approved) of designated users will be conducted within 2 years of plan approval; every 5years thereafter
1.2 Diverse audiences will have equal opportunity to understand and appreciate all management programs and support the Refuge's efforts to maintain and enhance wildlife populations and habitats.	Is there adequate opportunity for Refuge users to gain understanding and appreciation of Refuge efforts?	Conduct surveys of subject users	No Service standard; propose that initially, 50% of users demonstrate a basic understanding and appreciation of subject areas	Review of all outreach program components	Baseline surveys (OMB approved) of designated users will be conducted within 2 years of plan approval; every 5 years thereafter

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
2.1 Land managers, scientists, and other partners learn practices and techniques to study, manage, and monitor the boreal forest biome	Is there adequate opportunity for land managers, scientists, and other partners to learn practices and techniques to study, manage, and monitor the boreal forest biome?	Request feedback on level of opportunity and program diversity from designated users during training, and from current, past, and possible future users	No Service standard; propose that initially, 50% of users or other respondents indicate acceptable level of opportunity	Review of all outreach efforts regarding subject training and capability of the Refuge to increase opportunities if need is indicated	Baseline surveys (OMB approved) of designated users will be conducted within 2 years of plan approval; every 5 years thereafter
3.1 Visitors of all skills and abilities enjoy wildlife-oriented recreation opportunities in safe and secure settings.	Are Refuge facilities and programs providing safe and secure opportunities for wildlife recreation?	Request feedback on level of opportunity from designated users	No Service standard; propose that initially, 50% of users or other respondents indicate acceptable level of opportunity	Review of all programs and facilities, and the capability of the Refuge to increase opportunities if need is indicated	Baseline surveys (OMB approved) of designated users will be conducted within 2 years of plan approval; every 2 years thereafter
4.1 Visitors and Refuge personnel value and enjoy safe, well-maintained facilities and quality programs.	Are Refuge facilities and programs meeting the needs of Refuge users?	Request feedback on level of opportunity from designated users	No Service standard; propose that initially, 50% of users or other respondents indicate acceptable level of maintenance and programs	Review of all programs and facilities, and the capability of the Refuge to increase maintenance and programs if need is indicated	Baseline surveys (OMB approved) of designated users will be conducted within 2 years of plan approval; every 2 years thereafter

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
5.1 Preserve and, where necessary, restore the character and integrity of Wilderness for present and future generations.	Is the Refuge meeting the requirements of the Wilderness Act?	Conduct internal review of Refuge compliance with the WA, and request feedback from NGOs	Full compliance with WA requirements	Insure compliance	Initial review will be conducted within 2 years of plan approval; every year thereafter
Alternatives:					
Swanson River Oil and Gas Unit					
1.1 After the life of the project, most of the existing oil and gas related industrial roads, would be retained and maintained for public and administrative uses.	How will it be determined which industrial roads will be retained for use?	Conduct review of individual road conditions and locales in relation to wildlife habitats and uses; determinations will be made on the direct and indirect values to wildlife habitats, migration corridors, breeding areas, and other compatibility standards	NWRS compatibility standards will be applied	If standards for compatibility cannot be met, roads conversion to trails will not occur	Initial review will be conducted within 2 years of plan approval; as compatibility standards requirements apply

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
1.2 Up to 2 developed campgrounds consisting of "hardened" campsites, etc., would be provided.	Where will the campgrounds be located, and what will be the level of development?	Conduct review of potential sites in relation to wildlife habitats and uses; determinations will be made on the direct and indirect values to wildlife habitats, migration corridors, breeding areas, and other compatibility standards	NWRS compatibility standards will be applied	If standards for compatibility cannot be met, facility development will not occur	Initial review will be conducted within 2 years of Plan approval; as compatibility standards requirements apply
Mystery Creek Access Road and Pipeline Corridor					
3.1 Public use of the area would be required at points of entry.	How will visitor registration be accomplished and monitored?	Initiate registration on an honor system	At start-up, 50% compliance will be acceptable	If observations and field checks indicate poor compliance with an honor system, other registration methods will be investigated and instituted	Initial review will be conducted within 1 year of registration start-up

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
3.2 Public use (e.g., vehicle, pedestrian, horse, snowmachine) of the improved access road and pipeline corridor north to Chickaloon Bay and southwest to the East Fork of the Moose River would be allowed August 9–November 30.	How will public use of the access road and pipeline corridor be administered and monitored?	Regular monitoring of the area by staff in relation to wildlife habitats and uses, as well as recreation uses and frequency; monitoring emphasis will be on the direct and indirect values to wildlife habitats, migration corridors, breeding areas, and other compatibility standards	NWRS compatibility standards will be applied	If monitoring observations and field checks indicate poor compliance with vehicle use restrictions, other methods of control to minimize negative impacts to wildlife will be investigated and instituted	Initial review will be conducted within 1 year of Plan approval
Swanson River and Swan Lake Canoe Systems					
7.1 All canoeists would be required to register at entrance points, and maximum group size would be limited to 15 individuals without a special use permit. Dispersed camping would be allowed but may not exceed 14 days in any 30-day period.	How will visitor use and registration enforcement be monitored?	Regular monitoring of the registration compliance by LE and non-LE staff in conjunction with levels of visitor use and frequency.	NWRS Compatibility Standards will be applied	If monitoring observations and field checks indicate poor compliance, other methods of control to minimize negative impacts to wildlife and habitats may be investigated and instituted	Initial review will be conducted within 1 year of Plan approval

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
7.2 Campsites would be monitored and evaluated regularly using standard protocols. Management actions taken to address resource concerns, including temporary closures of selected campsites to encourage natural rehabilitation, may be implemented as needed.	What is the condition of frequently used campsites within the Canoe Systems?	1) Number of sites 2) Footprint of each site 3) Condition of vegetation at each site	No more than 10% increase in the number of established sites, increase in size of each site, or reduction in trees or other vegetation at each site	Complete additional planning to restrict use to acceptable levels and restore damaged sites	Site visits and impact inventory every 5 years
Upper Kenai River (Russian River to Skilak Lake)					
8.1 Non-Guided Public Use: Implement the management actions identified in the 1997 Interagency Upper Kenai River Cooperative Plan on the Refuge.	When will management actions be initiated, and how will visitors be notified of those actions?	Management action will be initiated and monitored for 1 year; visitors will be notified of management actions through print and broadcast media, signing at access points, and direct mailings to permittees and other commercial entities on the Kenai Peninsula and in southcentral Alaska.	Standards identified in the Upper Kenai River Cooperation Plan 1997 will be used	Management actions identified in the Upper Kenai River Cooperation Plan 1997 will be used	Sampling procedure and frequency identified in the Upper Kenai River Cooperation Plan 1997 will be used

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
8.2 Guided Use: Sportfishing Special use permits would be required for guides. Permits would be limited to 18, issued through attrition. Each permit would allow 10 starts per week with no more than 4 starts per day. Additional restrictions may be imposed if demand for services increases.	How will guided use be monitored and evaluated?	Management action will be initiated and monitored for 1 year; visitors will be notified of management actions through print and broadcast media, signing at access points, and direct mailings to permittees and other commercial entities on the Kenai Peninsula and in southcentral Alaska.	Standards identified in the Upper Kenai River Cooperative Plan will be used as a point of reference to develop baseline standards	Management actions identified in the Upper Kenai River Cooperative Plan will be used as a point of reference to develop management actions	Sampling procedures identified in the Upper Kenai River Cooperative Plan will be used as a point of reference to develop sampling procedures for this action
8.3 Guided Use: Sport Fish Incidental Use Program State-licensed guides not having Refuge permits may be issued incidental permits for as many as 3 trips per year, subject to quotas and blackout dates beyond current levels.	How will incidental permit activity be monitored and evaluated?	Management action will be initiated and monitored for one year; visitors will be notified of management actions through print and broadcast media, signing at access points, and direct mailings to permittees and other commercial entities on the Kenai Peninsula and in southcentral Alaska.	Incidental permit program not measurably contributing to area crowding	Reduce or eliminate incidental permits	Annual review of program and trends

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
8.4 Guided Use: Scenic Float Trips Special use permits would be required for scenic float-trip guides. Permittees would be limited to their highest annual client days reported during the preceding 3 years.	How will scenic float trip permit activity be monitored and evaluated?	Management action will be initiated and monitored for one year; visitors will be notified of management actions through print and broadcast media, signing at access points, and direct mailings to permittees and other commercial entities on the Kenai Peninsula and in southcentral Alaska.	Standards identified in the Upper Kenai River Cooperative Plan will be used as a point of reference to develop baseline standards	Management actions identified in the Upper Kenai River Cooperative Plan will be used as a point of reference to develop management actions	Sampling procedures identified in the Upper Kenai River Cooperative Plan will be used as a point of reference to develop sampling procedures for this action
8.5 Camping: Dispersed camping within 100 yards of the Kenai River or within ¼ mile of the Sterling Highway would not be allowed.	How will dispersed camping activity be administered, monitored, and evaluated?	Management action will be initiated and monitored for one year; visitors will be notified of management actions through print and broadcast media, signing at access points, and direct mailings to permittees and other commercial entities on the Kenai Peninsula and in southcentral Alaska.	Compliance with new camping restrictions	Increased law enforcement and education	Ongoing

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
Middle Kenai River (Skilak Lake Downstream to Refuge Boundary)					
9.1 Non-Guided Public Use Access: Non-guided public use would be allowed without restriction on number of users until a Limits-of-Acceptable-Change planning process is completed with stakeholders, including the State of Alaska, which would lead to the development of a step-down management plan.	How will non-guided use be monitored and evaluated, and when will the LAC process be initiated?	Management action will be initiated and monitored for one year; visitors will be notified of management actions through print and broadcast media, signing at access points, and direct mailings to permittees and other commercial entities on the Kenai Peninsula and in southcentral Alaska.	To be determined as part of the LAC process	To be determined as part of the LAC process	To be determined as part of the LAC process
9.2 Guided Use: Sportfishing Special use permits would be required for sportfishing guides. Permits would be limited to the number of permittees existing upon completion of this comprehensive conservation planning process, and existing permittees would be "grandfathered" in	How will guided use be monitored and evaluated?	Management action will be initiated and monitored for 1 year; visitors will be notified of management actions through print and broadcast media, signing at access points, and direct mailings to permittees and other commercial entities on the Kenai Peninsula and in southcentral Alaska.	Standards identified in the Upper Kenai River Cooperative Plan will be used as a point of reference to develop baseline standards	Management actions identified in the Upper Kenai River Cooperative Plan will be used as a point of reference to develop management actions	Sampling procedures identified in the Upper Kenai River Cooperative Plan will be used as a point of reference to develop sampling procedures for this action

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
Airplane Access to Lakes in Designated Wilderness					
10.1 Aircraft access would be allowed on 46 lakes located within designated Wilderness.	How will aircraft access in Wilderness lakes be monitored and evaluated?	Regular monitoring of the activity by staff in relation to wildlife habitats and uses, as well as level of recreation uses and frequency. Monitoring emphasis will be on the direct and indirect values to wildlife habitats, migration corridors, breeding areas, wilderness values, and other compatibility standards.	NWRS Compatibility Standards and Wilderness values will be applied	If monitoring observations and field checks indicate poor compliance with activity restrictions, other methods of control to minimize negative impacts to wildlife and wilderness values will be investigated and instituted	Initial review will be conducted within 1 year of Plan approval

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
Airplane Access to Chickaloon Flats					
11.1 Wheeled airplane access would be allowed year-round on 21 square miles of the Chickaloon Flats area that are unvegetated and the unmaintained Big Indian Creek airstrip; and floatplane access would be allowed on 6.5 miles of the Chickaloon River.	How will aircraft access in the Chickaloon Flats area be monitored and evaluated,,and how will designated landing areas be designated?	Regular monitoring of the activity by staff in relation to wildlife habitats and uses, as well as level of recreation uses and frequency. Monitoring emphasis will be on the direct and indirect values to wildlife habitats, migration corridors, breeding areas, and other compatibility standards.	NWRS Compatibility Standards will be applied	If monitoring observations and field checks indicate poor compliance with activity restrictions, other methods of control to minimize negative impacts to wildlife will be investigated and instituted	Initial review will be conducted within 1 year of Plan approval

Management Direction	Monitoring Question	Measured Action or Effect Key Indicator(s)	Management Standard(s) to Be Used	Possible Management Actions Triggered if Standard(s) Not Met	Sampling Procedure and Frequency
Snowmachine Access					
12.1 Snowmachines less then 46" in width and less than 1,000 pounds in weight would be allowed in designated areas December 1–April 30 when the Refuge manager determines that there is adequate snowcover; conduct studies in cooperation with the State of Alaska and other stakeholders to evaluate the effects of use on Refuge resources and visitor experiences. The results of those studies would be used to support future management decisions.	How will snowmachine activity and access be monitored and evaluated, and when will the results of the designated studies begin to influence management actions and decisions?	Regular monitoring of the activity by staff, in relation to wildlife habitats and uses, as well as level of recreation uses and frequency. Initial monitoring emphasis will be on the direct and indirect values to wildlife habitats, migration corridors, breeding areas, and other compatibility standards. Cooperative studies will be aimed at identifying and measuring key indicators of habitat and visitor experiences.	NWRS compatibility standards will be applied	If initial monitoring observations and field checks indicate poor compliance with activity restrictions, other methods of control to minimize negative impacts to wildlife will be investigated and instituted; results of cooperative studies will be investigated and instituted	Initial review will be conducted within 2 years of Plan's approval

6.9 Reference

USFWS. 2000. Service Manual. Available at: http://www.fws.gov/policy/602fw1.html. Accessed August 22, 2007

7. Consultation and Coordination with Others

7.1 Section 7 Compliance

No known (resident) Federally threatened or endangered species occur on the Refuge. The planned actions found in the Kenai National Wildlife Refuge Revised Comprehensive Conservation Plan (Plan) are unlikely to adversely affect species listed under the Endangered Species Act or designated critical habitat. Therefore, the U.S. Fish & Wildlife Service (Service) finds the plan to be fully consistent with Section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq: 87 stat 884, as amended).

7.2 Memorandums of Understanding and Agreement

Alaska Landscape Cumulative Effects Simulator (ALCES) Memorandum of Understanding
This 2005 Memorandum of Understanding establishes a cooperative framework to develop an Alaska Landscape Cumulative Effects Simulator (ALCES) for the Kenai Peninsula. Partners agree that there are benefits to compiling existing spatial data and combining such data with potential likely scenarios into a model for assessing the cumulative effects of current and projected land use practices on ecological, social, and economic attributes of the Kenai Peninsula. Signatories include Kenai National Wildlife Refuge, Chugach National Forest, Homer Soil and Water District, Kenai Fjords National Park, Kenai Peninsula Borough, Kenai Watershed Forum, Kenaitze Indian Tribe IRA, Ninilchick Traditional Council, Port Graham Village Council, Seldovia Village Tribe, The Wilderness Society, and the U.S. Environmental Protection Agency.

Alaska State Troopers Memorandum of Agreement
This 2007 revised and updated Memorandum of Agreement, which was originally signed in 1997, recognizes the mutual benefits of sharing law enforcement expertise, training, intelligence, equipment, and other facilities, between Refuge law enforcement officers and Alaska State Troopers. It determines the necessity and appropriateness of utilizing designated personnel, services, and facilities to assist in providing effective enforcement of Federal and State laws within Alaska.

Chickaloon Flats Memorandum of Agreement
This 1972 Memorandum of Agreement established a general framework for cooperatively managing the Chickaloon Flats area. Signatories include Kenai National Wildlife Refuge, Chugach National Forest, Alaska Department of Fish and Game, and Alaska Department of Natural Resources.

Interagency Brown Bear Study Team Memorandum of Understanding
This 2003 revised and updated Memorandum of Understanding, which was originally signed in 1984, establishes a general framework for collaborative research, monitoring, and information sharing about Kenai brown bears.

Signatories include Kenai National Wildlife Refuge, Alaska Department of Fish and Game, Chugach National Forest, and Kenai Fjords National Park.

Kenai Brown Bear Policy and Management Group Support Agreement and Memorandum of Understanding

This 2005 Memorandum of Understanding established the Kenai Brown Bear Policy and Management Group. This umbrella group is responsible for addressing brown bear policy and management issues through facilitation of interagency collaboration and funding. It supports resource management and information needs across jurisdictional boundaries, charters the Interagency Brown Bear Study Team (IBBST) as a subcommittee, and provides guidance to and oversees the IBBST. Signatories include Alaska Department of Fish and Game, U.S. Fish & Wildlife Service (Region 7), Chugach National Forest, and Kenai Fjords National Park.

Kenai Peninsula Cooperative Weed Management Area Memorandum of Understanding

This 2006 Memorandum of Understanding recognized the Kenai Peninsula Cooperative Weed Management Area and established the basis for participants to cooperate, coordinate activities, and share resources necessary for the prevention and control of invasive plants on public, private, and tribal lands across ownership boundaries within the Kenai Peninsula Cooperative Weed Management Area (KP-CWMA). Signatories include Kenai National Wildlife Refuge, Alaska Soil and Water Conservation District, City of Homer, Chugach National Forest, Homer Soil and Water Conservation District, Kachemak Bay State Park, Kachemak Bay Conservation Society, Kachemak Heritage Land Trust, Kenai Fjords National Park, Kenai Garden Club, Homer Kenai Soil and Water Conservation District, Natural Resource Conservation Service, Seldovia Native Association, Seldovia Village Tribe, and Tree Stewards.

Long Term Ecological Monitoring Program Memorandum of Understanding

This 2004 Memorandum of Understanding provides a general framework for working collaboratively on development of the Long-Term Ecological Monitoring Program (LTEMP) as an adjunct inventory to the Forest Service and Analysis Program. Signatories include U.S. Fish & Wildlife Service (Region 7), the U.S. Department of Agriculture, and the U.S. Forest Service Pacific Northwest Research Station.

Moose Research Center Memorandum of Agreement

This 2004 Memorandum of Agreement re-established a general framework for cooperative research and maintenance of the Moose Research Center. Signatories include Kenai National Wildlife Refuge and Alaska Department of Fish and Game.

Scenarios Network for Alaska Planning Memorandum of Understanding
This 2007 Memorandum of Understanding establishes a cooperative framework to develop spatially explicit output from ALCES and a Web site to deliver such information. Signatories include Kenai National Wildlife Refuge and the Scenarios Network for Alaska Planning (SNAP) at the University of Alaska Fairbanks.

USFS Law Enforcement Memorandum of Understanding
This 1994 Memorandum of Understanding provides policies and procedures to facilitate law enforcement operations on lands adjacent to Kenai Refuge. Signatories include Kenai National Wildlife Refuge and Chugach National Forest.

7.3 Consistency with the Alaska Coastal Management Program/Kenai Peninsula Borough Coastal Management Plan

The Alaska Coastal Management Program was established as a result of the Coastal Zone Management Act of 1972 and the Alaska Coastal Management Act of 1977, which directed the State of Alaska to implement a comprehensive coastal management program. The Kenai Peninsula Borough Coastal Management Plan, which was finalized in 2000 and revised in 2007, established broad goals and objectives for the entire Kenai Peninsula, including the Kenai National Wildlife Refuge. Under these acts, this Comprehensive Conservation Plan and Environmental Impact Statement must be consistent with the Kenai Peninsula Borough Coastal Management Plan.

The Alaska Coastal Management Program identifies 12 primary categories that are to be used in a consistency evaluation. The U.S. Fish & Wildlife Service finds this Comprehensive Conservation Plan for Kenai National Wildlife Refuge to be fully consistent with policies of the Alaska Coastal Management Program and the Kenai Peninsula Borough Coastal Management Plan.

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