US Fish & Wildlife Service

Final Environmental Assessment for the Fire Management Plan

Kenai National Wildlife Refuge

August 2013

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.

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.

FINDING OF NO SIGNIFICANT IMPACT

Adoption of Kenai National Wildlife Refuge Fire Management Plan

BACKGROUND

Kenai National Wildlife Refuge developed a Fire Management Plan (FMP) as a step-down management plan to the 2010 Comprehensive Conservation Plan (CCP). This FMP was written to meet Department of Interior and U.S. Fish and Wildlife Service requirements that every area with burnable vegetation must have a FMP. This FMP defines a program of wildland fire management actions to achieve specific goals, objectives and activities in the approved CCP. This FMP replaces the previous Kenai NWR FMP approved on September 28, 2001.

This environmental assessment (EA) was prepared to evaluate the effects associated with implementing the FMP. This EA complies with the National Environmental Policy Act (NEPA) in accordance with Council on Environmental Quality regulations (40 CFR 1500-1509) and Department of the Interior (DOI) (516 DM 8) and Service (550 FW 3) policies. NEPA requires examination of the effects of proposed actions on the natural and human environment.

This EA presented two alternatives: Alternative A (not selected) – the "no action alternative", which would have continued the current level of management, and Alternative B (selected alternative) – "the preferred alternative". Under both alternatives, management of fire on the landscape will occur in accordance with the Refuge CCP.

Alternative B (Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation - Selected Alternative) is essentially identical to Alternative A (no action) in every fire management program element (including the FMUs and fire management options), except hazardous fuels and wildfire mitigation. Wildfire mitigation includes measures to decrease the likelihood of property damage and injury due to human caused or naturally ignited fires and involves efforts such as the reduction or removal of hazardous fuels, wildfire preparedness, fire prevention, and FIREWISE activities.

Alternative B (Selected Alternative) proposed to treat more acres (as funding is available) because it includes fuel reduction activities in Community Wildfire Protection Plan (CWPP) and Community of Interest (COI) areas (see section 2.4.1.4). A potential (and likely) constraint for implementing treatments under either Alternative is adequate funding. The Refuge and cooperators will look for new sources of funding and compete regionally and nationally through federal channels for conventional hazardous fuels mitigation funding, but the reality of the federal hazardous fuels mitigation budget process is that this alternative may not be fully implemented.

This EA evaluated the use of prescribed fire, naturally ignited fire, and mechanical treatments to achieve fire management goals and objectives on Kenai NWR. The FMP for Kenai NWR, integrates all wildland fire management activities within the context of the Refuge's CCP and helps achieve land and resource management goals and objectives identified in the CCP.

FINDING

Based on the review and evaluation of the potential effects of the proposed action as set forth in the EA and other supporting documentation, I have determined that the proposed action of adopting the Fire Management Plan for Kenai National Wildlife Refuge is not a major action that would significantly affect the quality of the human environment within the meaning of Section 102(2) of the National Environmental Policy Act. The environmental review conducted by the Service supports the conclusion that impacts of the Fire Management Plan do not exceed a threshold of significance. Accordingly, the preparation of an Environmental Impact Statement on the proposed action is not required. The alternative of implementing the Fire Management Program would be the most beneficial to wildlife and habitat resources while facilitating habitat restoration and public use activities at the Refuge. Therefore, the implementation of this Fire Management Program is not a major federal action which would significantly affect the quality of the human environment within the meaning of Section 102(2)(C) of the National Environmental Policy Act of 1969. Accordingly, preparation of an Environmental Impact Statement on the proposed action is not required and a Finding of No Significant Impact is warranted.

SUPPORTING REFERENCES

Environmental Assessment, Fire Management Plan Kenai NWR. 2013.

Comprehensive Conservation Plan. Kenai National Wildlife Refuge. 2010.

2/8/14

Regional Director

Date

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UNITED STATES FISH AND WILDLIFE SERVICE
Environmental Action Memorandum

Within the spirit and intent of the Council on Environmental Quality's regulation for implementing the National Environmental Policy Act and other statutes, orders and policies that protect fish and wildlife resources, we have established the following administrative record and have determined that the adoption of the Fire Management Plan for lands within the Kenai National Wildlife Refuge is found not to have significant environmental effects as determined by the attached Environmental Assessment and Finding of No Significant Impact.

FMO Initiator Douglas F. Neuboald Fire Management Officer Kenai National Wildlife Refuge	12/16/2013 Date
Refuge Manager, Kenai National Wildlife Refuge	12/17/2013 Date
Chief, National Wildlife Refuge System – Alaska	1.27.14 Date
Regional Director – Alaska Region	2/8/14 Date

Final Environmental Assessment
for the
Fire Management Plan
Kenai National Wildlife Refuge

Executive Summary

The United States Fish and Wildlife Service ("Service") revised the Fire Management Plan (FMP) for the Kenai National Wildlife Refuge (NWR). An environmental assessment (EA) was developed to evaluate the effects associated with the proposed FMP. This EA complied with the *National Environmental Policy Act* (NEPA) in accordance with Council on Environmental Quality regulations (40 CFR 1500-1509) and Department of the Interior (DOI) (516 DM 8) and Service (550 FW 3) policies (see Section 1.10 below for additional regulatory compliance).

NEPA requires examination of the effects of proposed actions on the natural and human environment. Chapter 2 of this EA presented two alternatives: Alternative A (not selected) – the "no action alternative", which would have continued the current level of management, and Alternative B (selected alternative) – "the preferred alternative". Under both alternatives, management of fire on the landscape will occur in accordance with the Refuge CCP and with the Alaska Interagency Wildland Fire Management Plan (AIWFMP).

Alternative B (Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation - Selected Alternative) is essentially identical to Alternative A (no action) in every fire management program element (including the FMUs and fire management options), except hazardous fuels and wildfire mitigation. Wildfire mitigation includes measures to decrease the likelihood of property damage and injury due to human caused or naturally ignited fires and involves efforts such as the reduction or removal of hazardous fuels, wildfire preparedness, fire prevention, and FIREWISE activities.

Alternative B (Selected Alternative) proposed to treat more acres (as funding is available) because it includes fuel reduction activities in Community Wildfire Protection Plan (CWPP) and Community of Interest (COI) areas (see section 2.4.1.4). A potential (and likely) constraint for implementing treatments under either Alternative is adequate funding. The Refuge and cooperators will look for new sources of funding and compete regionally and nationally through federal channels for conventional hazardous fuels mitigation funding, but the reality of the federal hazardous fuels mitigation budget process is that this alternative may not be fully implemented.

Under Alternative B (Selected Alternative), the scope of the Refuge hazardous fuels and fire mitigation program will be expanded to include the nine CWPP areas (Table 2-3). Using state of the art spatial modeling tools (e.g. FSPro, FARSITE), the Refuge will collaborate with its cooperators and at risk communities to strategically place treatments to best mitigate the risk of wildfire. Given limited hazardous fuels mitigation funding, the Refuge could select specific treatments based upon cost. In addition to funding, the successful implementation of prescribed fire treatments may also be limited by adverse weather and fuel moisture conditions, and/or a lack of available resources (such as firefighters, equipment, helicopters).

Table 2-3. Comparison of alternatives

Map Item[1]	Refuge / WUI Location	Alternative A: No Action - Continue Current Management (Acres)		Alternative B: Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation (Acres)[8]	
		Prescribed Fire[2]	Mechanical Treatments[3]	Prescribed Fire[4]	Mechanical Treatments[5]
Kenai NWR Fuel Reduction Treatments					
1.	Sterling WUI / Lily Lake	16	184	415	0
2.	Sterling WUI / Skilak Loop	21	123	102	0
3.	Funny River WUI / Funny River Road Fuelbreak[6]	184	216	50	50
4.	Funny River WUI / Slikok	0	55	199	0
5.	Moose Research Center[7]	42	72	390	1,635
6.	Swanson River Oil Field	0	0	3,943	3,943
7.	Beaver Creek Oil Field	0	0	1,024	1,024
CWPP (WUI) Area Fuel Reduction Treatments[9]					
a.	Cooper Landing CWPP	0	0	0	0
b.	Diamond Ridge / Fritz Creek / Fox River CWPP	0	0	0	0
c.	Funny River CWPP	0	0	9,325	9,325
d.	Kalifornsky / Kasilof / Cohoe / Clam Gulch CWPP	0	0	12,646	12,646
e.	Kenai CWPP	0	0	0	0
f.	Nikiski/Salamatof / Grey Cliffs CWPP	0	0	7,800	7,800
g.	Ninilchik / Ninilchik Forties CWPP	0	0	0	0
h.	Sterling CWPP	0	0	18,346	18,346
i.	Soldotna / Ridgeway CWPP	0	0	1,204	1,204
	Total Treatment Acres	**263**	**650**	**54,240**	**54,769**
	Average Annual Treatment Acres	**17.5**	**43.3**	**3,616**	**3,651**

Notes:

1. Refer to the maps in Appendices C through N.
2. Acres of prescribed fire completed over the past 15 years
3. Acres of mechanical treatments completed over the past 15 years
4. Proposed acres of prescribed fire to be completed over the next 15 years (funding-dependent)
5. Proposed acres of mechanical treatments to be completed over the next 15 years (funding-dependent)
6. This access/egress fuelbreak has been treated and maintained in multiple entries since 1999
7. See the ADF&G 2013 Moose Research Center Habitat Enhancement Plan in Appendix O
8. Proposed treatment acres in Alternative B are estimates of treatable vegetation/fuel types (black spruce, white spruce, beetle-killed white spruce, and mixed spruce/hardwood forest). Specific treatment sites would be selected through spatial fire behavior modeling/analyses to identify key hazardous fuels for mitigation. Implementation would depend on funding.
9. The acreages listed under Alternative B for the Funny River and Sterling CWPPs include the acres listed in Alternative B in Map Items 1-4.

This EA evaluated the use of prescribed fire, naturally ignited fire, and mechanical treatments to achieve fire management goals and objectives on Kenai NWR. The FMP for Kenai NWR, integrates all wildland fire management activities within the context of the Refuge's CCP (http://alaska.fws.gov/nwr/planning/kenpol.htm) and helps achieve land and resource management goals and objectives identified in the CCP (USDI/USDA 2013). This FMP replaces the previous Kenai NWR FMP approved on September 28, 2001.

Final Environmental Assessment
for the
Fire Management Plan
Kenai National Wildlife Refuge

August 8, 2013

Prepared by

US Fish and Wildlife Service, Region 7

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Abbreviations

ADF&G	Alaska Department of Fish and Game
AIWFMP	Alaska Interagency Wildland Fire Management Plan
ANILCA	Alaska National Interest Lands Conservation Act
CAA	Clean Air Act
CCP	comprehensive conservation plan
CEQ	Council on Environmental Quality
CFFDRS	Canadian Forest Fire Danger Rating System
CFR	Code of Federal Regulations
COI	community of interest
CWPP	community wildfire protection plan
DAQ	Division of Air Quality
DOI	Department of the Interior
EA	environmental assessment
EPA	US Environmental Protection Agency
FMP	fire management plan
FMU	fire management unit
FONSI	finding of no significant impact
FWS	US Fish and Wildlife Service
GIS	Geographic Information System
KKAO	Kenai-Kodiak Area Office
MIST	Minimum Impact Suppression Techniques
MFRI	mean fire return interval
MRC	Moose Research Center
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NRCS	Natural Resource Conservation Service
NWCG	National Wildfire Coordinating Group
NWR	national wildlife refuge
PL	public law
PM	particulate matter
SD	standard deviation
SMP	smoke management plan
USC	United States Code
WFDSS	Wildland Fire Decision Support System
WUI	wildland urban interface

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Chapter 1. Purpose of and Need for Action

1.1 Introduction

The United States Fish and Wildlife Service ("Service") is proposing to revise the Fire Management Plan (FMP) for the Kenai National Wildlife Refuge (NWR). This environmental assessment (EA) is being prepared to evaluate the effects associated with the proposed FMP. This EA complies with the *National Environmental Policy Act* (NEPA) in accordance with Council on Environmental Quality regulations (40 CFR 1500-1509) and Department of the Interior (DOI) (516 DM 8) and Service (550 FW 3) policies (see Section 1.10 below for additional regulatory compliance). NEPA requires examination of the effects of proposed actions on the natural and human environment. Chapter 2 of this EA presents two alternatives, and Chapter 3 describes potential environmental consequences of each alternative.

1.2 Comprehensive Conservation Plans

The Service refers to its overall land management plans as comprehensive conservation plans (CCPs). The purpose of a CCP is to guide the management, protection, and restoration of wildlife habitat and protection of significant values on Service lands. The long-range CCPs are evaluated after 15 years but may be updated earlier as better management information is developed or resource priorities change.

Each Service unit is responsible for land management planning, including setting land use goals and objectives, implementing appropriate actions to accomplish the objectives, achieving outcomes and results, and evaluating the outcomes and results against the intended objectives. The CCP identifies fire's role in a particular area and for a specific benefit. The objectives in the CCP provide the basis for the development of fire management objectives and the fire management program in a designated area (USDI/USDA 2013).

The *Record of Decision for the Revised Comprehensive Conservation Plan and Environmental Impact Statement for Kenai National Wildlife Refuge, Alaska* (USFWS 2010a) was signed by the Service's Regional Director on November 17, 2009. The Record of Decision and CCP are available at http://alaska.fws.gov/nwr/planning/kenpol.htm.

1.3 Fire Management Policy and Direction

DOI and Service policies require that every area with burnable vegetation must have an approved FMP (DOI Manual Part 620 DM 1.4 and Service Manual 516 FW 1) that describes actions to prepare for and respond to a wildfire (fire suppression); plans for and manages vegetation by management actions, including prescribed fire; and completes other fire management business. The FMP must meet agency policy and direction contained in the following documents:

- *National Fire Plan: A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy* (USDI/USDA 2001a)

- *Managing Impacts of Wildfires on Communities and the Environment and Protecting People and Sustaining Resources in Fire Adapted Ecosystems – A Cohesive Strategy* (also known as the *National Fire Plan* (USDI/USDA 2001b)

- *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10 Year Comprehensive Strategy Implementation Plan* (an adjunct to thee *National Fire Plan* 2001) (USDI/USDA 2006)

- *Guidance for Implementation of Federal Wildland Fire Policy (USDI/USDA 2009)*

- *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10 Year Comprehensive Strategy Implementation Plan* (USDI/USDA 2011)

Among other policies, the FMP must provide for firefighter and public safety while it adheres to the DOI policy stated in 620 Department Manual 1 by giving full consideration to the use of wildland fire as a natural process during the fire management planning process.

The goal of an FMP is to plan and implement actions to help accomplish the mission of the National Wildlife Refuge System, which is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (095 FW 3.2).

As described in Service Manual (621 FW 2.2), the Refuge FMP provides the planning framework for all Refuge fire management decision making and identifies the approved course of action relating to fire as described in other plans. The FMP identifies actions to preserve, protect, and enhance natural and cultural resources (with specific regard to wildland fire) and provides the background and guidelines for managing wildfires and prescribed fires.

1.4 Fire Management Plans

An FMP identifies and integrates all wildland fire management (both planned and unplanned ignitions) and associated activities within the context of an approved CCP — an FMP is considered a step-down plan of a CCP. The FMP is supplemented by operations plans, including but not limited to preparedness plans, preplanned dispatch plans, fuels treatment plans, and prevention plans (USDI/USDA 2013). FMPs serve to promote interagency communication, coordination, and cooperation, which are vital to the effective and efficient use of the nation's wildland fire management resources (NWCG 2011) (see "Section 4.2. Fire Management Coordination" in Chapter 4 of this EA).

The FMP proposed for Kenai NWR will integrate all wildland fire management activities within the context of the Refuge's CCP (http://alaska.fws.gov/nwr/planning/kenpol.htm) and will help achieve land and resource management goals and objectives identified in the CCP (USDI/USDA 2013).

To maintain currency, FMPs are reviewed annually, using the nationally established annual review process. Plans are revised when significant changes occur or substantial changes in management are proposed. Minor plan revisions may be accomplished through amendments added to the plan and signed by the line officer and servicing fire management officer. Major scheduled revisions to FMPs follow the

15-year CCP revision cycle to provide consistency in objectives and management strategy formulation. Without a current FMP, prescribed fires may not be conducted, and a response to unplanned ignitions may only consider suppression strategies. Preparedness and prevention activities can continue in the interim period as outlined in the 2001 FMP (USFWS 2010a).

The proposed FMP will replace the previous Kenai NWR FMP approved on September 28, 2001. The FMP will follow the outline of the April 2009 interagency format and will incorporate current policy and terminology relating to interagency and Service fire management programs.

1.5 Environmental Assessment for the FMP

This EA proposes the use of prescribed fire, naturally ignited fire, and mechanical treatments to achieve fire management goals and objectives on Kenai NWR. The proposed treatments are based on the Refuge's CCP and fire management planning efforts. This EA will serve as the umbrella compliance document under NEPA for fire and fuels management actions. The management actions proposed in the selected alternative (based on the analysis in this EA), and as approved in the EA's Finding of No Significant Impact, will become the updated Kenai NWR FMP.

The goal of this EA is to present an *ecosystem-based approach* for protecting natural resources at Kenai NWR. An *ecosystem-based approach* is an environmental management methodology that recognizes the full array of interactions, including humans, within an ecosystem rather than considering single issues, such as just humans, species, or ecosystem services in isolation.

1.6 Location

Kenai NWR is located on the Kenai Peninsula in southcentral Alaska (Figure 1-1). The Refuge is one of 16 refuges in Alaska that, collectively, make up the Service's Alaska Region (Region 7) of the National Wildlife Refuge System. The Kenai NWR encompasses approximately 1.98 million acres of diverse landscapes and habitats from the Harding Icefield and the 6,000-foot Kenai Mountains west; to the glacial moraines, pothole lakes, forests, and wetlands of the Kenai Lowlands; and south from the Turnagain Arm of Cook Inlet to Kachemak Bay. About two-thirds of the Refuge (1.3 million acres) is designated wilderness in three distinct units: the Dave Spencer Wilderness (187,279 acres); the Mystery Creek Wilderness (46,086 acres); and the Andrew Simons Wilderness (1,087,434 acres).

Lands adjacent to the Kenai NWR are managed or owned by the Chugach National Forest, Kenai Fjords National Park, state of Alaska, Kenai Peninsula Borough, Alaska Native corporations, and private individuals. Most of the eastern boundary of the Refuge borders Forest Service and National Park Service lands. The northern boundary of the Refuge lies along the southern shoreline of Turnagain Arm (Cook Inlet). The western boundaries are classified as wildland urban interface (WUI), where state of Alaska lands, Alaska Native corporation lands, private lands, and the communities of Nikiski, Kenai, Soldotna, Sterling, Funny River, Kasilof, Clam Gulch, Ninilchik, Nikolaevsk, and Anchor Point (from north to south) border or are near the Refuge. To the south, the Refuge is bordered by Kachemak Bay, state of Alaska lands, and Kenai Fjords National Park. "Figure 1-2. Kenai Peninsula land status" depicts the land ownership on the Refuge and Table 1-1 lists the land ownerships and number of acres.

Figure 1-1. Kenai NWR location

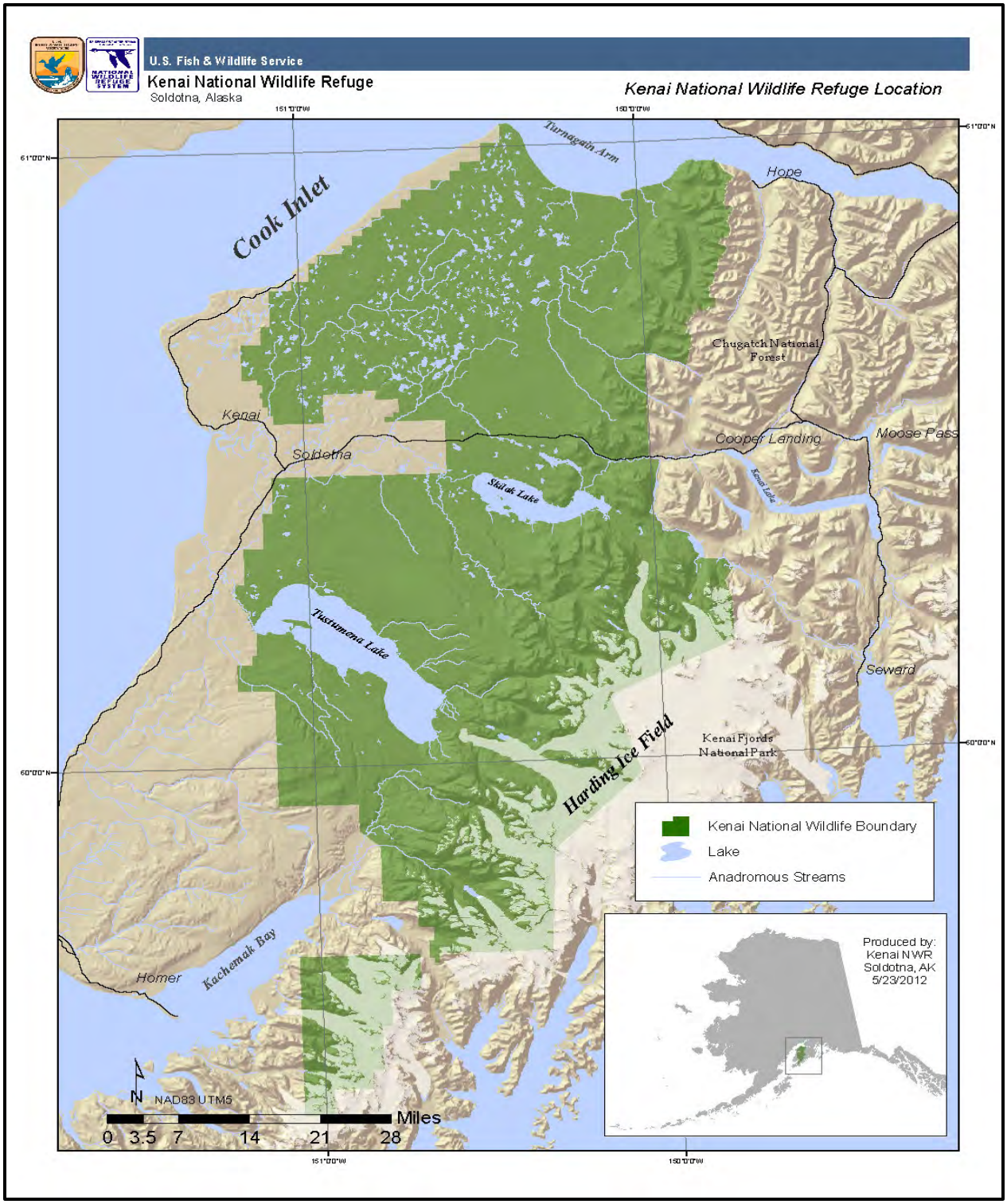


Figure 1-2. Kenai Peninsula land status

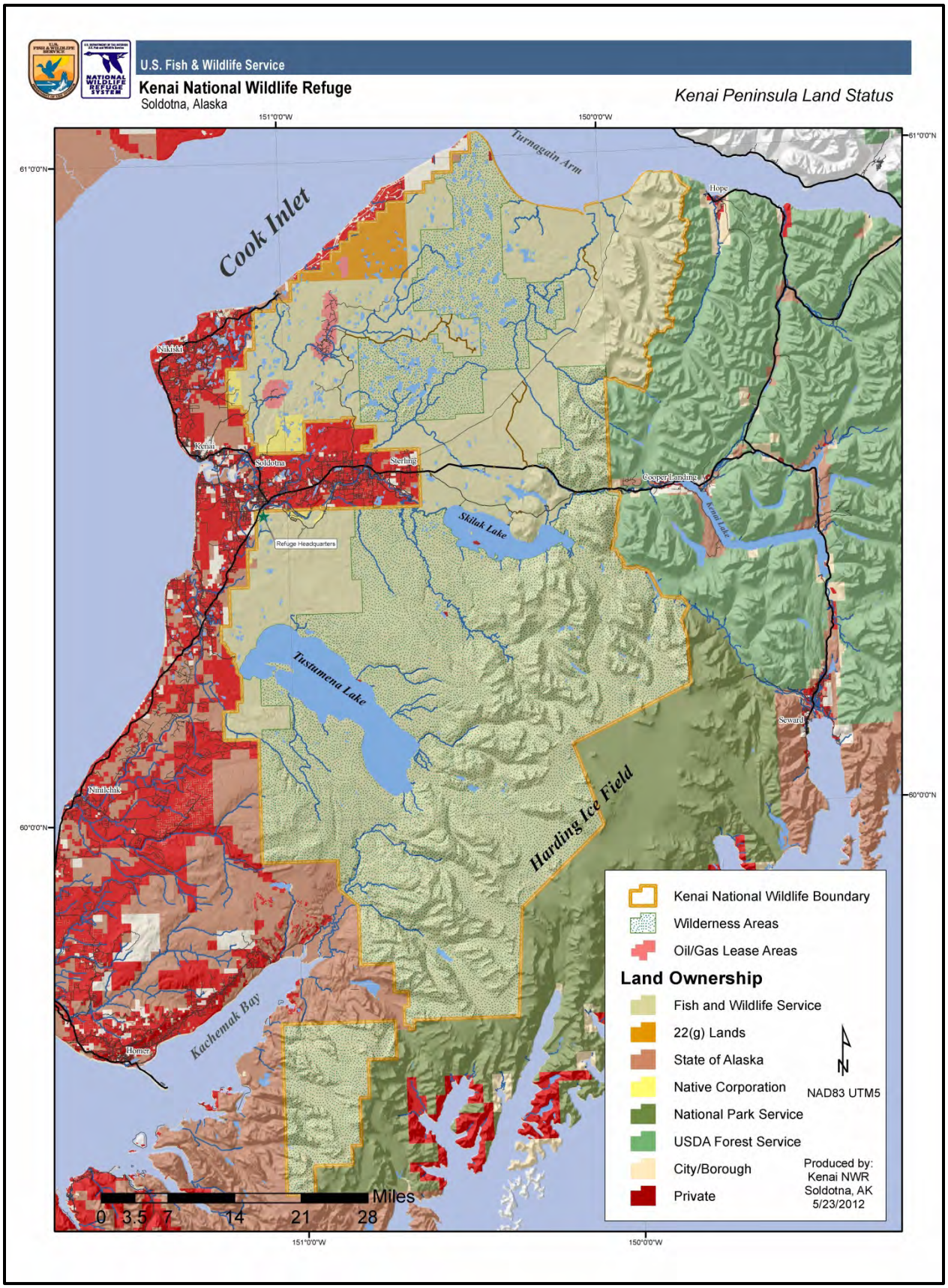


Table 1-1. Land ownership acres

Owner	Acres
US Fish and Wildlife Service	1,938,889
Wilderness	1,319,500
Non-wilderness	667,702
Private	525
State of Alaska	1,362
Alaska Native Corporation	46,041
Native Allotments	385

1.7 Purpose of Action

Service Manual (621 FW 2.2) requires that an FMP provides the planning framework for all Refuge fire management decision making and identifies the approved course of action relating to fire as described in other plans. An FMP identifies actions to preserve, protect, and enhance natural and cultural resources (with specific regard to wildland fire) and provides the background and guidelines for managing wildfires and prescribed fires. The purposes of the proposed FMP for Kenai NWR are to

1. protect life, property, human improvements, and cultural resources from the threat of wildland fire through prevention, education, mitigation, and restoration actions on and adjacent to the Kenai NWR; and

2. maintain the ecological integrity of the Kenai NWR by using prescribed fire (planned ignitions), wildfire, and mechanical treatment methods.

The fuel and fire management actions proposed in the alternatives (Chapter 2) are based on current fuels conditions on the Refuge, Service policy and direction, and the goals and objectives contained in the CCP for the Refuge. CCP objectives concerning fire will be discussed in detail in the FMP. The CCP is available for review at http://alaska.fws.gov/nwr/planning/kenpol.htm.

1.8 Need for Action

The following discussion summarizes the need for action (based on existing conditions) to demonstrate the link between those conditions and the purpose of fire management actions at the Refuge and on adjacent lands.

PURPOSE 1: Protect life, property, human improvements, and cultural resources from the threat of wildland fire through prevention, education, mitigation, and restoration actions on and adjacent to the Kenai NWR.

Need Based on Existing Conditions. The Service has a responsibility to provide for the prevention and management of unwanted wildfires that may adversely affect refuge infrastructure and neighboring public and private lands.

There is a need to prepare for potential wildfires. Preparation for potential wildfires includes measures such as maintaining access and egress routes; creating and maintaining fire breaks, fuel breaks, and defensible space; reducing the potential for unplanned fire occurrence; and ensuring that properly trained and equipped personnel are prepared to respond.

There is a need to protect Service assets and natural and cultural resources from wildfires ignited, either on or off the Refuge, and to protect Refuge neighbors from fires ignited on the Refuge. To facilitate this protection, the Refuge must proactively and strategically manage hazardous fuels on and adjacent to the Refuge in order to reduce the threat and the impacts of wildfires. Hazardous fuel reduction treatments should be implemented in the WUI and in other areas where hazardous fuel conditions exist.

A variety of methods, including prescribed fire and mechanical treatments, are needed to reduce unwanted hazardous fuels and thus minimize the spread and intensity of wildfire. Fuel treatments can include reducing or removing excessive ground and ladder fuels and increasing the distance between trees. Fuel treatments also help improve the management decision space and the opportunities for managing wildfires with multiple objectives (resource management as well as suppression).

There is a need to protect significant values at Kenai NWR. The estimated replacement cost of government-owned assets on Refuge lands is $102,909,849. The assets include buildings (including furnishing and fixtures), fences, information kiosks, signs, pedestrian boardwalks and bridges, observation decks, parking areas, public use comfort stations, and utilities (gas and electric—piping, wiring, poles). This list is just a sampling of the type of Service assets that could be at risk from a wildfire.

There is a need to collaborate with other federal, state, local, and tribal governments on how to best manage fire on the landscape for the benefit of Peninsula residents, communities, and Refuge resources. This includes the development and maintenance of Community Wildfire Protection Plans (CWPPs), interagency wildfire prevention plans, incident management plans, and hazardous fuels mitigation plans.

PURPOSE 2: Maintain the ecological integrity of the Kenai NWR by using prescribed fire (planned ignitions), wildfire, and mechanical treatment methods.

Need Based on Existing Conditions. There is a need to maintain the presence of fire on Refuge lands. Fire has affected terrestrial ecosystems since ancient times. Historically, fire was the primary disturbance regime that affected vegetation composition and structure (Collins and Gibson 1990). Fire is considered a significant ecological factor, and ecosystems have become adapted to frequent fires (Odum 1971). Fire suppression has had an effect on vegetation that would have existed historically or ordinarily in the presence of fire. According to Odum (1971), “The failure to recognize that ecosystems may be fire adapted has resulted in a great deal of mismanagement of man’s natural resources.”

In some areas of the Refuge, especially WUI areas along the Refuge boundary, native habitats have been affected by the spread of nonnative invasive plant species. In other areas of the Refuge, especially WUI areas along the Refuge boundary, there has been a decrease in the historical scope and occurrence of fire on the landscape.

There is a need to allow natural (lightning-ignited) fires to burn on the landscapes of the Refuge, especially in wilderness areas, to maintain healthy fire-adapted ecosystems. Human-caused and lightning-ignited wildfires that have occurred in WUI and intermix areas of the Kenai Peninsula over the last 50 years have been vigorously suppressed. Since 2000 on the Refuge, five naturally ignited wilderness wildfires (Mystery Hills, Pipe Creek, King County Creek, Moose Lake, and Shanta Creek) have been wholly, or partially suppressed to protect communities. These stand-replacement wildfires could have consumed thousands or tens of thousands of additional acres had the fires been allowed to burn.

One result of these past fire management practices is that forests in WUI areas and along the western boundaries of the Refuge are now at least moderately altered from a natural condition. Hazardous fuels, such as black spruce, beetle-killed white spruce and bluejoint reedgrass (*Calamagrostis canadensis*), have built up in some of these areas.

1.9 Decision to be Made

The Responsible Official (decision maker) for this action is the Kenai NWR Manager. The Refuge Manager will use the purpose of and need for the proposed fire management actions (described above in Sections 1.7 and 1.8), together with potential adverse and beneficial effects (see Chapter 3), as evaluation criteria to select the alternative that would best fulfill the purpose and respond to the need for action and that satisfactorily meets environmental guidelines. The Refuge Manager will decide whether there might be any significant adverse effects associated with the alternatives that would require the preparation of an environmental impact statement or whether the selected alternative would not result in significant adverse effects. The management actions contained in the selected alternative and as approved in the Finding of No Significant Impact will become the updated FMP for the Refuge.

1.10 Regulatory Compliance

The *National Wildlife Refuge System Improvement Act of 1997* provides guidelines and directives for the administration and management of all areas in the National Wildlife Refuge System. It states that national wildlife refuges must be protected from incompatible or harmful human activities to ensure that Americans can enjoy Refuge System lands and waters. Before activities or uses are allowed on a national wildlife refuge, the uses must be found to be compatible. A compatible use “will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuges.”

This EA was prepared by the Service and represents compliance with applicable federal statutes, regulations, executive orders, and other compliance documents, including the following:

- Administrative Procedures Act (5 USC551-559, 701-706, and 801-808), as amended
- Alaska National Interest Lands Conservation Act of 1980 (ANILCA), as amended (16 USC 140hh-3233, 43 USC 1602-1784)
- American Indian Religious Freedom Act of 1978 (42 USC1996)
- Antiquities Act of 1906 (16 USC431-433)
- Archaeological Resources Protection Act of 1979 (16 USC470)
- Bald Eagle Protection Act (16 USC 668-668d), as amended
- Clean Air Act of 1972, as amended (42 USC 7401 *et seq.*)
- Clean Water Act of 1972, as amended (33 USC 1251 *et seq.*)
- Endangered Species Act of 1973 (ESA), as amended (16 USC 1531 *et seq.*)
- Executive Order 12898, Federal Action Alternatives to Address Environmental Justice in Minority Populations and Low Income Populations, 1994.
- Executive Order 13112, Invasive Species (issued in February 1999)
- Fish and Wildlife Coordination Act of 1958 (16 USC 661 *et seq.*), as amended
- Fish and Wildlife Improvement Act of 1978 (16 USC 7421)
- Floodplain Management (Executive Order 11988)
- Migratory Bird Treaty Act (16 USC 703-712), as amended
- National Refuge System Administration Act of 1966 (16 USC 668dd-668ee), as amended
- National Environmental Policy Act (NEPA) of 1969 (42 USC 4321 *et seq.*), as amended
- Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500 *et seq*.)
- National Historic Preservation Act of 1966 (16 USC 470 *et seq.*), as amended
- Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001 *et seq.*)
- Protection and Enhancement of the Cultural Environment (Executive Order 11593)
- Protection of Wetlands (Executive Order 11990)
- National Pollutant Discharge Elimination System(33 USC 1251 *et seq.*), as amended
- Soil and Water Conservation Act of 1977 (16 USC 2001-2009), as amended

Further, this EA reflects compliance with applicable state of Alaska and local regulations, statutes, policies, and standards for conserving the environment and environmental resources such as water and air quality, endangered plants and animals, and cultural resources.

1.11 Climate Change

The DOI issued an order in January 2001, requiring federal agencies under its direction, that have land management responsibilities, to consider potential climate change effects as part of long-range planning endeavors.

Climate change has begun to influence the severity, frequency, and magnitude of wildfires in many regions of the United States. Records of wildfire show increasing area burned in Canada (Stocks et al. 2002; Gillett et al. 2004; Kasischke and Turetsky 2006); Alaska (Kasischke and Turetsky 2006); and the western United States (Westerling et al. 2006) over the past few decades. In the western United States, the annual area burned by large forest wildfires greater than 990 acres during the period from 1987 to 2003 was more than six times than that during the period from 1970 to 1986 (Westerling et al. 2006). Wildfire behavior is modified by climate, forest management, and fire suppression (Allen et al. 2002; Noss et al. 2006), and understanding the reasons for changing wildfire behavior is further complicated by changes in fire reporting over the period of record. However, recent changes in climate were likely the main drivers for increases in area burned in both the western United States (Westerling et al. 2006) and Canada (Gillett et al. 2004; Kasischke and Turetsky 2006; Girardin 2007).

The fire management program at Kenai NWR follows Service guidance on climate change. Adaptive management will be increasingly more important to assess climate change effects on management activity outcomes. Due to climate change, fire management treatments must be designed to anticipate where the biota will be in the future with or without the treatments. There is no reasonable expectation that communities of species will remain intact, with changes in their environment due to changes in climatic conditions. Historical conditions and treatments must be considered, but only after considering the future trajectory of species composition. Monitoring of fire management treatments and scientific investigation must be part of management to assess the need to adapt or maintain treatments that are currently being used. Fire management must be agile and adept to anticipate and respond to changes in conditions as changes in climate occur.

Scientific efforts are underway in Alaska to monitor climate change and its effects and to model/predict future impacts on biotic communities and physiographic features. Some of the more obvious and well-documented effects of climate change in southcentral Alaska include receding glaciers, drying wetlands, the upward movement of tree line, the spruce bark beetle epidemic, and expanding grasslands. Less obvious and/or less-documented effects include changes to fire regimes, lightning occurrence, and the spread of invasive species. One example of the climate research and monitoring, specific to the Refuge is included in “Appendix A: Executive Summary for the Kenai National Wildlife Refuge: Projected Vegetation and Fire Regime Response to Future Climate Change in Alaska, June 2009.”

The climate in boreal and arctic Alaska is changing (Hinzman et al. 2005). Mean annual air temperature in interior Alaska has increased by 1.3 degrees Celsius (°C) (34.3°Farenheidt (F) in the last 50 years and is expected to increase another 3°C – 7°C (37.4°F – 44.6°F) by the end of the 21st century (Chapin et al. 2010). The snow-free period has increased, up to 10 days in some areas, largely due to earlier spring snowmelt (Hinzman et al. 2005; Euskirchen et al. 2006). These changes will have numerous effects on vegetation, hydrology, insect occurrence, and wildlife that could fundamentally change boreal forest and tundra ecosystems. Effects include

- melting permafrost;
- melting sea ice, which has implications for marine mammals and regional weather patterns (Hu et al. 2010);
- drying wetlands (Riordan et al. 2006);
- Changing fire regimes (Kasischke et al. 2011), including changes in the initiation and end of fire season;
- Shifts in distribution of plants and animals (Murphy et al. 2010; Beck et al. 2011);
- Increased likelihood for invasive plant establishment (Villano 2008); and
- Increased possibility of wildlife disease and insect outbreaks.

Research and modeling efforts provide insight on potential future conditions, but specific agency guidance on addressing these changes is limited. The Service has developed a strategic plan for responding to climate change that includes three broad approaches: adaptation, mitigation, and engagement (USFWS 2010b). The core of the Service's response will be adaptation, defined as "planned, science-based management actions, including regulatory and policy changes, that we take to help reduce the impacts of climate change on fish, wildlife, and their habitats."

Fire managers are faced with numerous challenges as they consider refuge and other legal mandates as well as safety obligations in the face of changing fire regimes. The primary goal for mitigation in the Service's strategic plan is to sequester carbon and it is uncertain how sequestration objectives will be applied in Alaska, where numerous species depend on fire and where many naturally occurring, landscape-scale fires are allowed to burn if they do not threaten life or property.

In the absence of specific guidelines regarding fire management and climate change, fire management planning will continue to be based on guidance provided in refuge CCPs and associated step-down plans, the *Alaska National Interest Lands Conservation Act* (ANILCA), and evolving scientific data. Activities will be coordinated with Landscape Conservation Cooperatives and the regional Inventory and Monitoring Program when appropriate. Monitoring of fire effects and participation in research efforts will better inform management decisions in the face of climate change.

1.12 Permit and License Requirements

A prescribed fire plan will be developed and approved prior to implementation of each prescribed fire. The prescribed fires will be carried out in accordance with the requirements detailed in the final Kenai NWR FMP. Smoke generated by prescribed fires must be managed in compliance with the legal requirements of the *Clean Air Act* (42 USC 1857 *et seq.*) and local regulations and will be monitored by Service personnel.

The responsibility for the maintenance of air quality standards and the approval of agricultural type burning in the state rests with the Alaska Department of Environmental Conservation Division of Air Quality (DAQ). Guidelines imposed by the DAQ for smoke abatement on prescribed fires will be strictly

followed. The DAQ has the responsibility for issuing permits, defining the conditions when burning will be permitted, and determining what materials may be burned. Permitting procedures require this office to be consulted each and every time prescribed fire is applied in the Refuge. Smoke registration for prescribed fires in a Smoke Management Program (SMP)-II category (greater than 99 acres) is required at a minimum of two weeks before burning, and registration for an SMP-I category (less than 99 acres) burn is required by 10:00 am the day prior to burning. Registration procedures are completed by accessing the following website: http://dec.alaska.gov/air/OpenBurn/Burn_infor.htm. A Simple Approach Smoke Estimation Model or analysis may be conducted for all prescribed burns to occur in the Refuge. Given the proximity of the Refuge to rural communities, it must be assumed that all fires have the potential to adversely affect public interests and/or "critical targets."

For additional information, refer to the following:

- Interagency Standards for Fire and Fire Aviation Operations (aka the "Red Book") (USDA/USDI 2013) http://www.nifc.gov/policies/pol_ref_redbook_2013.html
- Smoke Management Guide for Prescribed and Wildland Fire (NWCG 2001) http://www.nwcg.gov/pms/pubs/SMG/SMG-72.pdf
- Alaska Enhanced Smoke Management Plan for Planned Fire Procedures Manual, June 3, 2009 (ADEC 2009) http://fire.ak.blm.gov/content/admin/awfcg_committees/Air%20Quality%20and%20Smoke%20Management/2_ESMP_Planned%20Fires%20Procedures%20062009.pdf

Chapter 2. Alternatives

2.1 Current Fire Treatment/Management Methods

The following types of treatment methods are currently used and would continue to be used to reduce hazardous fuels, regardless of the alternative chosen to become the new fire management plan (FMP) for Kenai National Wildlife Refuge (NWR). Implementation of any treatment is dependent on funding.

- **Prescribed fire** is a management tool used to manipulate vegetation. Prescribed fires may be loosely classified as broadcast, in which fire is applied across the landscape, or as debris burning as with pile or ditch burning.

- **Natural ignitions** are typically caused by lightning. Natural ignitions may be managed for resource benefit in wilderness and other areas where there is little to no threat of loss to structures or developed assets on and off public lands.

- **Mechanical treatments** are implemented using hand-held tools, chain saws, bulldozers, tractors, masticators, excavators, forestry cutters, chippers, and other specialty equipment. Mechanical treatments may also be used in conjunction with prescribed fire treatments as part of the overall treatment process to meet specific objectives and attain desired conditions.

- **Suppression** actions may include the construction of firelines by firefighters using hand tools, engines, heavy equipment (such as dozers), and aircraft (using water, retardant, and other water applicable chemicals to retard fire spread). Some suppression actions may be limited in wilderness areas, and in other areas suppression actions using heavy equipment or aircraft may be restricted based on the presence of cultural sites, riparian habitat, waterways, and critical habitat.

2.2 Fire Management Units

The National Wildfire Coordinating Group (NWCG 2013) defines a fire management unit (FMU) as a land management area definable by objectives, management constraints, topographic features, access, values to be protected, political boundaries, fuel types, and major fire regime groups that set it apart from the characteristics of an adjacent FMU. The FMU may have dominant management objectives and pre-selected strategies assigned to accomplish these objectives.

The Kenai NWR Comprehensive Conservation Plan (CCP) (USFWS 2010a) describes the Refuge's management categories. The CCP explains that a management category is used to define the level of human activity appropriate to a specific area of the Refuge. It is a set of Refuge management directions applied to an area in light of its resources and existing and potential uses to facilitate management and the accomplishment of Refuge purposes and goals. The four Refuge FMUs — wilderness, minimal, moderate, and intensive — correspond with the CCP's management category areas, with corresponding management direction and allowable human activities. The CCP has undergone thorough environmental

analysis and public input; thus the four FMUs, by association, have been publically vetted and approved. The four FMUs, which are the same for both alternatives proposed in this environmental assessment (EA), are described in detail in Appendix B.

There is another set of management directions that are applied to the FMUs (same for both alternatives) — the Alaska Interagency Wildland Fire Management Plan (AIWFMP) — which has been incorporated into the CCP, by reference. The AIWFMP is a statewide wildfire response plan. A summary of the AIWFMP is also included in Appendix B, along with a description of how the AIWFMP guidance is applied to each Refuge FMU.

The following guidance can be found in the CCP in the sections titled "Fire Management Program" and "Use of Fire as a Management Tool." Management direction will allow prescribed fire, wildfire, and mechanical treatments as the principle tools to improve wildlife habitats, reduce hazardous accumulations of wildland fuels, and maintain or restore natural fire regimes.

- Prescribed fire will be allowed in the Intensive, Moderate, Minimal, and Wilderness management categories (approximately 1,938,000 acres or 97.5% of the Refuge), though its use in the Wilderness management category could only occur under specific conditions defined in national Wilderness and Fire Management policies.
- Use of wildland fire will be allowed in the Intensive, Moderate, Minimal, and Wilderness management categories (1,938,000 acres or 97.5% of the Refuge), but use will be the default management action in the Minimal and Wilderness management categories (approximately 1,883,500 acres or 95% of the Refuge).
- Undesirable wildfires (that is, those not contributing to Refuge management goals or threatening human health and safety) will be suppressed through the use of a pre-identified management response.

General management direction from the Refuge CCP, regardless of FMU, is that the management of wildland fire for the benefit of Refuge ecosystems should be the guiding principle while taking measures to protect human life, property, and/or areas of special concern. The CCP can be accessed at the following website: http://alaska.fws.gov/nwr/planning/kenpol.htm.

2.3 Proposed Alternatives

2.3.1 Alternative A: No-Action Alternative, Continue Current Level of Management

Current management direction would continue under the no-action alternative. The Refuge would manage fire on the landscape in accordance with the Refuge CCP and with the AIWFMP. The proposed FMP follows the outline of the April 2009 interagency FMP format (USDA/USDI 2009b) and incorporates current policy and terminology relating to interagency and Service fire management programs. As a step-down plan from the CCP, the FMP describes actions to prepare for and respond to unplanned wildfire ignitions, to plan and conduct hazard fuels mitigation projects and prescribed fires, and to complete other fire management business.

The Kenai NWR uses prescribed fire as a tool in two management areas: hazardous fuels reduction and habitat management. This EA does not propose using prescribed fire for habitat management but only for hazard fuel reduction in or near Refuge developments, sensitive resources, and WUI or intermix areas to reduce or mitigate the risk of wildfire.

The Refuge would continue to treat hazardous fuels such as black spruce, white spruce, beetle-killed spruce, flammable brush species such as rusty menziesia (*Menziesia ferruginea)*and Labrador Tea (*Ledum palustre*), and grasses such as Bluejoint Reedgrass (*Calamagrostis canadensis*), or any combination of these fuels.

2.3.1.1 Wilderness FMU

The Wilderness FMU comprises 1,320,550 acres or 66.4% of Kenai NWR's total 1.98 million acres. Neither broadcast burning nor mechanical treatments have occurred in this FMU. During the 10-year period from 2003 to 2012, there were eight large wildfires (greater than 100 acres): six naturally ignited (lightning) fires, one human-caused fire, and one fire of unknown origin that burned a total of about 50,000 acres in this FMU. Four of the naturally ignited fires were managed for resource benefits, but two were suppressed.

2.3.1.2 Minimal FMU

The Minimal FMU comprises 703,550 acres or 35.5% of Kenai NWR's total 1.98 million acres. The following actions and level of fire management treatments would continue:

- There has been no past broadcast burning in this FMU.
- The current number of acres treated mechanically each year ranges from 0 to 216 acres.
- The current number of acres in WUI areas treated mechanically each year ranges from 0 to 216 acres.

During the 10-year period from 2003 to 2012, there were two large wildfires (one naturally ignited and one human-caused), that burned approximately 16,490 acres. The naturally ignited fire was managed for resource benefits.

2.3.1.3 Moderate FMU

The Moderate FMU comprises 179,000 acres or 9% of Kenai NWR's total 1.98 million acres. The following actions and level of fire management treatments would continue:

- The current number of acres treated annually with broadcast burning in this FMU ranges from 0 to 1,100 acres, which equates to approximately 0% to 0.6% of the FMU acres.
- The current number of acres treated mechanically each year ranges from 0 to 184 acres.
- The current number of acres in WUI areas treated mechanically each year ranges from 0 to 184 acres.

During the 10-year period from 2003 to 2012, there were no large wildfires in this FMU.

2.3.1.4 Intensive FMU

The Intensive FMU comprises 54,000 acres or 2.7% of Kenai NWR's total 1.98 million acres. The following actions and level of fire management treatments would continue:

- There has been no past broadcast burning in this FMU.
- The current number of acres treated mechanically each year ranges from 0 to 214 acres.
- The current number of acres in WUI areas treated mechanically each year ranges from 0 to 214 acres.

During the 10-year period from 2003 to 2012, there were no large wildfires in this FMU.

2.3.2 Alternative B: Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation

Alternative B is essentially identical to Alternative A (no action) in every fire management program element (including the FMUs and fire management options), except hazardous fuels and wildfire mitigation. Wildfire mitigation includes measures to decrease the likelihood of property damage and injury due to human caused or naturally ignited fires and involves efforts such as the reduction or removal of hazardous fuels, wildfire preparedness, fire prevention, and FIREWISE activities.

Alternative B proposes to treat more acres (as funding is available) because it includes fuel reduction activities in Community Wildfire Protection Plan (CWPP) and Community of Interest (COI) areas (see section 2.4.1.4 below). The program elements described for Alternative A, that would be the same for Alternative B, are not repeated here. Instead, the descriptions presented in the following sections, deal exclusively with hazardous fuels and wildfire mitigation.

While the CWPP and COI areas are included in both alternatives, Alternative A would not implement a collaborative strategic program of hazardous fuels and wildfire mitigation for those areas. Conversely, Alternative B is a proposal to collectively or holistically analyze wildfire and fuels hazards and risks and develop a program of strategic mitigation for the Refuge FMP.

2.3.2.1 Vision of the Wildland Fire Management Program

The Service's vision for wildland fire management on the Kenai NWR is to design and implement a program of work in alignment with the mission of the Service and the National Wildlife Refuge System, and in concert with the establishing purposes of the Refuge and its wilderness that promotes the following:

- Naturally ignited fire is accepted and valued as an ecosystem process and healthy fire adapted ecosystems are maintained;
- Wildfires are managed both to protect human life, private property and other values at risk, and to accomplish identified resource management objectives; and

- Communities of the Kenai Peninsula are resistant to wildfire damage, and biologically diverse landscapes of the Refuge are resilient to the effects of fire.

To realize this vision, the Refuge Fire Management Program must work cooperatively and collaboratively with Refuge Managers, other Refuge Staff, the Regional Fire Management Branch, Refuge cooperators and partners, and with the public. The Service must help its neighbors—the residents of the Kenai Peninsula—adopt FireWise practices and promote FireWise Communities. The Service needs to use the best available science to analyze landscapes, identify hazards and assess risks, and develop a strategic hazardous fuels treatment plan for the Refuge, especially where WUI and intermix areas adjoin Refuge lands. The Service also needs to explore new ways to reach area residents and Refuge visitors with fire safety and fire prevention information, thereby reducing the number of abandoned, unattended, and escaped campfires.

2.3.2.2 Coordination, Outreach, and Education

As recognized in current wildland fire policy, effective fire management requires close coordination between local communities and other government agencies, particularly those communities that experience high wildland fire risk in the WUI, and partner agencies that share fire prevention concerns for those communities. As the management of private lands has become an increasingly important factor in the fire risk equation, the Service has recognized the importance of providing outreach, education, and support to local communities to reduce wildland fire hazards in and near those communities. The State of Alaska Department of Natural Resources, Division of Forestry Kenai-Kodiak Area Office (KKAO) provides fire protection and suppression services to the local communities and surrounding wildlands of the Kenai Peninsula and the Kodiak archipelago. KKAO partners with the Kenai NWR fire management program for numerous activities, including the following:

- Preparedness and suppression
- Fire prevention, outreach, and education programs
- Wildfire risk mitigation, including hazardous fuels management

2.3.2.3 Purpose of Community Wildfire Protection Plans

The *Healthy Forests Restoration Act of 2003* (Public Law [PL] 108-148) encourages the development of CWPPs, and communities (or counties) may at their option develop a plan. A CWPP enables local communities to improve their wildfire mitigation capacity and work with government agencies to identify high fire risk areas and prioritize areas for mitigation, fire suppression, and emergency preparedness. The minimum requirements for CWPPs are as follows (SAF 2004):

1. **Collaboration:** Local and state government representatives, in consultation with federal agencies or other interested groups, must collaboratively develop a CWPP.

2. **Prioritized Fuel Reduction:** A CWPP must identify and prioritize areas for hazardous fuels reduction and treatments. Furthermore, the plan must recommend the types and methods of treatment that will protect at-risk communities and their essential infrastructures.

3. **Treatments of Structural Ignitability:** A CWPP must recommend measures that communities and homeowners can take to reduce the ignitability of structures throughout the area addressed by the plan.

At the local level, successful implementation of fuel treatments must include community decision makers collaborating with federal, state, and local governments; Alaska Native Corporations; community-based groups; landowners; and other interested persons. Collaboration is used to establish priorities, cooperate on activities, and increase public awareness and participation to reduce the risks to communities and surrounding lands. While land management agencies make the decisions on matters affecting public lands, these collaborative efforts will produce programs that can be supported broadly and implemented successfully.

In the CWPP areas, these plans provide a seamless guide for fuel reduction across ownerships, identifying those treatments to be completed by public agencies and those to be completed by private landowners. The CWPP is composed of both WUI and intermix communities and is defined as areas where human habitation and development meet or intermix with wildland fuels (USDA/USDI 2001b:752–753). Human encroachment upon wildland ecosystems within recent decades is increasing the extent of the WUI and is therefore having a significant influence on wildland fire management practices.

Within the Kenai Peninsula Borough, the nine CWPP areas (see Figure 2-3) listed below are adjacent to the Kenai NWR, have been identified as being at high risk from wildland fires originating on or adjacent to federal lands, and have developed CWPPs. The maps for the individual CWPP areas are presented in the following appendices:

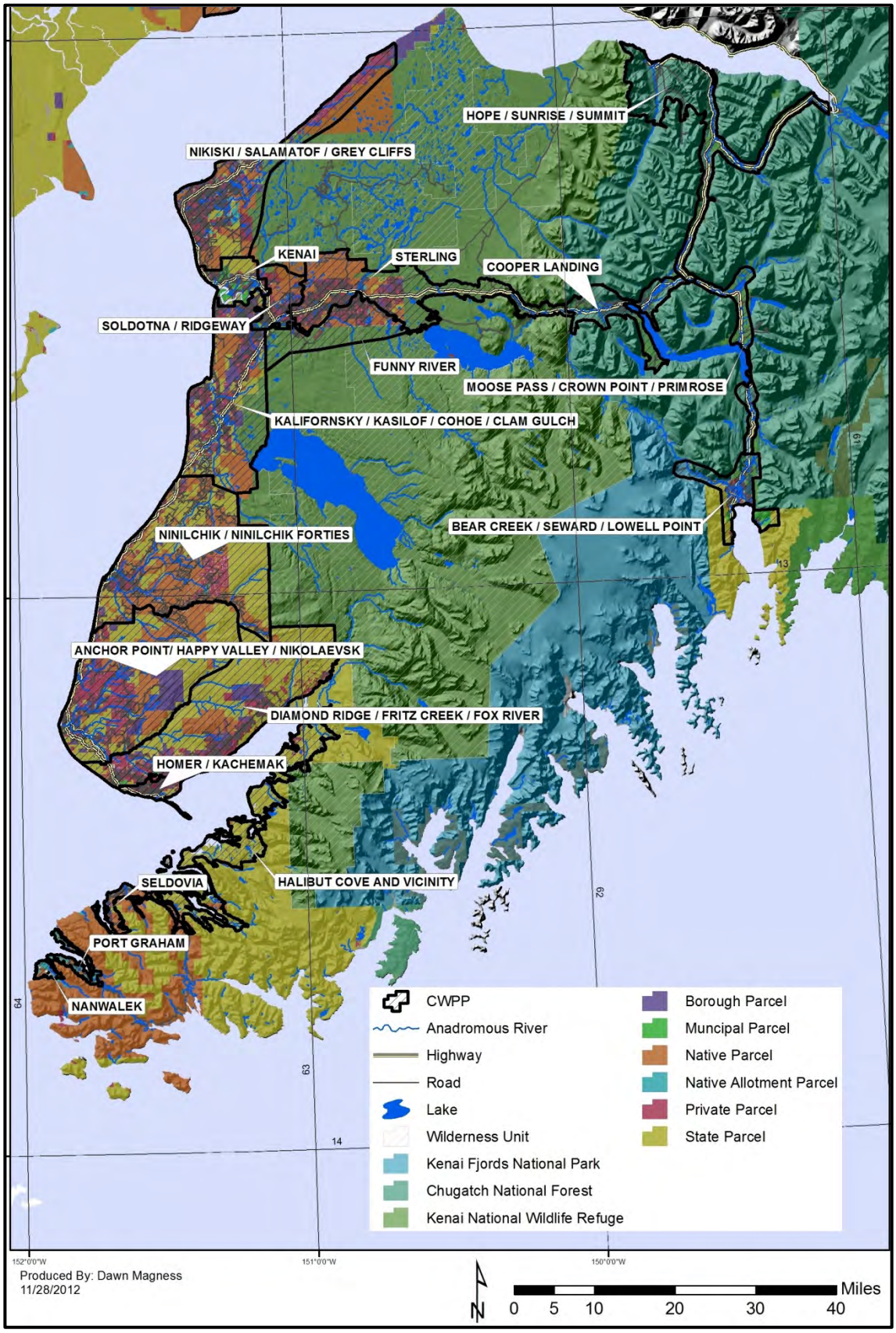
- Appendix C: Cooper Landing
- Appendix D: Diamond Ridge / Fritz Creek / Fox River
- Appendix E: Funny River
- Appendix F: Kalifornsky / Kasilof / Cohoe / Clam Gulch
- Appendix G: Kenai
- Appendix H: Nikiski / Salamatof / Grey Cliffs
- Appendix I: Ninilchik / Ninilchik Forties
- Appendix J: Soldotna / Ridgeway
- Appendix K: Sterling

In addition to the nine CWPP areas, there are three COIs within the boundaries of the Refuge.

- Appendix L: Swanson River Oil Field
- Appendix M: Beaver Creek Oil Field
- Appendix N: Moose Research Center

These three COIs include year-round residents, structures, equipment, infrastructure, and other valuable assets identified as being at high risk from wildfires originating on or off the Refuge.

Figure 2-3. Kenai Peninsula CWPP areas



The CWPPs are collaborative, living documents that are reviewed and updated on a regular basis by an interagency committee (the Kenai Peninsula Borough's All Lands All Hands Committee), in consultation with members of the respective communities. The All Lands All Hands Committee, also known as the Kenai Forest, Wildland Fire and Fuels Management Coordinating Committee, was established by an interagency Memorandum of Understanding in 2004 and again in 2010. The committee prepared the original five-year All Lands All Hands Action Plan in 2004 and revised it in 2011. Committee members participated in the completion of 20 CWPPs for the Borough, including the nine listed above. The committee meets at least twice each year to collaborate and plan management activities.

The CWPPs provide a wealth of information to Refuge land and fire managers and their cooperators, including wildfire hazard and risk information, location of assets/values to be protected and planned mitigation activities.

Using the CWPPs and spatial modeling tools, Refuge fire managers propose to develop spatially strategic hazardous fuels and wildfire mitigation projects and treatments that will help the Refuge and its adjacent communities accomplish their mutual goals and objectives.

2.3.2.4 Summaries of the CWPPs

Cooper Landing CWPP

The Cooper Landing CWPP area is adjacent to the eastern boundary of the Refuge within the Kenai River Valley. Although about 43 acres of the CWPP area lies inside the Refuge, the Refuge acres are within designated Wilderness areas: Mystery Creek Wilderness north of the Sterling Highway and Andrew Simons Wilderness south of the Kenai River. At this time, the Refuge is not proposing hazardous fuels treatments in the Cooper Landing CWPP area because the area is designated wilderness.

Diamond Ridge / Fritz Creek / Fox River CWPP

The Diamond Ridge / Fritz Creek / Fox River CWPP area is adjacent to the southern boundary of the Refuge, north and west of Kachemak Bay. About 203 acres of the Refuge lie in this CWPP Area. However, these Refuge acres are within the Andrew Simons Wilderness Area, and there is no known fire history at that location due to the elevation and local climate. The Refuge has no plans for hazardous fuels treatments in this area.

Funny River CWPP

The Funny River CWPP area contains almost 28,000 acres of the Refuge, south of the Kenai River and from the west end of Skilak Lake to the Refuge Headquarters, just south of Soldotna. The community of Funny River and its interagency cooperators have been very active in the implementation of the Funny River CWPP (see Table 2-1 for the CWPP project lists). This community activism is due in part to the active fire history of the area, which includes, most recently, the 2009 Shanta Creek Fire (13,000+ acres) and the 2005 King County Creek Fire (10,000+ acres). Both of these fires were ignited by lightning in or near the Andrew Simons Wilderness Area, and both had the potential to threaten Funny River residents. The northern boundary of the Andrew Simons Wilderness abuts the private lands of the Funny River community between the Killey and Funny rivers. Lands in the community and its surroundings are dominated by large continuous stands of black spruce. This hazardous fuel type covers about one-third (9,325) of the Refuge acres in the CWPP area. While the Refuge has actively treated hazardous fuels along much of its boundary in this CWPP area (Funny River Road fuelbreak and Slikok treatments, and contingency fire lines established during the Shanta Creek Fire), the risk of wildfire damage to communities remains high.

Table 2-1. KPB Spruce Bark Beetle Mitigation Program: Project Status of CWPPs Areas of Concern

CWPP Area	Project Name	Fuel Treatment	WUI Acres	Ownership	Treatment Type	Estimated Cost Assuming No Value Of Wood Material	Treatment Status
COMPLETED PROJECTS							
Kasilof	North Cohoe Loop Beach Access Road	Removal of SBB[1] trees and treatment of slash to eliminate fuel continuity around community and public recreation area	~45 acres	Alaska DNR/Private	Hand felling: Could be contract bid or assigned to DOF/Chugachmiut hazard crew. Slash to be treated.		Completed 1/2012
Kenai	Float Plane Road	Removal of SBB trees and treatment of slash to eliminate fuel continuity around community and Kenai Airport	~80 Acres	City of Kenai/Private	Contract Bid: Hand or Mechanical Treatment		Completed 2009
Nikiski	KPB Nikiski Poolside parcels	Removal of SBB trees and treatment of slash to eliminate fuel continuity around community and public recreation area	~95 Acres	KPB	Timber Sale: Mechanical Treatment		Completed 2010: 93 acres
Moose Pass	Trail Lakes Fish Hatchery	Removal of SBB trees and treatment of slash to eliminate fuel continuity around infrastructure and enhance safety zone area	~15 Acres	Alaska DNR	Contract Bid: Hand or Mechanical Treatment		Completed 2009
Funny River	Funny River Road	Removal of SBB trees and treatment of slash to eliminate fuel continuity around or into community	8 miles	Public and Private	Contract Bid: Hand or Mechanical Treatment		Completed 2009
Soldotna	Kenai River & Campgrounds	Removal of SBB trees and treatment of slash to eliminate fuel continuity around community and public recreation area	45 acres	Public and Private	Hand felling: assigned to DOF hazard crew. Slash to be treated.		Completed KPB DOF 2010
Soldotna	Sport Lake Public Access Area	Removal of SBB trees and treatment of slash to eliminate fuel continuity around community and public recreation area	1 acre	Public and Private	Hand felling: assigned to DOF hazard crew. Slash to be treated.		Completed City of Soldotna
Soldotna	Main Road Buffers	Hazard Trees along road corridors	5 miles	Public and Private	Contract Bid: Hand or Mechanical Treatment		Completed 2010/11
Ninilchik	Continued SBB ROW Work	Continued effort to get landowners to allow SBB projects to remove hazard trees		Mixed	Contract Bid: Hand or Mechanical Treatment		Continued through 2011
Clam Gulch	Clam Gulch State Parks Parcel	Removal of SBB trees and treatment of slash to eliminate fuel continuity around community and public recreation area	~150 Acres	Alaska DNR	Contract Bid: Mechanical Treatment		Completed 2010/2011: 119 acres
COMPLETED PROJECTS (CONTINUED)							
Homer	Baycrest Ski Trail	Create 100 foot fuel break along 20 miles of trails by removing hazard trees and treating slash	~250 Acres	Mixed: KPB, City of Homer, Private	Timber Sale on KPB: Could be contract bid or assigned to DOF/Chugachmiut hazard crew. Slash to be treated.		Completed 2010/2011: 80 acres
Homer	Paul Banks School	Remove `110 slash piles from previous project crew work	~20 Acres	KPB	Contract bid to remove using 4 wheeler/trailer in frozen conditions		Completed 2009

Table 2-1. KPB spruce bark beetle mitigation program: Project status of CWPPs areas of concern, 1/12/2012 (continued)

CWPP Area	Project Name	Fuel Treatment	WUI Acres	Ownership	Treatment Type	Estimated Cost Assuming No Value Of Wood Material	Treatment Status
Homer	Bridge Creek Reservoir	Reduce fuels surrounding City of Homer water reservoir	210 Acres	City of Homer/KPB	Contract Bid: Mechanical and Hand Treatment		Completed 2011: 80 acres
Homer	Diamond Creek State Park Lands	Removal of SBB trees and treatment of slash to eliminate fuel continuity around community and public recreation area	~90 Acres	Alaska DNR	Hand felling: Could be contract bid or assigned to DOF/Chugachmiut hazard crew. Slash to be treated.		Completed 8/2012: 105 acres
Ninilchik	Garrison Ridge F&G Parcel	Removal of SBB trees and treatment of slash to eliminate fuel continuity around or into community	~20 acres	Alaska DNR	Contract Bid: Hand or Mechanical Treatment		Completed spring 2012: 20 acres
City of Kenai	KPB Slash Disposal Sites	Provide/Maintain public slash disposal sites to promote Defensible Space Projects	4 sites borough wide: Kenai, Funny River, Kasilof, Hope		Contract Bids	$40,000.00/per year	Completed 8/2013
ONGONG PROJECTS							
Kenai	Beach Gullies	Removal of SBB trees and treatment of slash to eliminate fuel in gulches leading into the community from the beaches from the Senior Center to Forest	~40 Acres	City of Kenai/Private	Hand felling: Could be contract bid or assigned to DOF/Chugachmiut hazard crew. Slash to be treated.		Ongoing
Soldotna	Tsalteshe Trails						DOF 2010 & 2011: Ongoing
UNCOMPLETED PROJECTS							
Clam Gulch	Marathon Gas Pad	Removal of SBB trees and treatment of slash to reduce chance of ignition and protect community and infrastructure	~10 Acres	Private	Contract Bid: Mechanical Treatment	$10,000.00	
Funny River	Utility Corridors	Removal of SBB trees and treatment of slash to remove hazards to community electrical service		Private	Contract Bid: Mechanical Treatment	$25,000.00	
Nikiski	Captain Cook State Park	Removal of SBB trees and treatment of slash to eliminate fuel continuity around public recreation area	100 acres, 6 miles of ROW work		Contract Bid: Mechanical Treatment	$45,000.00	
				Total Estimated Cost of Unfinished Projects		$80,000.00	

Note:

1. SBB = spruce bark beetle

The Refuge is collaborating with the Alaska Division of Forestry and the Kenai Peninsula Borough to assess the hazards and reduce the risk of unwanted wildfires in this area. Using the best available fire behavior modeling tools, the Refuge and its cooperators will strategically select and treat black spruce stands and other hazardous fuels in the CWPP area on both sides of the Refuge boundary. Any hazardous fuels mitigation treatments proposed for the wilderness portion of the CWPP area must undergo a Minimum Requirements Analysis and must meet the provisions of the *Wilderness Act of 1964.*

Two new wildfire mitigation treatments that are being implemented by Refuge cooperators in 2013, include: (1) an Alaska Division of Forestry project (funded by Service WUI grant) to construct a 60- to 80-acre fuelbreak on private lands along the Refuge boundary west from the Funny River; and (2) a Natural Resource Conservation Service (NRCS) funded project to develop a fire break on private lands just east of the Funny River.

Kalifornsky / Kasilof / Cohoe / Clam Gulch CWPP

The Kalifornsky / Kasilof / Cohoe / Clam Gulch CWPP area encompasses about 18,874 acres along the western boundary of the Refuge. This CWPP Area borders the western shoreline of Tustumena Lake and includes the Kasilof River Valley and the four communities for which it is named. About two-thirds of the Refuge acres in this CWPP (12,646) are covered by hazardous fuel types including black spruce, white spruce, beetle-killed white spruce, and mixed spruce/hardwood forests. The Refuge is collaborating with the Alaska Division of Forestry and the Kenai Peninsula Borough to assess the hazards and reduce the risk of unwanted wildfires in this area. Using the best available fire behavior modeling tools, the Refuge and its cooperators will strategically select and treat black spruce stands and other hazardous fuels in the CWPP area on both sides of the Refuge boundary.

Kenai CWPP

The Refuge is immediately adjacent to the northeast corner of the Kenai CWPP area. That area of the Refuge is dominated by wetlands (muskegs/bogs), and while there are isolated stringers of black spruce in the area, the Refuge is proposing no hazardous fuels treatments at this time.

Nikiski / Salamatof / Grey Cliffs CWPP

The Nikiski / Salamatof / Grey Cliffs CWPP area lies to the north of Kenai, between the Refuge and Cook Inlet, and includes about 23, 649 acres of the Refuge. North of the community of Nikiski and the end of the Spur Highway at Captain Cook State Park, this CWPP area is roadless and accessible only by all-terrain vehicle, snowmobile, or boat. There are dozens of remote cabins and home sites along the Refuge boundary in this area. While hazardous fuels mitigation work is ongoing in and around Nikiski and Salamatof and within Captain Cook State Park, the Refuge has not yet addressed fuels hazards in this area due to its inaccessibility. The unincorporated community of Grey Cliffs has been identified as a community-at-risk (extreme) on the Alaska State list. A wildfire in that area of the Refuge would likely threaten numerous homes in the Grey Cliffs community and would be extremely difficult to suppress due to the lack of access. There are about 7,800 acres of treatable hazardous fuels within the Refuge portion of this CWPP area.

Ninilchik / Ninilchik Forties CWPP

The Ninilchik / Ninilchik Forties CWPP area lies along the western border of the Refuge south of Tustumena Lake and includes about 415 acres of the Refuge. While there are hundreds of remote recreational cabins, residences, and outbuildings in the Ninilchik Forties community, immediately adjacent to the Refuge boundary, Refuge lands in this CWPP area are within the Andrew Simons

Wilderness. The area has an active fire history, which includes the 1995 Crooked Creek Fire (17,000+ acres); the 2005 Fox Creek Fire (26,000+ acres); and the 2007 Caribou Hills Fire (63,000+ acres). The effects of those fires (consumption of hazardous fuels), when coupled with the protection of wilderness values, has led the Refuge to decide not to develop plans for hazardous fuels mitigation on its lands in this CWPP area.

Soldotna / Ridgeway CWPP

The Soldotna / Ridgeway CWPP area is surrounded by the Sterling, Funny River, Kalifornsky, and Kenai CWPP areas to the east, south, and west and by the Refuge to the north. It encompasses about 4,816 acres of the Refuge, of which about 25% or 1,204 acres are treatable hazardous fuel types. The Refuge is collaborating with the Alaska Division of Forestry, the Kenai Peninsula Borough, and the Alaska Department of Fish & Game (ADF&G) to assess hazards and reduce the risk of unwanted wildfires in this area. Using the best available fire behavior modeling tools, the Refuge and its cooperators will strategically select and treat black spruce stands and other hazardous fuels in the CWPP area on both sides of the Refuge boundary.

Sterling CWPP

The Sterling CWPP area borders the Soldotna / Ridgeway CWPP area to the east and the Funny River CWPP area to the north, and it includes the Sterling Highway access/egress corridor from the community of Sterling east to the Cooper Landing CWPP area. The Sterling CWPP area is bordered to the north and south by the Refuge and includes about 36,691 acres of Refuge lands. About one-half of the Refuge acres in the CWPP area (18,346 acres) are treatable hazardous fuel types (black spruce, white spruce, white spruce beetle-kill, and mixed spruce/hardwood forest). The Refuge has actively implemented hazardous fuels mitigation treatments (Lily Lake and Skilak Loop) in this CWPP area in the past, and proposes to continue these activities and others over the next planning period.

Swanson River Oil Field COI

The Swanson River Oil Field COI area lies completely within the boundaries of the Kenai NWR to the north of Sterling and encompasses about 7,887 acres of the Refuge, one-half of which (3.943 acres) are covered by treatable hazardous fuel types. This oil field includes the first producing oil well in Alaska's history (the Discovery Well) and more than 50 other wells with hundreds of buildings, storage tanks, pipelines, roads, telecommunication towers, power lines, other infrastructure, equipment, and full-time year-round occupancy by more than 100 workers and managers (currently). The only road access/egress is via the Swanson River Road south to the Sterling Highway. Hazardous fuels (including large dense stands of black spruce, white spruce, beetle-killed white spruce, and mixed spruce/hardwood forests) surround this producing oil and gas field. The Refuge is proposing to strategically select and implement hazardous fuels mitigation treatments in and around the oil field and along the Swanson River Road to protect lives and valuable infrastructure.

Beaver Creek Oil Field COI

The Beaver Creek Oil Field COI area lies completely within the boundaries of the Refuge, just north of the communities of Kenai and Soldotna. It encompasses about 4,098 acres of the Refuge, one-quarter of which (1,024 acres) are covered by treatable hazardous fuel types. While it is a much smaller development than the Swanson River Oil Field, it also contains several wells, buildings, tanks, pipelines, power lines, and other infrastructure with equipment and full-time year-round occupancy by workers and managers. The only road access/egress is via the Marathon Road south to the Spur Highway in Kenai.

The Refuge is proposing to strategically select and implement hazardous fuels mitigation treatments in and around the oil field and along the Marathon Road to protect lives and valuable infrastructure.

Moose Research Center COI

The Moose Research Center (MRC) COI area lies completely within the boundaries of the Refuge, northeast of Sterling, Alaska. This one-of-a-kind wildlife research facility and its interface area cover about 11,375 acres of the Refuge. The MRC is surrounded on three sides (north, east, and south) by the Dave Spencer Wilderness Area, which includes the world-class Swanson River and Swan Lake Canoe Trails. The MRC is owned by the Refuge but operated through an interagency agreement by the ADF&G. Assets at the MRC include residential cabins, barns, storage buildings, a laboratory, propane tanks, fences, corrals, and other infrastructure. ADF&G employees and managers occupy the MRC year-round. The only access/egress route is via the Swan Lake Road west to the Swanson River Road, then south to the Sterling Highway in Sterling, Alaska. The Refuge has worked cooperatively with the ADF&G to treat hazardous fuels at the MRC over the last 10 years and proposes to continue that program of work. In collaboration with the Refuge, the ADF&G has prepared the 2013 Moose Research Center Habitat Enhancement Plan (see Appendix O). While the planned treatments in the MRC Habitat Enhancement Plan are designed to regenerate moose browse for the captive animals, the treatments also strategically cut and remove black and white spruce and other trees, thereby mitigating hazardous fuels in the complex.

2.3.2.5 Proposed Treatments under Alternative B

The types of treatments that may be used to remove or reduce hazardous fuels and mitigate wildfire risks under Alternative B include mechanical treatments (clearing, thinning, pruning, cutting and piling, mastication) and prescribed fire treatments (pile burning, broadcast burning), and post-treatment seeding and tree/shrub planting, using less flammable native species such as willow (*Salix* spp.), alder (*Alnus* spp.), birch (*Betula neoalaskana*, *B. glandulosa*), or aspen (*Populus tremuloides*), especially where the desire is to replace bluejoint reedgrass.

Mechanical treatments may be accomplished by hand crews with chain saws and hand tools, by public biomass removal (firewood permit), or by tracked equipment such as dozers, excavators and skid-steers with various cutting, shearing, grappling or masticating attachments (shearing blades, tree shears, mowers, roller-choppers, feller-bunchers, grinders and masticating rollers), or by rubber-tired equipment such as hydro-axes and mowers.

Prescribed fires are accomplished by the Refuge Fire Management Program, at times with assistance from its cooperators. The Refuge maintains a staff of qualified firefighters with the necessary skills and prescribed fire qualifications to accomplish its prescribed fire program.

The hazardous fuels to be treated include black spruce, white spruce, beetle-killed spruce, mixed spruce/hardwood forests, flammable brush species such as rusty menziesia, Labrador tea, and bluejoint reedgrass, or fuels complexes where multiple types of hazardous fuels are combined.

An effective hazardous fuels treatment program on the Refuge, when coupled with communities and neighborhoods where fuel hazards and fire risk are mitigated, would provide the best management environment for Refuge managers to be able to manage natural fires for resource benefits.

2.3.2.6 Collaborative Management of Strategically Planned Fuels Treatments

In planning hazardous fuels projects for the Refuge, fire managers locate proposed treatments based upon road access, values at risk, fuel type, fuel hazard, relative risk from wildfire, and/or desired vegetation changes. The overarching goal of the fuels program is to allow fire to play its natural role in the ecosystem while providing for the safety of surrounding communities. Maintaining the largely natural and intact fire regimes in the undeveloped wildlands of the Refuge into the future will be at least partially dependent upon the strategic placement and effectiveness of hazardous fuels treatments within the Refuge.

The CWPPs identify the areas of highest concern. Most of the CWPPs have identified significant areas of risk from fires moving off the Refuge and into communities. Both the relative risk and the public concern associated with natural fires managed for resource benefit can be reduced or mitigated with an active and successful hazardous fuels mitigation program. The majority of hazardous fuels reduction projects should address a strategic mix of on- and off-Refuge treatments in the highest risk areas (see Table 2-2).

Table 2-2. Fire risk ratings for CWPP and COI lands

CWPP / Community of Interest (COI)	Risk Rating	CWPP Total Acres	Refuge Acres
Cooper Landing	High	32,600.00	42.70
Diamond Ridge / Fritz Creek / Fox River	Extreme	159,400.00	203.10
Ninilchik / Ninilchik Forties	Extreme	172,600.00	415.10
Sterling	High	86,600.00	36,691.50
Funny River	High	43,500.00	27,976.40
Soldotna / Ridgeway	High	21,200.00	4,816.30
Kenai	Extreme	20,800.00	0.02
Nikiski / Salamatof / Grey Cliffs	Extreme	102,000.00	23,648.70
Kalifornsky / Kasilof / Cohoe / Clam Gulch	Extreme	117,400.00	18,873.80
Beaver Creek Oil Field (COI)	High	N/A	4,098.00
Swanson River Oil Field (COI)	Extreme	N/A	7,887.00
Moose Research Center COI	Extreme	N/A	11,375.00

While it is possible that Refuge habitat management goals and objectives might also be addressed through careful planning of hazardous fuels mitigation projects, the proposed FMP will only address fire management goals and objectives. Habitat treatment plans for the Refuge would require new site-specific or area analyses and would need to relate directly to the goals and objectives identified in the Kenai NWR's revised CCP (USFWS 2010a). Future habitat management plans and CWPPs will overlap, allowing land managers to comprehensively leverage hazardous fuels and habitat treatment benefits. In general, allowing natural fire on the greater Refuge landscape provides the best opportunity for landscape-level disturbance that can benefit wildlife. In areas at risk from wildfire, more intensive project design will be necessary to accomplish both hazardous fuels and habitat maintenance or enhancement objectives.

2.3.3 Comparison of Alternatives

While both alternatives are founded upon the same Refuge and fire management goals and objectives, they differ in scope. In Alternative A (No Action, Continue Current Level of Management), the actions proposed under the hazardous fuels mitigation program are limited to projects and treatments already planned and approved through other step-down plans and previous NEPA analyses (such as the 2006 Skilak Wildlife Recreation Area Management Plan and 1996 Moose Management Plan). Examples of ongoing hazardous fuels mitigation projects and treatments that would continue to be implemented (dependent upon funding) under Alternative A include Skilak Loop, Lily Lake, Slikok and the Funny River Road fuelbreak projects.

Under Alternative B (the preferred alternative), the scope of the Refuge hazardous fuels and fire mitigation program would be expanded to include the nine CWPP areas, the Swanson River and Beaver Creek Oil and Gas Fields, and the Moose Research Center. Using state of the art spatial modeling tools such as FSPro, FARSITE, the Interagency Fuels Treatment Decision Support System, and others, the Refuge would collaborate with its cooperators and at risk communities to strategically plan and locate hazardous fuel reduction treatments to mitigate the risk of wildfire.

A potential constraint for implementing treatments under Alternatives A and B is adequate funding. While the Refuge and its cooperators look for new sources of funding and compete regionally and nationally through federal channels for conventional hazardous fuels mitigation funding, the reality of the federal hazardous fuels mitigation budget process is that this alternative may not be fully implemented.

Table 2-3 below, provides a comparison of the fire management treatments and range of acres proposed to be treated annually under each alternative. The acreages listed in the prescribed fire and mechanical treatment columns under Alternative B are estimates of the maximum potential acreage of the treatable vegetation types (black spruce, white spruce, beetle-killed white spruce, and mixed spruce/hardwood forest). Specific treatment sites would be selected through spatial fire behavior modeling/analyses to identify key areas where hazardous fuels mitigation would produce the most benefit. Selected treatment sites would be subjected to environmental, biological, and cultural/historical assessments before approval. Implementation would depend on available funding. That is, given limited hazardous fuels mitigation funding, the Refuge could select specific treatments based upon cost. The successful implementation of prescribed fire treatments may also be limited by adverse weather and fuel moisture conditions, and/or a lack of available resources (such as firefighters, equipment, helicopters).

2.4 Alternatives Considered But Dismissed From Detailed Analysis

No other alternatives were considered for detailed analysis.

2.5 Mitigation Measures

Mitigation measures and constraints would be implemented to avoid or substantially reduce a treatment's adverse environmental effects. The FMU discussions in Appendix B include mitigation measures. Table 2-4 below lists additional measures that will be implemented in all fuel and fire management actions.

Table 2-3. Comparison of alternatives

Map Item[1]	Refuge / WUI Location	Alternative A: No Action - Continue Current Management (Acres)		Alternative B: Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation (Acres)[8]	
		Prescribed Fire[2]	Mechanical Treatments[3]	Prescribed Fire[4]	Mechanical Treatments[5]
Kenai NWR Fuel Reduction Treatments					
1.	Sterling WUI / Lily Lake	16	184	415	0
2.	Sterling WUI / Skilak Loop	21	123	102	0
3.	Funny River WUI / Funny River Road Fuelbreak[6]	184	216	50	50
4.	Funny River WUI / Slikok	0	55	199	0
5.	Moose Research Center[7]	42	72	390	1,635
6.	Swanson River Oil Field	0	0	3,943	3,943
7.	Beaver Creek Oil Field	0	0	1,024	1,024
CWPP (WUI) Area Fuel Reduction Treatments[9]					
a.	Cooper Landing CWPP	0	0	0	0
b.	Diamond Ridge / Fritz Creek / Fox River CWPP	0	0	0	0
c.	Funny River CWPP	0	0	9,325	9,325
d.	Kalifornsky / Kasilof / Cohoe / Clam Gulch CWPP	0	0	12,646	12,646
e.	Kenai CWPP	0	0	0	0
f.	Nikiski/Salamatof / Grey Cliffs CWPP	0	0	7,800	7,800
g.	Ninilchik / Ninilchik Forties CWPP	0	0	0	0
h.	Sterling CWPP	0	0	18,346	18,346
i.	Soldotna / Ridgeway CWPP	0	0	1,204	1,204
	Total Treatment Acres	**263**	**650**	**54,240**	**54,769**
	Average Annual Treatment Acres	**17.5**	**43.3**	**3,616**	**3,651**

Notes:

1. Refer to the maps in Appendices C through N.
2. Acres of prescribed fire completed over the past 15 years
3. Acres of mechanical treatments completed over the past 15 years
4. Proposed acres of prescribed fire to be completed over the next 15 years (funding-dependent)
5. Proposed acres of mechanical treatments to be completed over the next 15 years (funding-dependent)
6. This access/egress fuelbreak has been treated and maintained in multiple entries since 1999
7. See the ADF&G 2013 Moose Research Center Habitat Enhancement Plan in Appendix O
8. Proposed treatment acres in Alternative B are estimates of treatable vegetation/fuel types (black spruce, white spruce, beetle-killed white spruce, and mixed spruce/hardwood forest). Specific treatment sites would be selected through spatial fire behavior modeling/analyses to identify key hazardous fuels for mitigation. Selected treatment sites would be subject to environmental, biological, and cultural/historical assessments before approval. Implementation would depend on funding.
9. The acreages listed under Alternative B for the Funny River and Sterling CWPPs include the acres listed in Alternative B in Map Items 1-4.

Table 2-4. Mitigation measures

Resource	Mitigation Measure
Human Health and Safety	
Prescribed Fire	• Each prescribed fire will require a detailed and comprehensive prescribed fire plan that has been reviewed by a technical specialist and approved by the Refuge Manager and Refuge archaeologist. • The prescribed fire plans, which will include smoke management plans, will be prepared by the Land Manager and Service Region 7 Fire District staff prior to implementing prescribed fires. • Prescribed fires will comply with applicable regulations of the Alaska State Forestry Division and Alaska Air Quality Division, and will be carried out in accordance with the constraints identified on each refuge's spatial FMP maps. • Agency or local law enforcement may be requested for traffic control if smoke impacts visibility on roads or highways. • Warning signs will be posted to advise motorists of a prescribed burn in progress and the potential for reduced visibility on roads that may be impacted by a prescribed burn. • Ample notification will be given to landowners in WUI areas. Notices may also be posted to inform other adjacent landowners or nearby communities of prescribed fires. • Press releases will be provided to the local media to inform the public in advance of a prescribed fire. • The Alaska State Forestry Division, the local fire departments, county sheriffs' offices, and other parties as identified within the individual burn plan will be notified prior to prescribed burns. • Prescribed fires will not be started until all contingency forces are confirmed to be on-site or in standby status, as specified in the prescribed fire plan.
Invasive/Exotic Plants	
Prevention	• Vehicles will minimize driving in areas infested with invasive/exotic plants at a time when movement of seeds is likely, and when this is not possible, vehicles and equipment will be cleaned after leaving an infested area. Vehicles and equipment will be considered clean when a visual inspection does not disclose seeds, soil, vegetative matter, and other debris that could contain or hold seeds. • A designated location will be identified for the cleaning described above. This will be in a spot not conducive to exotic weed establishment and will be monitored for incipient weed populations.
Water Resources	
	• Minimize soil disturbance and thus potential for sediment delivery to streams and ponds during prescribed fire by using previously prepared vegetated firebreaks or existing barriers such as roads and trails, even if this results in a slight increase in burned area. • Prevent or minimize soil erosion and thus potential for sediment delivery to streams and ponds by retaining a high proportion (80% or more) of surface cover in vegetation, litter (dead leaves, grass, and other dead plant parts), and fibrous root systems. • Heavy equipment will be closely monitored in designated areas to minimize adverse effects on wetlands and other resources at risk. • Retardants and foams will not be used within 300 feet of any waterway.
Soils	
	• Prevent or minimize soil erosion by retaining a high proportion (80% or more) of surface cover in vegetation, litter (dead leaves, grass, and other dead plant parts), and fibrous root systems. • Minimize soil disturbance for fire lines in prescribed fire and for wildfires by using previously prepared vegetated fire breaks or existing barriers such as roads, trails, and streams, even if this results in a slight increase in burned area. • Prevent or minimize soil compaction by limiting vehicles to designated roads. • Heavy equipment use will require approval from refuge manager or designee for each incident. • Ground disturbed by suppression activities will be rehabilitated.

Table 2-3. Mitigation measures (continued)

Resource	Mitigation Measure
Cultural Resources	
	• Heavy equipment will avoid known cultural/historic resources adverse effects on cultural resources. • Cultural resource sites will only be treated, as necessary, if they are at risk of infestation by invasive/exotic plants and if fuel loads on the site would put the resource at increased risk of damage or destruction in the event of a wildfire. • The refuge manager will be contacted immediately if previously unrecorded cultural resources are discovered during any vegetation treatments. The Refuge archaeologist will record, delineate, and ensure protection of cultural resources. • Identify all cultural resources within a jurisdiction using archaeological surveys and consultations with cultural specialists, tribal representatives, and other knowledgeable people (identifying sites is often cost prohibitive for many agencies and management priorities are not structured to fund surveys). • Include resource advisors at all stages of wildfires and prescribed fires (prevention, planning, implementation, restoration). • Plot firelines/firebreaks to avoid known cultural resources. • Map, mark, or flag cultural resources during wildfire suppression and rehabilitation and prescribed burn implementation. • Provide all fire workers with basic training on cultural resources. • Design plans to protect resource values at risk. • Where wildfire poses risks to cultural resources, reduce fuels near archaeological and historic sites mechanically or with prescribed fire to reduce damages from future wildfire. • Determine effects of heat treatment and fire suppression tactics (such as foams, retardants) on cultural resources at risk (exposed resources • In instances of wildfire, develop a post-fire data recovery and/or restoration program that is sensitive to cultural resource concerns.

Chapter 3. Affected Environment and Environmental Consequences

3.1 Introduction

This chapter describes current conditions (affected environment) and the potential beneficial and adverse effects (environmental consequences) that could result from implementation of either of the alternatives:

Alternative A: No Action—Continue Current Level of Land Management (Prescribed Fire, Mechanical Treatments, and Fire Suppression)

Alternative B: Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation

3.2 Assessing Resources and Effects

3.2.1 Resources Analyzed in Detail

The affected environment and environmental consequences are described together for each of the following resources analyzed in detail:

Section 3.3 Fire and Fuels Management

Section 3.4 Biological Environment

Section 3.5 Water and Soil Resources

Section 3.6 Air Quality

Section 3.7 Cultural Resources

Section 3.8 Service Values

Section 3.9 Public Health and Safety

3.2.2 Resources Not Analyzed

The following topics were not analyzed in this environmental assessment (EA) because they would not be affected by, or would not be differentially affected by, either of the alternatives. In addition, the consequences of overall management of the Refuge, which encompasses its fire management program, upon each of the following resources/assets were addressed in the Revised Comprehensive Conservation Plan and Environmental Impact Statement and are incorporated by reference:

- Environmental justice concerns because there would be no disproportionately high or adverse human health or environmental effects on minority populations and low-income populations.
- Social and economic values and conditions
- Recreation

- Transportation systems

3.2.3 Analysis Period (Duration of Effects)

Short-term effects (both beneficial and adverse) are those that would occur during treatment implementation and persist up to one year.

Long-term effects (both beneficial and adverse) are those that would be noticeable for decades after treatment, depending on treatment objective.

3.2.4 Definitions for Evaluating Effects

The "Environmental Consequences" section for each resource describes the types of effects that would result from taking no action (Alternative A) or implementing Alternative B. Those effects are described according to the definitions in sections 3.2.4.1 and 3.2.4.2.

3.2.4.1 Types of Effects

Beneficial effects are those that would result in a positive change in the condition or nature of the resource, usually with respect to a standard or objective. It is a change that would move a condition or resource toward its desired condition.

Adverse effects are those that would result in a negative change in the condition or nature of the resource, usually with respect to a standard or objective. It is a change that would move a condition or resource away from its desired condition.

Direct effects are caused by the action and would occur at the same place and time as the action.

Indirect effects are also caused by the action, would occur later in time, and are further removed in distance but are still reasonably foreseeable; or the response of the target resource is triggered by the reaction of another resource to the proposed action.

Cumulative effects are those that would result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions.

3.2.4.2 Intensity of Effects

"Intensity" refers to the severity of effects or the degree to which an action may adversely, or beneficially affect a resource. The following intensity definitions are used throughout this Chapter 3 to describe effects.

Negligible: An action that would affect very few individuals of species populations or would not affect the existing natural and human environment in the analysis area. The change would be so small or localized that it would have no measurable or perceptible consequence.

Minor: An action that would affect a relatively small number of individuals within species populations or would not affect the existing natural or human environment in the analysis area. The

change would require considerable scientific effort to measure, be very localized in area, and have barely perceptible consequences.

Moderate: An action that would cause measurable effects on a relatively moderate number of individuals within a species population and on noticeable areas of the natural and human environment in the analysis area. Species populations of species or natural system function might deviate from normal levels under existing conditions, but all species would remain indefinitely viable in the analysis area.

Major: An action that would have drastic consequences (adverse effects) or a high level of beneficial effects for a species population or the natural and human environment. The change would be readily apparent throughout the analysis area. Major adverse effects could be considered significant.

3.2.5 Indicators

Indicators are measureable factors that are used to describe resource conditions. The indicators used to describe desired and current conditions are the same indicators used to predict the potential effects that could result from implementation of either of the proposed alternatives described in Chapter 2. The focus of this EA is on the analysis of effects from implementing fuel reduction actions. The indicators are therefore only described and used in "Section 3.3. Fire and Fuels Management."

3.2.6 Analysis of Cumulative Effects

The Council on Environmental Quality (CEQ) regulations (at section 1508.7) define a cumulative impact [effect] as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

The CEQ provided additional guidance (memorandum prepared by James L. Connaughton, Chairman, White House Council on Environmental Quality, June 24, 2005 [CEQ 2005]) on the extent to which agencies of the federal government are required to analyze the environmental effects of *past actions* when they describe the cumulative environmental effects of a proposed action

CEQ interprets the *National Environmental Policy Act* and its regulations on cumulative effects as requiring analysis and a concise description of the identifiable present effects of past actions to the extent they are relevant and useful in analyzing whether the reasonably foreseeable effects of the agency proposal for action and its alternatives may have a continuing, additive, and significant analysis, agencies should relationship to those effects. In determining what information is necessary for a cumulative effects analysis, determine which information is "relevant to reasonably foreseeable significant adverse impacts, is essential to a reasoned choice among alternatives, and can be obtained without exorbitant cost" (40 CFR 1502.22).

3.2.7 Present and Reasonably Foreseeable Future Actions in the Vicinity of Kenai NWR

Section 2.4.2.3 (Chapter 2) describes the CWPP and COI areas on and adjacent to the Kenai NWR. Treatments in off-refuge areas could contribute to cumulative effects when considered along with the treatments proposed inside the Refuge.

3.3 Fire and Fuels Management

This section summarizes the current fuels conditions and potential fire behavior at the Kenai NWR and the effects from taking no action (Alternative A) or from implementing Alternative B. This section only analyzes the effects of fuels treatments on fuel loads, flame length, rate of spread, fire behavior, and fire risk and hazard. It does not cover the use of fire for vegetation and habitat benefits; this is discussed in the "Biological Environment" section.

3.3.1 Methodology

Landscape level vegetation mapping and analysis are based on LANDFIRE (http://www.landfire.gov/), a cooperative project between the US Department of Agriculture–US Forest Service and the US Department of the Interior. LANDFIRE is used to depict major ecosystems, wildlife habitat, vegetation or canopy characteristics, landscape features, and wildland fire behavior, effects, and regimes. However, because the data are created on a coarse scale due to the scope of the nationwide data set, the applicability of data products varies by location and specific use. There is an ongoing interagency effort to update and improve the accuracy of LANDFIRE data by providing vegetation, fuels, and disturbance data and submitting corrections that adjust for errors in cover type to the national database.

The Refuge has a Geographic Information System (GIS) and maintains its own geospatial vegetation database. Refuge data are used for Refuge specific analyses and for comparison with LANDFIRE. The Refuge and its cooperators also collaborate with the Kenai Peninsula Borough to maintain an interagency geospatial vegetation database, which is based upon satellite imagery and field sampling. This database has produced Peninsula-wide wildfire hazard and risk assessments and interagency fuels mitigation maps.

Current vegetation conditions are also established through on-site evaluation of species composition, stand structure, and fuel load. Pre-treatment methods to collect and analyze data may include the establishment of photo points, collecting fuel samples to determine fuel loading and fuel moisture, and/or the establishment of monitoring plots to establish a comprehensive data set of species present within the site. For purposes of developing individual burn plans for a specific treatment, Scott and Burgan's (2005) 40 fuel models were used to depict general characteristics such as vegetative continuity, height, tons per acre of live/dead fuels, and basic fire behavior characteristics.

3.3.1.1 Scope of the Analysis

Analysis Area. The analysis area for the fire and fuels analysis includes the Kenai NWR and the CWPP and COI areas identified in Chapter 2. The maps are in the following appendices:

- Appendix C: Cooper Landing
- Appendix D: Diamond Ridge / Fritz Creek / Fox River
- Appendix E: Funny River
- Appendix F: Kalifornsky / Kasilof / Cohoe / Clam Gulch
- Appendix G: Kenai
- Appendix H: Nikiski / Salamatof / Grey Cliffs

- Appendix I: Ninilchik / Ninilchik Forties
- Appendix J: Soldotna / Ridgeway
- Appendix K: Sterling
- Appendix L: Swanson River Oil Field
- Appendix M: Beaver Creek Oil Field
- Appendix N: Kenai Moose Research Center

Analysis Period. Fire behavior was modeled for current conditions, immediately after treatment, and at 2-5 years after treatment.

3.3.1.2 Indicators

Predicting the potential behavior and effects of wildland fire is an essential task in fire management. Mathematical surface fire behavior and fire effects models and prediction systems are driven in part by fuelbed inputs such as load, bulk density, fuel particle size, heat content, and moisture of extinction. To facilitate use in models and systems, fuelbed inputs have been formulated into fuel models. A fuel model is a set of fuelbed inputs needed by a particular fire behavior or fire effects model. Scott and Burgan (2005) fuel models were identified in the Refuge and are described below in Section 3.3.3.3.

Indicator: Fuels

Measurement: Fuel Load. The weight of dead and down woody fuel is measured in tons per-acre. The weight of standing brush and foliage can also be predicted if all or a portion is expected to be added to the dead and down fuel loading. Fuel loading is used to predict fire behavior by using the current and expected fuel loading to select the correct fuel model (see the discussion below under "Affected Environment") to use in fire behavior prediction systems. Components of fuel loading include fuel sizes and their proportion, arrangement, and continuity. *Total fuel* is all fuel, both living and dead, present on a site. *Available fuel* is the amount of fuel that will burn under a specific set of fire conditions.

Measurement: Flame Length. This is the length of flame measured in feet, from the base of the flame to the tip of the flame. Longer flame lengths increase resistance to control and the likelihood of torching events and crown fires in forest areas. Flame length is influenced by fuels, weather, and topography and presence of volatile resins or oils in living vegetation. As illustrated in Table 3-1, increasing flame lengths above 4 feet may present serious control problems to firefighters because they are too dangerous to be directly contained by hand crews (Schlobohm and Brain 2002; Anderson 1982). Flame lengths over 8 feet are generally not controllable by ground-based equipment or aerial retardant and present serious control problems, including torching, crowning, and spotting.

Measurement: Rate of Spread. Rate of spread is the horizontal distance that the flame zone moves per unit of time (feet per minute) and usually refers to the head fire segment of the fire perimeter. It is directly related to the amount of heat received by the fuels ahead of the flaming zone. Rate of spread is strongly influenced by fuels, winds, and topography—it generally increases with increasing wind speed, slope, and amount of fine fuels.

Table 3-1. Relationship between flame length and potential for success of active suppression

Flame Length	Description
Less than 4 feet	Fires can generally be attacked at the head or flanks by firefighters using hand tools. A hand line should hold the fire.
4–8 feet	Fires are too intense for direct attack at the head with hand tools. A hand line cannot be relied on to hold the fire. Bulldozers, engines, and retardant drops can be effective.
8–11 feet	Fire may present serious control problems, such as torching, crowning, and spotting. Control efforts at the head will probably be ineffective.
Greater than 11 feet	Crowing, spotting, and major fire runs are probable. Control efforts at the head of the fire are ineffective.

Source: NWCG 2004.

3.3.1.3 Fire Risk and Fire Hazard

The likelihood of future fires causing unacceptable resource damage is influenced by two factors: fire risk and fire hazard. Fire risk is the probability of a fire occurring in the Refuge and is based on historic fire records. Fire hazard, on the other hand, is dependent upon fuel conditions, including the accumulation of dead and living vegetation and fire weather. Under historic fire return intervals, fuel accumulation would be considerably less than current levels. A particular area may have a low historic risk of fire occurrence, but the fuel hazard, and thus fire severity, may be high enough to result in unacceptable lethal levels of vegetation mortality (lethal effects are those where fires result in greater than 70% mortality of vegetation) (USFS 2000).

3.3.1.4 Fire Behavior, General Discussion

Fire behavior describes how a fire burns, where it burns, how fast it travels, how much heat it releases, and how much fuel it consumes. It is important to understand what controls fire behavior and how to predict it because this knowledge helps predict wildfire risk and fire effects, control wildfires, and to conduct prescribed fires.

Fire behavior is controlled by *three interacting components: fuels, weather, and topography*. Fuels provide the energy source for fire. Fuel availability, which depends on both fuel arrangement and fuel moisture, determines if fires will burn as surface or crown fires. Weather elements, such as temperature, relative humidity, wind, precipitation, and atmospheric stability, also combine to influence fire behavior by regulating fuel moisture and rate of spread. Topography can influence fire indirectly, by mediating wind patterns, or directly—fires burning upslope spread faster than fire burning on flat land.

Component: Fuels

Fuel is all living and dead plant material that can be ignited by a fire. Fuel characteristics strongly influence fire behavior and the resulting fire effects on ecosystems. Fires vary widely in the kind of fuels that burn (for example, live vs. dead fuels, surface vs. ground fuels), the total amount of fuels that burn, and the rate or intensity at which these fuels burn. These characteristics of fuel consumption, in turn, determine peak temperatures reached, the duration of heat, and the stratification of heat above and below the soil surface (NWCG 2001).

Predicting the potential behavior and effects of wildland fire is an essential task in fire management. Mathematical surface fire behavior and fire effects models and prediction systems are

driven in part by fuelbed inputs such as load, bulk density, fuel particle size, heat content, and moisture of extinction. Fuelbeds are classified in six strata or layers: (1) tree canopy; (2) shrubs/small trees; (3) low vegetation; (4) woody fuels; (5) moss, lichens, and litter; and (6) ground fuels (duff). Each of these strata can be divided into separate categories based on specific characteristics and relative abundance. Modification of any fuel stratum has implications for fire behavior, fire suppression, and fire severity (Graham et al. 2004).

Component: Weather

Of the three fire behavior components, weather is the most likely to fluctuate. Accurately predicting fire weather remains a challenge for forecasters, particularly during drought conditions. As spring and summer winds and rising temperatures dry fuels, particularly on south-facing slopes, conditions can deteriorate rapidly, creating an environment that is susceptible to wildland fire. Fine fuels (grass and leaf litter) can cure rapidly, making them highly flammable in as little as one hour following light precipitation. Low live fuel moistures of shrubs and trees can significantly contribute to fire behavior in the form of crowning and torching.

Component: Topography

Topography is the third component and is important in determining fire behavior. Steepness of slope, aspect (direction the slope faces), elevation, and landscape features can all affect fuels, local weather (by channeling winds and affecting local temperatures), and rate of spread of wildfire.

3.3.1.5 Components That Influence Fire Behavior at Kenai NWR

Some of the topographic and climatic features of the western Kenai Peninsula can have a major influence on fire behavior on the Refuge. Cold air drainage from the Harding ice field and associated large glaciers produce localized turbulence and downslope winds that can be extreme and can arise suddenly, producing dramatic changes in fire behavior. The Skilak glacier and the downslope winds it produces on Skilak Lake is one example. Severe turbulence and downslope foehn or east winds can occur anywhere along the west slope of the Kenai Mountains when conditions are right.

During the late spring and early summer fire season, moist ocean breezes from the southwest are the norm. These diurnal or daily sea breezes tend to have a dampening effect on fire behavior as relative humidity is increased. However, when temperatures are high, these moist winds can produce thunderstorms and lightning along the foothills of the Kenai Mountains. Occasionally, cool, dry north winds occur on the refuge, which have been known to cause severe fire behavior with relative humidity in the 20% range.

Due to the rain shadow effect of the Kenai Mountains to the east and the Alaska Range to the west, annual precipitation on the Kenai lowlands, ranges from 25 inches at Homer and 19 inches at Kenai to 17 inches at Sterling. About half of this annual precipitation falls as light rain or drizzle, between early August and November. Soil and duff moistures during this period are generally high, and fire severity or depth of burn is correspondingly low and spotty. From mid-April to July, the refuge experiences its longest days (up to 20 hours of daylight) and lowest relative humidity. These factors, in addition to the typical lack of precipitation in early summer, can contribute to extreme fire weather and fire behavior on the Kenai. Running crown fires and long-range spotting are possible during these times.

The lowland areas of the western Kenai Peninsula are populated by large stands of black spruce. Fires characteristically burn with high intensity and slow, predictable rates of spread. Surface fuels of shrubs, feather mosses and lichens are the primary carrier of fire in these areas. Ignition of the tree crowns will occur just behind the flaming front if flame lengths are sufficient to ignite the lower lichen-covered branches. Very low relative humidity and high wind can produce sudden, extreme fire behavior in these stands.

3.3.2 Desired Conditions

The desired conditions are that fire risk and fire hazard at Kenai NWR are low because treatments (prescribed fire and/or other treatment methods) have been implemented to remove or minimize the amount of total fuels. The potential for a wildfire to result in a loss of life or damage to infrastructure and other values is reduced at the Refuge. When identified, fuels are treated to reduce fire behavior (low rate of spread and short [less than 4 feet] flame lengths) and resistance to control.

Generally, the following will help achieve desired conditions for fire behavior:

- Large prescribed fire projects and other fuel treatments have modified natural stand structure to alter fire behavior.
- Strategically located fuelbreaks are present, where fuel accumulations have reduced fire behavior potential. This will provide safe areas for suppression crews to work and anchor control lines, thereby reducing the probability of fires spreading to adjacent properties and allowing safe use of roads that are key access routes for firefighters and escape routes for residents and other publics.

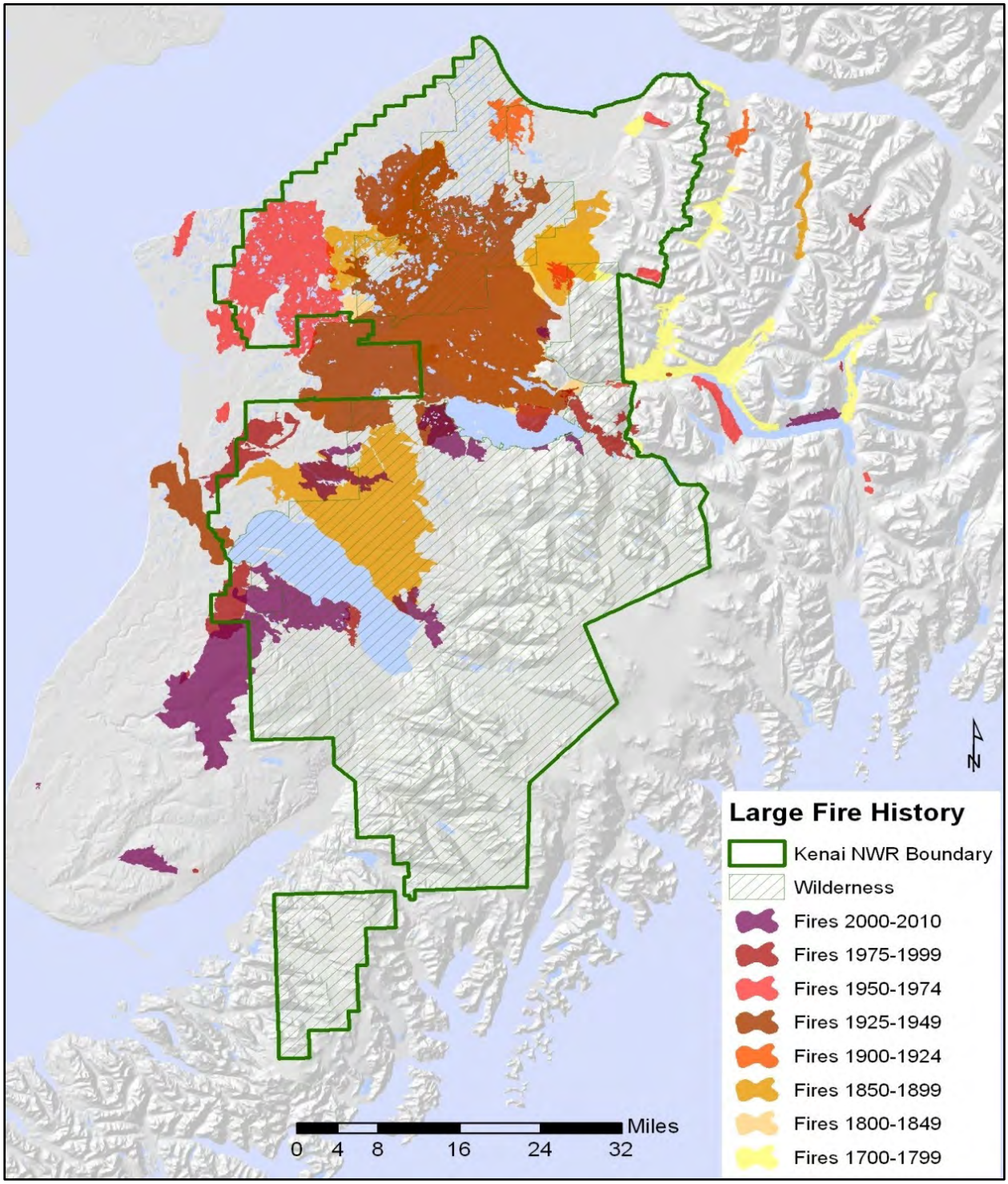
3.3.3 Affected Environment

3.3.3.1 Fire History at Kenai NWR

An aerial view of the Kenai NWR reveals a mosaic pattern of spruce and mixed hardwood stands in every stage of post-fire forest succession. Historical records of past fire activity are somewhat lacking compared with other regions of the United States, but a number of studies of fire frequency on the Kenai Peninsula have been completed (Lutz 1960; DeVolder et al. 1999) or are in progress. Several studies have documented large fires back to 1708. These studies included the collection of lake sediment and soil charcoal samples and the dendro-chronological dating of fire-scarred and fire-killed trees. Annual narratives prepared by refuge managers, record fire data beginning in 1941. From 1974 to the present, official fire records and State Forestry Fire Reports complete the extent of Refuge fire data. The known large fire history of the Kenai Peninsula is shown in Figure 3-1.

According to data from 1974 to 2005, the average number of wildfires (both naturally ignited and human caused) on the Refuge is 7.75 fires per year. These fires burn an average of 2,080 acres per year. These averages were influenced by several large fires in 2004 and 2005. The fires from those two years increased the average number of fires by 0.41 fires per year and the average annual acres burned by 1,286 acres per year. Wet fire seasons generally experience fewer fire starts and lower acreage burned, while dry years see a higher frequency of ignitions, greater fire severity and larger wildland fires. Over the years 2002-2011, 70 Refuge fires burned 68,832.3 acres. The 10-year averages are 7 fires per year and 6,883 acres per fire.

Figure 3-1. History of large fires at Kenai NWR



Climate change may be affecting the frequency and sources of ignition on the Kenai Peninsula and the Refuge. In the absence of reliable weather and fire information prior to 1947, anecdotal information is that lightning and lightning-caused fires are not a typical occurrence on the Peninsula. This is supported by the number of fires started by humans (1,149) and the number started by lightning (50) in the years 1990 to 2005. While less than 5% of the Peninsula's fires were started by lightning, almost 25% of these 50 lightning fires were in 2005 alone.

3.3.3.2 Summary of Kenai Peninsula Fire History Studies Conducted at the Kenai NWR 1997-2004

White/Lutz Forests

The mean fire return interval (MFRI) for the past 2,500 years was estimated as 515 ± 355 (1 standard deviation [SD]) years (range 105–1,642 years). This estimate is based on a sample size of n = 112 radiocarbon dates of soil charcoal at 22 sites from Anchor Point to Nikiski. Dates older than 2,500 years were omitted from the MFRI calculation because of the possibility that soil charcoal has degraded after this period of time, thus censoring the available sample pool.

The mean time-since-fire was estimated at 605 ± 413 years (median 444 years, range 90–1,518 years) for all sites (Bert and Anderson 2006).

Black Spruce Forests

The MFRI for the entire study area for the past 300 years was estimated as 89 ± 43 years (1 SD) years (range 25-185 years). This estimate was based on 1,022 basal cross-sections and 771 increment cores of lowland black spruce. Twelve fires were dated as occurring in 1708, 1762, 1801, 1828, 1883, 1834, 1849, 1867, 1874, 1884, 1888, and 1898.

The primary study area was in the 110,000-hectare (271,816 acres) 1947 Burn. A secondary study area of 10,000 hectare (24,710 acres) was located in the Pipeline Road area, northeast of the 1947 Burn (DeVolder et al. 2000).

Mixed White and Black Spruce and Hardwoods Forests

The MFRI for the Paradox Lake area (about 6 miles north of Sterling) was estimated at 130 ± 66 years (1 SD) years with 35 fires separated by intervals of 40 to 270 years occurring during the last 4,600 years since the arrival of black spruce on the landscape.

This estimate is based on sedimentary charcoal in a 30-foot core taken from Paradox Lake (informal name) at a depth of 52 feet, supplemented with a 28-inch short core of near-surface sediments. The total charcoal fire history record spanned about 13,000 calendar years; MFRIs were longest during the shrub-herb tundra phase (138 ± 65 years); decreased after expansion of birch, willow, and aspen (77 ± 49 years) and white spruce (*Picea glauca*) (81 ± 41 years); and increased again with the arrival of black spruce (*P. mariana*) (130 ± 66 years) (Anderson et al. 2006).

3.3.3.3 Current Fuels and Expected Fire Behavior

Fire behavior varies with habitat. Large areas of the Refuge include stands of mixed spruce/hardwoods, white spruce, shrublands, and grasslands. Mixed spruce/hardwood stands generally burn with less intensity than black spruce, having less ladder fuel and more canopy shading. Pockets of

hardwoods provide a natural barrier to fire spread; crowning spruce fires will normally drop to the ground when encountering a hardwood stand, in all but the most extreme conditions. Fires also do not carry as well in the brush and shrubland found on the Refuge, especially where sparse. Labrador tea, however, can be a primary carrier of fire. Dead or cured stands of bluejoint reedgrass can produce rapid rates of spread and high intensity, especially when cured.

Refuge lands, other than those covered by glaciers or water, are covered by a diverse mix of forest types and vegetation communities, which are represented by a variety of fuel types and complexes, and their corresponding fire behavior characteristics. The *Fuel Model Guide to Alaska Vegetation* (Cella et al. 2008) and its associated *Fuel Model Crosswalk* (Scott 2008*)*, describe the fuel models of Alaska and the Kenai Peninsula and a comparison of the three fuel model guides used for various applications in Alaska, Those three guides are the Northern Forest Fire Laboratory's 13 Fuel Models (Anderson 1982); Scott and Bergen 40 Fuel Models (2005); and Canadian Forest Fire Danger Rating System (CFFDRS) (Alexander et al. 1996). The Refuge uses all three fuel model guides at different times for different applications. The CFFDRS is the primary system used to predict fire danger and fire behavior in Alaska.

Using the 40 Standard Fire Behavior Fuel Models (Scott and Burgan 2005), the Refuge is represented by the fuel models and their corresponding fire behavior characteristics, which are described in Table 3-2 below. It is important that fire and fuel managers apply the fuel models in order to predict the current and projected fuel hazard and fire severity. Fuel refers to all living and dead plant material that can be ignited by a fire. Fuel characteristics strongly influence fire behavior and the resulting fire effects on ecosystems. The fuel models listed here are distributed throughout the four FMUs described in Chapter 2 and in Appendix B.

3.3.4 Environmental Consequences

3.3.4.1 Alternatives A and B

Hazardous fuels reduction is the most frequently cited example of pre-suppression activities that are nearly unanimously favored over the reactive system of suppression. Active management can improve the health and resiliency of the land, which contributes to reduced fire hazard (WFLC 2010). The use of prescribed fire and wildfire is, overall, the most cost-effective long-term fire management strategy for restoring and maintaining lands in a desirable condition. All fuel-reduction actions under both alternatives would help reduce fire risk to maximize long-term protection to communities and natural and cultural resources, while minimizing the costs of fire suppression and emergency rehabilitation of lands or structures damaged by wildfire and maximizing available resources for fire suppression on lands adjacent to the Refuge.

The purpose of all treatment methods in each fuel model is to affect current and future predicted fire behavior, and this can be done by reducing or removing ground, ladder, and crown fuels in order to maintain desirable fuel models or to change a fuel model to alter fire behavior and reduce fire hazard.

The majority of Service lands have evolved with fire. The wildlife and plants supported by grasslands, shrublands, riparian/wetland areas, and woodlands/forests depend on fire for their survival. The lack of periodic fire in these wildlands (due to fire suppression or fragmentation of landscapes from human development) has actually increased the risk of wildfire.

Table 3-2. Current fuel models for Kenai NWR

Fuel Model Fuel Type	Fuel Model Code (Number)	Summary Characteristics	Adjective Class for Predicted Fire Behavior[1]
ROS = rate of spread; FL = flame length			
GR Grass	GR1 (101)	**Short, Sparse Dry Climate Grass (Dynamic)** The primary carrier of fire is sparse grass, though small amounts of fine dead fuel may be present. The grass in GR1 is generally short, either naturally or by grazing, and may be sparse or discontinuous. The moisture of extinction of GR1 is indicative of a dry climate fuelbed, but GR1 may also be applied in high-extinction moisture fuelbeds because, in both cases, predicted spread rate and flame length are low compared to other GR models.	ROS: moderate FL: low
	GR2 (102)	**Low Load, Dry Climate Grass (Dynamic)** The primary carrier of fire is grass, though small amounts of fine dead fuel may be present. Load is greater than GR1, and fuelbed may be more continuous. Shrubs, if present, do not affect fire behavior.	ROS: high FL: moderate
	GR3 (103)	**Low Load, Very Coarse, Humid Climate Grass (Dynamic)** The primary carrier of fire is continuous, coarse, humid-climate grass. Grass and herb fuel load is relatively light; fuelbed depth is about 2 feet. Shrubs are not present in significant quantity to affect fire behavior.	ROS: high FL: moderate
	GR4 (104)	**Moderate Load, Dry Climate Grass (Dynamic)** The primary carrier of fire in GR4 is moderately course continuous grass. Load and depth are greater than GR2; fuelbed depth is about 2 feet. (Note: bulleted text in the draft FMP says "tall grass.")	ROS: very high FL: high
GS	GS1 (121)	**Low Load, Dry Climate Grass-Shrub (Dynamic)** The primary carrier of fire is grass and shrubs combined. Shrubs are about 1 foot high, grass load is low. Moisture of extinction is low.	ROS: moderate FL: low
SH Shrub	SH1 (141)	**Low Load Dry Climate Shrub (Dynamic)** The primary carrier of fire is woody shrubs and shrub litter. Low shrub fuel load, fuelbed depth about 1 foot; some grass may be present.	ROS: very low FL: very low
	SH2 (142)	**Moderate Load Dry Climate Shrub** Shrubs cover at least 50% of the site. The primary carrier of fire is woody shrubs and shrub litter. Moderate fuel load, depth about 1 foot. Grass is sparse or not present.	ROS: low FL: low
	SH3 (143)	**Moderate Load, Humid Climate Shrub** Shrubs cover at least 50% of the site. The primary carrier of fire in SH3 is woody shrubs and shrub litter. Moderate shrub load, possibly with pine overstory or herbaceous fuels; fuel bed depth 2 to 3 feet.	ROS: low FL: low
	SH4 (144)	**Low Load, Humid Climate Timber-Shrub** The primary carrier of fire in SH4 is woody shrubs and shrub litter. Low to moderate shrub and litter load, possibly with pine overstory, fuel bed depth about 3 feet.	ROS: high FL: moderate
TU Timber–Understory	TU1 (161)	**Low Load Dry Climate Timber-Grass-Shrub (Dynamic)** The primary carrier of fire is low load of grass and/or shrub with litter.	ROS: low FL: low
	TU3 (163)	**Moderate Load, Humid Climate Timber-Grass-Shrub (Dynamic)** The primary carrier of fire in TU3 is a moderate litter load from the forest canopy mixed with grass and shrub components. Extinction moisture is high.	ROS: high FL: moderate
	TU4 (164)	**Dwarf Conifer With Understory** The primary carrier of fire in TU4 is short conifer trees mixed with grass or moss understory.	ROS: moderate FL: moderate
	TU5 (165)	**Very High Load, Dry Climate Timber-Shrub** The primary carrier of fire is heavy forest litter with a shrub or small tree understory.	ROS: moderate FL: moderate

Table 3-2. Current fuel models for Kenai NWR (continued)

Fuel Model Fuel Type	Fuel Model Code (Number)	Summary Characteristics	Adjective Class for Predicted Fire Behavior[1]
TL Timber–Litter	TL1 (181)	**Low Load Compact Conifer Litter** The primary carrier of fire is compact dead and down woody fuel (forest litter) beneath a forest canopy and with a fuelbed that has recently burned but is able to carry wildland fire. Light to moderate load, fuels 1 to 2 inches deep. May be used to represent a recently burned forest.	ROS: very low FL: very low
	TL2 (182)	**Low Load Broadleaf Litter** The primary carrier of fire is dead and down woody fuel (litter) beneath a forest canopy, where the fuelbed has not recently burned, and the fuelbed is composed of broadleaf (hardwood) litter. Low load, compact broadleaf litter.	ROS: very low FL: very low
	TL6 (186)	**Moderate Load Broadleaf Litter** The primary carrier of fire is moderate load broadleaf litter, less compact than TL2.	ROS: moderate FL: low
SB Slash/ Blowdown	SB1 (201)	**Low Load Activity Fuel** The primary carrier of fire in SB1 is light dead and down activity fuels (slash) and debris from wind damage (blowdown). Forested areas with heavy mortality may be modeled with SB fuel models. Fine fuel load is 10 to 20 tons per acres, weighted toward fuels 1 to 3 inches diameter class, depth is less than 1 foot.	ROS: moderate FL: low
NB Nonburnable	NB1 (91)	**Urban/Developed** Consists of land covered by urban and suburban development. To be called NB1, the area under consideration must not support wildland fire spread. In some cases, areas mapped as NB1 may experience structural fire losses during a wildland fire incident; however, structure ignition in those cases is either house-to-house or by firebrands, neither of which is directly modeled using fire behavior fuel models. If sufficient fuel vegetation surrounds structures such that wildland fire spread is possible, then choose a fuel model appropriate for the wildland vegetation rather than NB1.	ROS: none FL: none
	NB2 (92)	**Snow/Ice** Land covered by permanent snow or ice is included in NB2. Areas covered by seasonal snow can be mapped to two different fuel models: NB2 for use when snow-covered and another for use in the fire season.	ROS: none FL: none
	NB6	This fuel model is a custom model for wet vegetated areas that typically do not burn.	ROS: none FL: none
	NB7	This fuel model is a custom model for drier vegetated areas that typically do not burn.	ROS: none FL: none
	NB8 (98)	**Open Water** Land covered by open bodies of water such as lakes, rivers and oceans.	ROS: none FL: none
	NB9 (99)	**Bare Ground** Land devoid of enough fuel to support wildland fire spread. Such areas may include gravel pits, arid deserts with little vegetation, sand dunes, rock outcroppings, beaches, and so forth.	ROS: none FL: none

Source: Scott and Burgan (2005)

Note 1. for Table 3-2: Adjective class definitions for predicted fire behavior

Adjective Class	Rate of Spread (chains/hour*)	Flame Length (feet)
Very low	0-2	0-1
Low	2-5	1-4
Moderate	5-20	4-8
High	20-50	8-12
Very high	50-150	12-25
Extreme	>150	>25

*one chain = 66.0001 feet

The dangers of excluding natural fire include: large and damaging fires resulting from the accumulation of flammable vegetation above historic levels; loss of life or serious injury to firefighters and the public; property loss and damage; adverse health effects and impaired visibility from intense or extended periods of unmanageable smoke; loss of plant and animal species and their habitats; and damage to soils, watersheds, and water quality.

Table 3-3 presents the potential direct and indirect effects on each fuel model from actions proposed under each alternative. The biggest change between Alternatives A and B would be the number of acres in each fuel model — Alternative B would result in slightly more acres treated in a fuel model.

Adverse cumulative effects could occur, from the continued presence of hazardous fuels (black spruce, white spruce, and beetle-killed spruce), and from changes/increases in the flashy fuels – the flammable grasses and shrubs that can build up in the absence of fire or treatment and in the ever-expanding wildland urban interface (WUI) areas as a result of eliminating fire from those areas. As increasing community development expands the WUI along the Refuge boundary, the incidence of human-caused fire is likely to increase, as will the need to suppress wildfires in the WUI and on Refuge lands adjacent to the WUI. This will increase the need for hazardous fuels mitigation within and adjacent to the WUI as wildfire is aggressively suppressed to protect communities. The lack of fire as an agent of change in the ecosystem, demands an alternative: intensive management of hazardous fuels, if a goal of land management is to protect communities from damaging wildfires.

Under Alternative B, all treatments conducted by the Service, in combination with treatments conducted by other organizations and agencies, would result in temporary to short-term negligible to minor adverse cumulative effects on the fuel models. However, short- to long-term minor to major beneficial cumulative effects would result when fuel models are improved, and the hazards and risks of damaging wildfires are reduced as a result of fuel-reduction treatments both on and off the Refuge. Adverse cumulative effects resulting from fuel reduction treatments under Alternative B, could include: short- to long-term minor to moderate adverse effects from the increased motorized access to the Refuge (forest thinning, pruning, and prescribed fires can open new pathways for all-terrain vehicles, snowmachines, and other motorized equipment); compacted soils and/or soil erosion from increased motorized use; the spread of invasive species due to increased human activity; and increased human-caused wildfires.

Table 3-3 Direct and indirect effects on each fuel model at Kenai NWR

Fuel Model	Fuel Model Title	Alternative A: No Action, Continue Current Management	Alternative B: Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation
GR1 (101)	Short, Sparse Dry Climate Grass (Dynamic) ROS: moderate FL: low	The goal of any treatments in this fuel model would be to reduce the potential ROS from moderate to low. Maintaining or improving the fuel model would provide long-term minor to moderate beneficial effects on predicted fire risk and fire hazard. If a wildfire were to occur, there could be short-term negligible to moderate adverse effects, depending on fire risk and fire hazard in the area of the fire and the Service resources and values damaged or destroyed	The goal of any treatments in this fuel model would be to reduce the potential ROS from moderate to low. Maintaining or improving the fuel model would provide long-term minor to moderate beneficial effects on predicted fire risk and fire hazard. With fuel treatments being conducted in CWPP and COI areas, there would be a greater reduction in hazardous fuels, thus resulting in both short- and long-term moderate to major long-term beneficial effects on resources and values inside and outside the Refuge boundary. If a wildfire were to occur, there could be short-term minor to moderate adverse effects, depending on fire risk and fire hazard in the area of the fire and the resources and values (Service and private) damaged or destroyed.
GR2 (102)	Low Load, Dry Climate Grass ROS: high FL: moderate	The concern here is high ROS, even with the moderate FL. This fuel model would likely remain the same or improve to GR1 because all fuel reduction treatments would be used, where needed, thus providing long-term minor to moderate beneficial effects on predicted fire risk and fire hazard. If a wildfire were to occur, there could be short-term minor to major adverse effects, depending on fire risk and fire hazard in the area of the fire and the resources and values (Service and private) damaged or destroyed.	The concern here is high ROS, even with the moderate FL. With fuel treatments being conducted in CWPP and COI areas, there would be a greater reduction in hazardous fuels, thus resulting in both short- and long-term moderate to major long-term beneficial effects on resources and values inside and outside the Refuge boundary. If a wildfire were to occur, there could be short-term minor to major adverse effects, depending on fire risk and fire hazard in the area of the fire and the resources and values (Service and private) damaged or destroyed.
GR3 (103)	Low Load, Very Coarse, Humid Climate Grass ROS: high FL: moderate	Same effects as described for GR2.	Same effects as described for GR2.
GR4 (104)	Moderate Load, Dry Climate Grass (Dynamic) ROS: very high FL: high	The concern here is the predicted very high ROS and high FL. This fuel model would be a high priority for fuel reduction treatments. Improving the fuel model would provide long-term minor to moderate beneficial effects on predicted fire risk and fire hazard. If a wildfire were to occur in areas with this fuel model, there could potentially be both short- and long-term minor to moderate adverse effects, depending on the particular location and fuel load.	The concern here is the predicted very high ROS and high FL. Fuel reduction treatments would be a high priority, particularly on Service lands and in CWPP and COI areas. Improving the fuel model would provide long-term minor to moderate beneficial effects. If a wildfire were to occur in areas with this fuel model, there could potentially be both short- and long-term minor to moderate adverse effects, depending on the particular location and fuel load.
GS1 (121)	Low Load, Dry Climate Grass-Shrub ROS: moderate FL: low	Same effects as described for GR1.	Same effects as described for GR1.

Table 3-3. Direct and indirect effects on each fuel model at Kenai NWR (continued)

Fuel Model	Fuel Model Title	Alternative A: No Action, Continue Current Management	Alternative B: Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation
SH1 (141)	Low Load Dry Climate Shrub ROS: very low FL: very low	This fuel model would likely remain the same because all fuel reduction treatments would be used, if needed, but this fuel model is not a priority for treatment due to the already predicted low ROS and FL. Maintaining the fuel model would provide long-term negligible to minor beneficial effects on fire risk and fire hazard. If a wildfire were to occur in areas with this fuel model, there could potentially be short-term negligible to minor adverse effects, depending on fire risk and fire hazard in the area of the fire and the Service resources and values damaged or destroyed.	This fuel model would likely remain the same because all fuel reduction treatments would be used, if needed, but this fuel model is not a priority for treatment due to the already predicted low ROS and FL. Maintaining the fuel model would provide long-term negligible to moderate beneficial effects on fire risk and fire hazard on Service lands and in CWPP and COI areas. If a wildfire were to occur in areas with this fuel model, there could potentially be short-term negligible to minor adverse effects, depending on fire risk and fire hazard in the location (on Service land or in CWPP and COI areas) of the fire and the resources and values damaged or destroyed.
SH2 (142)	Moderate Load Dry Climate Shrub ROS: low FL: low	This fuel model would likely remain the same because fuel reduction treatments would only be implemented, as needed, but with the already low ROS and FL, this fuel model is not a priority for treatment. Maintaining the fuel model would provide long-term negligible to minor beneficial effects. If a wildfire were to occur, there could be short-term negligible to minor adverse effects, depending on fire risk and fire hazard in the area of the fire and the Service resources and values damaged or destroyed.	This fuel model would likely remain the same because fuel reduction treatments would only be implemented, as needed, but with the already low ROS and FL, this fuel model is not a priority for treatment. Maintaining the fuel model would provide long-term negligible to moderate beneficial effects on fire risk and fire hazard on Service lands and in CWPP and COI areas. If a wildfire were to occur, short-term negligible to minor adverse effects, depending on the particular location (on Service land or in CWPP and COI areas) and fuel load.
SH3 (143)	Moderate Load, Humid Climate Shrub ROS: low FL: low	This fuel model would likely remain the same. This fuel model is not a priority for treatment. Maintaining the fuel model would provide long-term negligible to moderate beneficial effects. If a wildfire were to occur, there could be short-term negligible to minor adverse effects, depending on fire risk and fire hazard in the area of the fire and the Service resources and values damaged or destroyed.	This fuel model would likely remain the same. This fuel model is not a priority for treatment. Maintaining the fuel model would provide long-term negligible to moderate beneficial effects. If a wildfire were to occur, short-term negligible to minor adverse effects, depending on the particular location (on Service land or in CWPP and COI areas) and predicted fire risk and fire hazard in areas with this fuel model.
SH4 (144)	Low Load, Humid Climate Timber-Shrub ROS: high FL: moderate	The concern here is high ROS, even with the moderate FL. This fuel model would likely remain the same or improve because all fuel reduction treatments would be used, where needed, thus providing long-term minor to moderate beneficial effects by reducing the predicted fire risk and fire hazard on Service lands. If a wildfire were to occur, there could be short-term negligible to moderate adverse effects, depending on fire risk and fire hazard in the area of the fire and the Service resources and values damaged or destroyed.	The concern here is high ROS, even with the moderate FL. This fuel model would likely remain the same or improve because all fuel reduction treatments would be used, where needed, thus providing long-term minor to moderate beneficial effects by reducing predicted fire risk and fire hazard on Service lands and in CWPP and COI areas. If a wildfire were to occur, there could be short-term negligible to moderate adverse effects, depending on fire risk and fire hazard in the area of the fire and the Service resources and values damaged or destroyed

Table 3-3. Direct and indirect effects on each fuel model at Kenai NWR (continued)

Fuel Model	Fuel Model Title	Alternative A: No Action, Continue Current Management	Alternative B: Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation
TU1 (161)	Low Load Dry Climate Timber-Grass-Shrub ROS: low FL: low	This fuel model would likely remain the same because all fuel reduction treatments would be used, if needed, but this fuel model is not a priority for treatment due to the already predicted low ROS and FL. Maintaining the fuel model would provide long-term minor to moderate beneficial effects by reducing predicted fire risk and fire hazard on Service lands. If a wildfire were to occur, there could be short-term negligible to minor adverse effects, depending on fire risk and fire hazard in the area of the fire and the Service resources and values damaged or destroyed.	This fuel model would likely remain the same because all fuel reduction treatments would be used, if needed, but this fuel model is not a priority for treatment due to the already predicted low ROS and FL. Maintaining the fuel model would provide long-term minor to moderate beneficial effects by reducing predicted fire risk and fire hazard on Service lands and in CWPP and COI areas. If a wildfire were to occur, there could be short-term negligible to minor adverse effects, depending on fire risk and fire hazard on Service lands and in CWPP and COI areas and the resources and values damaged or destroyed.
TU3 (163)	Moderate Load, Humid Climate Timber-Grass-Shrub ROS: high FL: moderate	The concern here is high ROS, even with the moderate FL. This fuel model would likely remain the same or improve because all fuel reduction treatments would be used, where needed, thus providing long-term minor to moderate beneficial effects by reducing the predicted fire risk and fire hazard. If a wildfire were to occur, there could potentially be short-term minor to moderate adverse effects, depending on fire risk and fire hazard on Service lands and in CWPP and COI areas and the resources and values damaged or destroyed.	The concern here is high ROS, even with the moderate FL. Fuel reduction treatments would be a priority, particularly in the CWPP and COI areas. This fuel model would likely remain the same or improve because all fuel reduction treatments would be used, where needed, thus providing long-term minor to moderate beneficial effects by reducing the predicted fire risk and fire hazard. If a wildfire were to occur, there could potentially be short-term minor to moderate adverse effects, depending on fire risk and fire hazard on Service lands and in CWPP and COI areas and the resources and values damaged or destroyed.
TU4 (164)	Dwarf Conifer with Understory ROS: moderate FL: moderate	The goal of any treatments in this fuel model would be to reduce the ROS and FL from moderate to low, resulting in a potential fire behavior similar to TU1. Maintaining or improving the fuel model would provide long-term minor to moderate beneficial effects by reducing the predicted fire risk and fire hazard on Service lands. If a wildfire were to occur, there could potentially be short-term negligible to moderate adverse effects, depending on the particular location and fuel load on Service lands with this fuel model and the resources and values damaged or destroyed.	The goal of any treatments in this fuel model would be to reduce the ROS and FL from moderate to low, resulting in a potential fire behavior similar to TU1. Maintaining or improving the fuel model would provide long-term minor to moderate beneficial effects by reducing the predicted fire risk and fire hazard on Service lands and in CWPP and COI areas. If a wildfire were to occur, there could potentially be short-term negligible to moderate adverse effects, depending on the particular location and fuel load in areas with this fuel model and the resources and values damaged or destroyed.
TU5 (165)	Very High Load, Dry Climate Timber-Shrub ROS: moderate FL: moderate	The goal of any treatments in this fuel model would be to reduce the ROS and FL from moderate to low. Maintaining or improving the fuel model would provide long-term minor to moderate beneficial effects by reducing the predicted fire risk and fire hazard on Service lands.	The goal of any treatments in this fuel model would be to reduce the ROS and FL from moderate to low. Maintaining or improving the fuel model would provide long-term minor to moderate beneficial effects by reducing the predicted fire risk and fire hazard on Service lands and in CWPP and COI areas.

Table 3-3. Direct and indirect effects on each fuel model at Kenai NWR (continued)

Fuel Model	Fuel Model Title	Alternative A: No Action, Continue Current Management	Alternative B: Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation
		If a wildfire were to occur, there could potentially be short-term negligible to moderate adverse effects, depending on the particular location and fuel load on Service lands with this fuel model and the resources and values damaged or destroyed.	If a wildfire were to occur, there could potentially be short-term negligible to moderate adverse effects, depending on the particular location and fuel load in areas with this fuel model and the resources and values damaged or destroyed.
TL1 (181)	Low Load Compact Conifer Litter ROS: very low FL: very low	This fuel model would likely remain the same. This fuel model is not a priority for treatment due to the current very low ROS and FL. Maintaining the fuel model would provide long-term negligible to minor beneficial effects by maintaining the current low predicted fire risk and fire hazard. If a wildfire were to occur, there could potentially be short-term negligible to minor adverse effects, depending on the particular location and predicted fire risk and fire hazard on Service lands and the resources and values damaged or destroyed.	This fuel model would likely remain the same. This fuel model is not a priority for treatment due to the current very low ROS and FL. Maintaining the fuel model would provide long-term negligible to minor beneficial effects by maintaining the current low predicted fire risk and fire hazard. If a wildfire were to occur, there could potentially be short-term negligible to minor adverse effects, depending on the particular location and predicted fire risk and fire hazard on Service lands and CWPP and COI areas and the resources and values damaged or destroyed.
TL2 (182)	Low Load Broadleaf Litter ROS: very low FL: very low	This fuel model would likely remain the same. This fuel model is not a priority for treatment due to the current very low ROS and FL. Maintaining the fuel model would provide long-term negligible to minor beneficial effects by maintaining the current very low predicted fire risk and fire hazard on Service lands. If a wildfire were to occur, there could potentially be short-term negligible to minor adverse effects, depending on the particular location and predicted fire risk and fire hazard on Service lands and the resources and values damaged or destroyed.	This fuel model would likely remain the same. This fuel model is not a priority for treatment due to the current very low ROS and FL. Maintaining the fuel model would provide long-term negligible to minor beneficial effects by maintaining the current very low predicted fire risk and fire hazard on Service lands and in CWPP and COI areas. If a wildfire were to occur, there could potentially be short-term negligible to minor adverse effects, depending on the predicted fire risk and fire hazard on Service lands and CWPP and COI areas and the resources and values damaged or destroyed.
TL6 (186)	Moderate Load Broadleaf Litter ROS: moderate FL: low	The goal of any treatments in this fuel model would be to reduce the ROS from moderate to low. Maintaining or improving the fuel model would provide long-term minor to moderate beneficial effects by reducing the predicted fire risk and fire hazard on Service lands. If a wildfire were to occur, there could potentially be short-term negligible to minor adverse effects, depending on the particular location and predicted fire risk and fire hazard on Service lands and the resources and values damaged or destroyed.	The goal of any treatments in this fuel model would be to reduce the ROS from moderate to low. Maintaining or improving the fuel model would provide long-term minor to moderate beneficial effects by reducing the predicted fire risk and fire hazard on Service lands. If a wildfire were to occur, there could potentially be short-term negligible to minor adverse effects, depending on the particular location and predicted fire risk and fire hazard on Service lands and CWPP and COI areas and the resources and values damaged or destroyed.

Table 3-3. Direct and indirect effects on each fuel model at Kenai NWR (continued)

Fuel Model	Fuel Model Title	Alternative A: No Action, Continue Current Management	Alternative B: Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation
SB1 (201)	Low Load Activity Fuel (Slash) or Debris from Wind Damage (Blowdown) ROS: moderate FL: low	The goal of any treatments in this fuel model would be to reduce the potential ROS from moderate to low, resulting in a potential fire behavior similar to TU4 or TU5. Maintaining or improving the fuel model would provide long-term minor to moderate beneficial effects by reducing fire risk and fire hazard on Service lands. If a wildfire were to occur, there could potentially be short-term negligible to moderate adverse effects, depending on the particular location and predicted fire risk and fire hazard on Service lands and the resources and values damaged or destroyed.	The goal of any treatments in this fuel model would be to reduce the potential ROS from moderate to low, resulting in a potential fire behavior similar to TU4 or TU5. Maintaining or improving the fuel model would provide long-term minor to moderate beneficial effects by maintaining the current very low predicted fire risk and fire hazard on Service lands and in CWPP and COI areas. If a wildfire were to occur, there could potentially be short-term negligible to moderate adverse effects, depending on the particular location and predicted fire risk and fire hazard on Service lands and CWPP and COI areas and the resources and values damaged or destroyed.
NB	Nonburnable (insufficient wildland fuel to carry wildland fire under any condition) • NB1 (91): Urban/Developed — these areas would not be adversely affected by mechanical treatments or prescribed fire or wildland fire, except for temporary smoke effects. • NB2 (92): Snow/Ice — these areas would not be adversely affected by mechanical treatments or prescribed fire or wildland fire. • NB6 (96): This fuel model is a custom model for wet vegetated areas that typically do not burn. • NB7 (97): This fuel model is a custom model for drier vegetated areas that typically do not burn • NB8 (98): Open Water: these areas would not be adversely affected by mechanical treatments or prescribed fire or wildland fire. • NB9 (99): Bare Ground — these areas would not be adversely affected by mechanical treatments or prescribed fire or wildland fire.		

3.4 Biological Environment

The vegetation and wildlife on Kenai NWR, are unusually diverse for this latitude because of the juxtaposition of two biomes on the Kenai Peninsula: (1) the northern fringe of the Sitka spruce-dominated coastal rainforest on the eastern side of the Kenai Mountains, and (2) 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 a mixture 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 the 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. Eighteen formations have been classified on the Refuge under the National Vegetation Classification System.

The Comprehensive Conservation Plan (CCP) for the Kenai NWR contains extensive information about the biological environment of the refuge. The CCP and other refuge information are located at the following websites:

Kenai NWR website: http://www.fws.gov/refuge/kenai/

Refuge planning website for the 2010 CCP: http://alaska.fws.gov/nwr/planning/kenpol.htm

3.4.1 Affected Environment—Vegetation

Eighteen landscape types were classified on the Refuge, including 12 terrestrial vegetation classes, 4 aquatic classes, and 2 abiotic classes (rock and ice). The landscape classes correlate to the fuel models presented in Table 3-2 above. The 18 landscape types in Table 3-4 are grouped in this section according to “Grasslands and Shrubs,” “Forests and Woodlands,” and “Wetlands (Fens and Peatlands) and Riparian Habitats.”

Table 3-4. The 18 landscape types on Kenai NWR

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 (non-alder)	0.363	6,884
Alpine tundra	6.888	130,491
Alpine shrub	5.413	102,549
Streams (non-anadromous)	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

The stream, lake, estuarine, rock, and ice landscape types would not be affected by fuel reduction treatments, so they are not discussed in this document.

3.4.1.1 Grasslands and Shrublands

Grasslands

The grassland areas include several species of grasses, a large variety of sedges (Cyperaceae family), and forbs (refer to Appendix F in the Refuges 2010 CCP, p. 11).

The grassland habitat type is a composite of naturally occurring patches of bluejoint reedgrass, mostly linear features associated with human disturbance such as right-of-ways, pipeline corridors, and roadsides. Bluejoint reedgrass currently represents 3% of the Refuge but will likely increase in the future as it replaces stands of beetle-killed spruce. Although bluejoint reedgrass is native, it can be highly invasive and suppress stand regeneration for many decades (Berg 2005).

Shrublands

Lowland Shrub

This vegetation type occupies 5% of the Refuge, and is dominated by permanent shrub communities, primarily willow 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.

Subalpine Shrub

This vegetation type occupies 5% 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. Some of the plant species that occur frequently in this vegetation type include 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, narcissus-flowered anemone (*Anemone narcissiflora*), cloudberry, starflower, alpine blueberry (*Vaccinium uliginosum*), and monkshood (*Aconitum delphinifolium*).

Alpine Shrub–Lichen Tundra

This vegetation type covers about 7% of the Refuge in the Kenai Mountains. About 87% of this type is composed of dwarf shrub and lichen tundra, and 13% is tall shrub (alder and willow) thickets usually associated with tundra. This is habitat for several wildlife species, including caribou (*Rangifer tarandus*), Dall sheep (*Ovis dalli dalli)*, and ptarmigan (*Lagopus lagopus*).

3.4.1.2 Forests and Woodlands

Black Spruce

Black spruce occupies 15% of the Refuge (or 30% 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 an MFRI of more than 80 years. Large fires in 1947 and 1969 established much of the age-class distribution in this forest type. More than 45% of black spruce forests are in the 41- to 60-year class, with 5% estimated to be less than 40 years old. Following fire, black spruce is often converted to early successional hardwood species, 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 reedgrass, crowberry *(Empetrum nigrum)*, field horsetail *(Equisetum arvense)*, 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)*.

White Spruce

White spruce represents almost 10% of the Refuge (or 19% of the forests on the Refuge). This vegetation type is dominated by white spruce and Lutz spruce (*Picea* X *lutzii*), a hybrid between Sitka (*Picea sitchensis*) and white spruce, with occasional scattered paper birch (*Betula papyrifera*) or quaking aspen (*Populus tremuloides*) in the overstory canopy. It occurs mostly in the Kenai Mountains and uplands of the Caribou Hills and Tustumena Benchlands. Since the 1985 CCP 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 in the understory.

As a result of beetle-induced mortality, 50% of the white spruce forest is estimated to be in the early stages of regeneration. Less than 5% 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, field horsetail, false toadflax, twinflower, pink pyrola *(Pyrola asarifolia)*, wintergreen *(Pyrola secunda)*, prickly rose, arctic raspberry *(Rubus arcticus)*, strawberryleaf raspberry *(Rubus pedatus)*, marsh fern *(Thelypteris dryopteris)*, starflower *(Trientalis europaea)*,and lingonberry.

Spruce Bark Beetle in Black and White Spruce Forests

The spruce bark beetle is the dominant agent of disturbance in spruce forests of the Kenai Peninsula. Beetles selectively attack mature spruce trees (more than 6 inches diameter at breast height) because large slow-growing trees are less able to resist the establishment of adult female beetles in the phloem (food-carrying tissue of a plant). Bark beetles are always active somewhere on the Peninsula at low levels; there have been repeated outbreaks over the last 250 years with an average return interval of 52 years (Berg et al. 2006). However, the outbreak of the last 20 years has been of unprecedented size and intensity. Beetles infected 4 million acres of forested land in southcentral Alaska, of which more than 800,000 acres on the Kenai Peninsula experienced 80%–90% spruce mortality. Increasing temperatures and drought stress due to of global warming are likely increasing the rate of spruce bark beetle outbreaks on the Peninsula (Berg et al. 2006).

Mountain Hemlock

Mountain hemlock (*Tsuga mertensiana*) occupies less than 2% of the Refuge (or 3% of forests on the Refuge). It generally grows in a high-elevation band between white and Lutz spruce and alpine shrub-tundra. Almost all (98%) of the hemlocks on the Refuge are estimated to be more than 80 years old, so they represent an important source for old-growth forest for wildlife species, such as marten (*Martes americana*), that depend on these forests.

Hardwoods

This vegetation type occupies 5% of the Refuge (or 10% of the forests on the Refuge). This type is characterized primarily by paper birch and, to a lesser extent, quaking aspen and balsam poplar

(*P. balsamifera*). Although this forest type is fairly well distributed across all age classes, more than 50% is estimated to be less than 60 years old. Early successional and intermediate-stage hardwood, which constitute about 40% of the Refuge, are important habitat for moose and snowshoe hares, birds, and other wildlife.

Mixed Hardwood–Softwood (Conifers)

The mixed hardwood and softwood (or broadleaf and needleleaf [conifers]) vegetation type occupies 18% of the Refuge (or 36% of all forests on the Refuge). Several alliances (Viereck et al. 1992) make up this forest type; the most common are spruce–paper birch–balsam poplar, quaking aspen–spruce, and spruce–paper birch. The mixed hardwood-softwood forests are mostly mature, with 70% of this type estimated to be more than 120 years old. This vegetation type may be a transitional stage from hardwood to softwood.

3.4.1.3 Wetlands (Fens and Peatlands) and Riparian Habitats

Sphagnum moss-dominated fens and peatlands are defined by periodic saturation or coverage of the soil by water. Only 3% 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 et al. 2005).

Riparian habitats contain various terrestrial plant communities distinguished by their association with lakes, ponds, and streams. Riparian habitat makes up only 5% of the Refuge but it is perhaps the most valuable wildlife habitat. It is essential to 36 species of birds (26% 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.

3.4.2 Environmental Consequences—Vegetation

3.4.2.1 Alternatives A and B

Both alternatives could result in potential beneficial and adverse effects on vegetation. For all vegetation types, a possible adverse effect of prescribed fire is that the fire could escape beyond the boundary of the planned burn and affect desirable grass and shrub species; especially those species not fire adapted or resilient to disturbance. In areas where native plant species might not recover following a fire (includes both prescribed fire and wildfire), adverse effects could be both short and long term if invasive species spread and outcompete the native species for resources (sunlight, moisture, soil nutrients) in the burned areas. Adverse effects would range from minor to major, depending on vegetation type, the extent of the fire and fuel load, and potential for invasive plants to spread into the disturbed areas.

The use of heavy equipment to carry out mechanical treatments will be closely monitored to minimize adverse effects on nontarget vegetation. Any disturbance to surrounding vegetation during mechanical removal of hazardous fuels could result in temporary to short-term minor adverse effects.

The environmental consequences for specific vegetation types are described below.

3.4.2.2 Grasslands and Shrublands

Grasslands

One of the primary management concerns related to grasslands is the invasion of shrubs, trees, invasive plants, and noxious weeds into grasslands. Even some species of native plants can be highly aggressive, moving into disturbed areas and preventing the growth of other species that may be more desirable for a variety of reasons, including fuels characteristics. One such concern is bluejoint reedgrass in WUI areas and beetle-killed areas.

Beneficial Effects

Prescribed fire in grasslands would result in a reduction of fuel loads, thus fire hazard, and beneficial effects would be minor to moderate over both the short and long term.

Fire would result in other long-term beneficial effects because fire kills woody plants, allowing sunlight to reach the soil and changing the soil pH and nutrient availability (NIFC 2010; USFWS 2010a). Native grasses and forbs have greater seed production, germination, and establishment after a fire because burning allows plant nutrients to be returned to the soil and used again. Fire promotes the growth of native grasses and forbs, providing a competitive advantage for the native species. The productivity of native plant species usually increases following a fire, and growth is stimulated by the removal of litter and preparation of the seedbed (mowing is not a good replacement for fire because it does not reduce plant litter).

There would also be long-term minor to moderate beneficial effects from mechanical treatments to remove bluejoint reedgrass and invasive shrubs and trees that have become established on grasslands.

Adverse Effects

Long-term minor to moderate adverse effects could result if fire caused bluejoint reedgrass to spread. Light surface burning tends to increase the abundance of bluejoint reedgrass (Dyrness and Norum 1983; Smith and Janes 1978; Viereck et al. 1992). Fire will kill aboveground vegetation of bluejoint reedgrass. Following low-severity fires, bluejoint reedgrass will typically sprout from on-site surviving rhizomes, but severe fires will also kill belowground rhizomes (Smith and Janes 1978; Sylvester and Wein 1981). Buried or wind-dispersed seeds may be the primary source of plant establishment on severely burned sites (MacDonald and Lieffers 1991; Sylvester and Wein 1981).

Shrublands

Beneficial Effects

As explained in the wildlife section below, some species, such as the moose (*Alces alces*) and snowshoe hare (*Lepus americanus*), inhabit lowland shrubland vegetation, such as willows. Following light fires, most willows (such as feltleaf willow [*Salix alaxensis*]) recover quickly, sending up new shoots from undamaged root crowns. Few, if any, seedlings establish following this type of burn because organic soil layers are only partially consumed, preventing seedling establishment. Severe fires in these vegetation types can kill willows by completely removing soil organic layers and charring the roots (Zasada 1986). Sprouts develop more rapidly than seedlings and can reach heights over 20 inches after the first growing season. The density of Feltleaf willows probably increases or remains constant for up to 30 years after a forest fire, but thereafter declines as young trees overtop it (Foote 1983; Parminter 1984).

In addition, fuel reduction actions using fire and/or mechanical treatments in low shrub areas would result in long-term beneficial effects because fire behavior during any future wildland fires may not be high or extreme and would be easier to suppress.

Adverse Effects

The adverse effects that could result from the use of fire or mechanical treatments in shrublands would be the same or similar to those described above for grasslands.

Subalpine and alpine shrub-lichen tundra areas are not a priority for fuel-reduction treatments because the predicted fire behavior is currently low. However, a naturally occurring wildland fire could result in the same beneficial effects on shrub growth (such as willow) as described above and similar adverse effects.

3.4.2.3 Forests and Woodlands

White and Black Spruce

Beneficial Effects

Fuel reduction treatments would focus on removing the dead standing and downed spruce killed by the spruce bark beetle or other natural disturbances such as wind events. This is cause for concern because wind-thrown spruce provide prime breading habitat for spruce beetles that can subsequently move into adjacent live standing trees. Another focus of fuel-reduction treatments is to thin, remove, or convert black spruce forests and woodlands to a less flammable condition. Mitigation is critical because hazardous fuels and falling trees can also impact watershed resources and human health and safety. The beneficial effects would range from minor to major over the long term because the fire hazard would be lower when fuel loads are reduced or removed, and potential fire behavior is moderated. The reduction or removal of fuels (such as shrubs, small trees, low vegetation, and dead standing trees) or the thinning of crowns of live trees can create conditions where soils and ground vegetation are exposed to more sunlight.

Adverse Effects

Contrary to the beneficial effects, there could be potential adverse effects when ground vegetation, such as grasses, are exposed to more sunlight, which may dry grasses faster following the reduction or removal of hazardous fuels. Dry fuel is much more combustible, and it is generally the grass fuel, leaf litter, and small twigs that will permit a fire to take hold in the first place since they are able to reach combustion temperature comparatively fast. The adverse effects could be both short and long term and could range from minor to moderate if too much drying occurs, creating more unwanted fuels and increasing the fire hazard.

Mountain Hemlock

Beneficial Effects

As stated earlier, 98% of the hemlocks on the Refuge are more than 80 years old and represent an important source for old-growth forest for species (such as marten) that depend on these forests. Protecting these forests through fuel-reduction treatments would result in long-term beneficial effects as ground fuels (forest litter) and ladder fuels (low-lying branches and shrubs) are removed, thus serving to reduce the behavior (rate of spread and flame length) of any future wildland fire in these areas.

Adverse Effects

The adverse effects would be the same or similar to those described above for black and white spruce.

Hardwoods

Beneficial Effects

The goal of any fuels treatments in these areas would be to keep the fuel load, thus fire hazard, as low as possible and fire behavior that has a low rate of spread and flame length. Fire can promote growth of hardwood through either seeding or resprouting. Severe fires will kill trees rather than stimulating sprouting but may promote seed establishment

Adverse Effects

In terms of hazard fuel, however, most deciduous trees are fire-resistant, and such plants do not readily ignite. They may be damaged or even killed by fire, but their foliage and stems do not significantly contribute to a fire's intensity.

Mixed Hardwood–Softwood (Conifers)

Beneficial Effects

About 70% of this vegetation type is estimated to be more than 120 years old. These stands include both white/Lutz spruce and black spruce mixed with aspen, birch, cottonwood, and poplar and a wide range of stand conditions. In some stands, spruce bark beetles have killed a high percentage of the white/Lutz spruce, leaving mature hardwoods and downed dead spruce with grass, forb, and shrub understories. The beneficial effects would be the same or similar to those described above for black and white spruce, hemlock, and hardwoods.

Adverse Effects

The adverse effects would be the same or similar to those described above for black and white spruce, hemlock, and hardwoods.

3.4.2.4 Wetlands (Fens and Peatlands) and Riparian Habitats

There would be no fuels treatments in wetlands or riparian areas to reduce encroachment of trees (such as black spruce) into these areas. Riparian vegetation often contains mixed spruce/deciduous species, but these areas are not a high priority target for fuel-reduction projects.

3.4.3 Affected Environment—Wildlife

Appendix F of the 2010 CCP for Kenai NWR contains an extensive list of wildlife species identified on the Refuge, including 164 insects, 151 birds, 30 mammals, and 20 fish. The CCP is available at http://alaska.fws.gov/nwr/planning/kenpol.htm.

3.4.3.1 Special Status Wildlife Species

There are no federally listed threatened or endangered species known to breed or overwinter on the Refuge, but the following is a candidate species for federal listing:

- The Kittlitz's murrelet (*Brachyramphus brevirostris*) 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). During summer, habitats are characterized by close proximity to tidewater glaciers and waters offshore of remnant high-elevation glaciers and deglaciated coastal mountains. Their eggs are typically laid on bare ground in unvegetated scree fields, coastal cliffs, rock ledges, and talus above timberline in coastal mountains. This species would not be affected by prescribed fire or wildland fire.

In April 2006 the Alaska Department of Fish and Game (ADF&G) completed its comprehensive wildlife conservation strategy titled, *Our Wealth Maintained: A Strategy for Conserving Alaska's Diverse Wildlife and Fish Resources* (ADF&G 2006), which is supported through the State Wildlife Grant program. The ADF&G currently uses the comprehensive wildlife conservation strategy to assess the needs of species with conservation concerns and to prioritize conservation actions and research. Appendix 4 of the strategy contains conservation action plans for wildlife species and species groups. The species specifically mentioned in Appendix 4 for the Kenai Peninsula include the following:

- Kenai red squirrel (*Tamiasciurus hudsonicus kenaiensis*), whose range is the forested habitat of the Kenai Peninsula. The greatest concern for the red squirrel and marten is the degraded to very degraded habitat condition as a result of forest loss due to bark beetle infestation on an unprecedented scale and the replacement of standing forests with grasslands (ADF&G 2006). The decline in squirrel populations could adversely affect predators.
- Kenai marten (*Martes americana kenaiensis*). Small isolated populations of marten may be at risk from habitat loss (as described for the red squirrel) and over-trapping.

Several "State species of conservation concern" identified in Appendix 7 of Alaska's Wildlife Action Plan are found on the Refuge:

- 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

The following are several local populations of terrestrial wildlife species that have been identified by Refuge staff as *species of special interest*:

- A subspecies of red fox (*Vulpes vulpus kenaiensis*)— very rare; potential candidate for local extirpation; candidate for restoration efforts
- Marten—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
- Marbled murrelet (*Brachyramphus marmoratus*)—unknown nesting occurrence

3.4.3.2 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 the 192 bird species recorded on or just adjacent to the Refuge, 113 are known to breed in the area.

The categories of bird species on the Refuge include passerines, raptors, waterfowl, marsh and waterbirds, shorebirds, and marine birds.

3.4.3.3 Mammals

Carnivores

Black bears (*Ursus americanus*) are estimated to number 3,000 on the Kenai Peninsula (Suring and Del Frate 2002). They are widely distributed in most forest habitats on the Refuge and also occur above the tree line in the Kenai Mountains. Brown bears (*Ursus arctos*) occur in southeastern Alaska, on Kodiak Island, on the Kenai Peninsula, along the Alaska Peninsula, and in coastal areas. The Kenai Peninsula brown bear population was estimated to be 624 in 2010 (Morton et al. 2013).

Ungulates

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.

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 more than 1,000 animals in four herds.

Only two complete censuses of Dall sheep were done on the Kenai Peninsula. In 1968, estimates were 2,200–2,500 animals; while in 1992, population size was estimated at 1,508–1,774. There are 12 count areas on the Kenai Peninsula. The count area from Killey Glacier to Tustumena Glacier continues to have the highest numbers of sheep. Data from ADF&G's annual survey and inventory reports suggest that the caribou population may be declining. Severe winter weather, competition with Dall sheep, and overharvesting may be causing a decline.

Small Mammals

Some of the small mammals that can be found on the Refuge include Vagrant shrew (*Sorex vagrans*), masked shrew (*Sorex cinereus*), dusky shrew (*Sorex monticolus*), pygmy shrew (*Sorex hoyi*), singing vole (*Microtus miurus*), tundra vole (*Microtus oeconomus*), northern red-backed vole (*Clethrionomys rutilus*), and northern bog lemming (*Synaptomys borealis*).

The little brown bat (*Myotis lucifugus*) is found on the Refuge, but little is known about its distribution and movements.

Furbearers

The Refuge's river otter (*Lontra canadensis*) population appears to occur in relatively low numbers. 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.

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.

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. There are recent documented reports of least weasel from the southern portion of the Kenai Peninsula and many scattered unconfirmed sightings elsewhere.

Little is known about the status of the Refuge's mink (*Mustela vison*) and muskrat (*Ondatra zibethicus*) populations, which are thought to be largely regulated by habitat conditions.

Other furbearers on the Refuge include wolverine (*Gulo gulo*), lynx (*Lynx canadensis*), coyote (*Canis latrans*), wolf (*Canis Lupis*), red fox, and marten.

3.4.3.4 Herptiles (Reptiles and Amphibians)

The wood frog (*Rana sylvatica*) is the only amphibian known to occur on the Refuge.

3.4.3.5 Fish

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 (*Oncorhynchus tshawytscha*), sockeye (*Oncorhynchus nerka*), coho (*Oncorhynchus kisutch*), pink (*Oncorhynchus gorbuscha*), and chum salmon (*Oncorhynchus keta*). In addition, rainbow trout (*Oncorhynchus mykiss*), Dolly Varden (*Salvelinus malma*), Arctic char (*Salvelinus alpinus*), and lake trout (*Salvelinus namaycush*) are native to the Refuge. Arctic grayling (*Thymallus arcticus*) and northern pike (*Esox lucius*) are both exotic fish species that occur on the Refuge.

3.4.4 Environmental Consequences—Wildlife

3.4.4.1 Alternatives A and B

The wildlife species summarized above may inhabit, breed, forage in, or migrate through more than one habitat type; that is, grassland, shrubland, forest/woodland, or wetland/riparian areas. The effects

discussions are organized according to vegetation community and how wildlife could be affected by fuel reduction treatments and wildland fire suppression in a particular habitat type.

3.4.4.2 Grasslands and Shrublands

The wildlife species that inhabit grassland areas would benefit from a greater abundance of native grass and forb species. Protecting native plant species would help maintain the diverse structure in grass fields that creates cover and nesting sites for an array of grassland-dependent wildlife that already inhabit Refuge lands or more that could in the future. Native grasses provide nesting, brood rearing, escape, and roosting cover. The presence of forbs in managed grasslands is important because they diversify structure and invertebrate resources. Many bird species are most abundant in fields with a strong forb component. Plant diversity increases food sources, such as seeds, in addition to increasing the number of different insects that use a grassland area, and insects are an extremely important food source for young birds as they begin to grow and fledge.

Prescribed Fire

The effects of prescribed fire on wildlife can be both adverse and beneficial. Prescribed fire used to reduce fuel loads can have secondary beneficial effects by improving habitat, which is a value to wildlife. For example, depending on shrub component, fire could stimulate sprouting of willows (refer to the Grasslands discussion above in Section 3.5.1.10), which would benefit moose and snowshoe hares. Berry production can be stimulated by fire, benefitting species (such as birds, small mammals, furbearers, and bears) that feed on berries (for example, squashberry (*Viburnum edule*), lingonbery. blueberry (*Vaccinium uliginosum*), and nagoonberry (*Rubus arcticus*).

Fire removes dry, dead plant matter that has built up over the years, opening up space for new growth and creating thicker, younger cover and increasing food availability by stimulating seed production (USFWS 2010a). The burned areas provide better nesting cover and attract ground-nesting birds. The burned areas also provides improved brood-rearing habitat by increasing the amount and variety of food available for young birds. Prescribed fire would produce long-term minor to major beneficial effects on grassland wildlife.

Any potential negligible to minor adverse effects on grassland and shrubland wildlife can be minimized by planning spring burns early enough to avoid the breeding and nesting season of most wildlife. Birds and some mammals usually leave the area ahead of the fire (USFS 2012). Few animals are unable to escape prescribed fire, and small mammals that inhabit grasslands find shelter by burrowing under a log or staying in an underground burrow (this is also true of the wood frog). Any nests destroyed by the fire are usually replaced through re-nesting (USFS 2012).

Mechanical Treatments

Wildlife may be displaced during mechanical treatments, which would result in temporary negligible to minor adverse effects, depending on the extent of treatment. Adverse effects would increase to minor or moderate and last longer as a result of fuel break construction or maintenance activities if burrows are covered or ground fuels (such as litter or logs) that provide cover are removed.

Fire Suppression

Suppression actions would result in both adverse and beneficial effects. Adverse effects could be minor to major and long term, depending on the size of the fire, the extent of firelines or fuel breaks (if

created), and the location of the wildfire in relation to wildlife habitat threatened (particularly critical habitat). Beneficial effects on wildlife would be realized if suppression efforts protected important habitat areas or minimized loss of habitat. Beneficial effects would be immediate and long term and range from minor to major.

Fire-fighting foams and retardants are often necessary to contain and extinguish wildfires. The Patuxent Environmental Science Center conducted a study on the impacts of wildfire control chemicals on terrestrial vertebrates and invertebrates. Small mammals were selected for primary focus in the study since they are not highly mobile and were expected to be exposed to the chemical within the treated area. Birds, however, likely foraged outside the study site. Further, the density of small mammals was expected to be greater inside the study area than birds. Eggs and nestlings of birds nesting in the study sites were monitored because they may have been exposed to the chemical via direct contact or ingestion.

Small mammal trapping data indicated the meadow vole (*Microtus pennsylvanicus*) was the most common mammal species. Other species trapped included the thirteen-lined ground squirrel (*Citellus tridecemlineatus*) and field mouse (*Peromyscus* spp.). Only the meadow vole was abundant enough for statistical analysis. Study results indicate that there were no effects on the survival rate or and population size for the meadow vole.

Adams and Simmons (1999) summarized results of studies on the ecological effects of firefighting foams and retardants. White-footed mouse showed no mortality or signs of sub-acute toxicity for any product tested. However, Silv-Ex foam caused periods of stupor and lack of coordination but no mortality in exposed kestrels, and some mortality of red-winged blackbirds exposed to two retardants was recorded. Exposure to 0.3% Silv-Ex foam produced no effects on the survival rate or population size of meadow mole (*Microtus pennsylvanicus*), and no effects on ants were recorded (Vyas et al. 1996). Although no toxicological studies appear to have been carried out on any native vertebrates, the long-term effects of fire retardants and foams appear to be minimal.

Another study (MTDC 2007) states that “Permanent or persistent exposures through [terrestrial] environmental pathways are not expected, since the application “footprint” of these chemicals is quite limited in terms of foraging areas and species habitat for any individual animal, and the ingredients generally degrade in the environment. Although bioaccumulation was evaluated in simple predator-prey scenarios, the potential for long-term biomagnification in the terrestrial food web was not evaluated for this same reason.”

MTDC (2007) notes that the surfactants in the foams were predicted to pose risks to aquatic species from runoff containing residues of fire-fighting chemicals. The quantitative risk assessment (MTDC 2007) for aquatic species from individual ingredients in the firefighting chemical products predicted the following:

- Runoff: No risks were predicted for survival of populations of non-sensitive species. Risks to survival of individuals of sensitive fish species in small streams in some ecoregions were associated with a surfactant in one foam product. Risks to survival of individuals of sensitive fish and aquatic stages of amphibians in small streams in some ecoregions were predicted from a surfactant in one water enhancer.

- Accidental application across stream: All retardant and foam products present risk to survival of populations or individuals of one or more aquatic species if applied across a small stream. In a large stream, sufficient dilution was achieved to decrease the risk to negligible.
- Accidental spill: All concentrated and mixed retardant and foam products present risk to one or more aquatic species if spilled into a small stream at the volumes assumed in risk assessment. In a large stream, sufficient dilution was achieved to decrease to the risk to negligible.

The study (MTDC 2007) also explains that because fire-fighting chemicals can be used anywhere that a wildland fire occurs, the physical, chemical, and biological attributes of the natural system in which the chemicals are deposited will have a great impact on the environmental transport and fate of chemicals in that system, including the concentration of chemicals in water, soil, or as residues on terrestrial species diet items.

Mitigation measures, included under each fire management unit (FMU) described in Chapter 2, states that retardants and foams will not be used within 300 feet of any waterway. The reason for this mitigation measure is that study results on fire retardants, such as Phos-Chek D75-F, and foams, such as Silv-Ex, showed that the foams were 10 times more toxic to fish, such as rainbow trout and chinook salmon, and between 10-258 times more toxic for fathead minnow than the fire retardants tested. The toxic component of retardant chemicals in aquatic systems is ammonia (McDonald et al. 1996), and fish are less tolerant than are macroinvertebrates. In contrast, the higher toxicities of foams to aquatic invertebrates, such as *Daphnia* and *Hyalella*, is due to the surfactants they contain, which lower the surface tension of water and decrease the ability of aquatic organisms to obtain oxygen (McDonald et al. 1996).

Adhering to the operational constraints when retardants and foams are used during a wildfire would prevent or reduce the potential for adverse effects on aquatic wildlife in all areas of the refuges.

3.4.4.3 Woodlands and Forests

The woodland and forest areas on the refuges provide feeding, resting, breeding, and wintering habitat for a diversity of native forest-dwelling birds, mammals, reptiles, amphibians, and invertebrates. The actions taken to protect the woodland and forests areas would provide long-term minor to major benefits to wildlife.

Some minor to moderate disturbance to wildlife may occur when conducting fuel reduction and other vegetation treatments. Any adverse effects would be negligible to minor and temporary, lasting only as long as it takes to complete the action. It is unlikely that any wildlife would be permanently displaced. The beneficial effects that would result from increasing the amount of native woodland and forest habitat would be moderate to major over the long term.

Prescribed Fire

As with prescribed fire in grassland habitat (refer to the “Grasslands and Shrublands” section above), the effects on woodland and forest wildlife could be both adverse and beneficial. Fuel reduction

using prescribed fire would result in greater protection to residual, unburned woodland/forest habitat, which is a benefit to wildlife.

Mechanical Treatments

The effects on wildlife would be the same as described above for "Grasslands and Shrublands."

Fire Suppression

Caribou winter in spruce forests and woodlands and in open, windswept bogs where the snow is not too deep for foraging. While fire in lowland forests is considered beneficial to moose winter range, it is considered adverse to caribou winter range. The suppression of fires on caribou winter range that support forage lichens could benefit caribou by protecting winter range. Letting natural fires burn would adversely affect caribou.

3.4.4.4 Wetland, Riparian, and Marsh Wildlife

There would be no fuels treatments in wetlands or riparian areas to reduce encroachment of trees (such as black spruce) into these areas, thus there are no predicted adverse effects on wildlife species that nest, breed, or forage in these areas.

See the discussion above for the potential adverse effects of fire suppression chemicals on aquatic species.

3.5 Water and Soil

3.5.1 Affected Environment

3.5.1.1 Water Resources

The Kenai River, the largest river system on the Peninsula, drains about 2,148 square miles (5,563 square kilometers). Approximately 54% of the watershed is on the Refuge, 37% 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) and Skilak Lake (25,000 acres). More than 4,600 smaller lakes dot the Refuge, mostly in the Moose, Swanson, and Chickaloon river drainages.

3.5.1.2 Soil

Soils of the Refuge are sedimentary, consisting of glacial deposits from the Alaska Range and alluvial/colluvial deposits from the Kenai Mountains, which are composed of shale. Soils can be sandy, silty, or gravelly and well-drained to poorly-drained. Some soils are sensitive to erosion, especially on slopes, and some soils are susceptible to compaction, especially wetlands and riparian areas. According to a 2008 permafrost map, there are some areas of isolated permafrost on the Kenai Peninsula (Jorgenson et al. 2010).

3.5.2 Environmental Consequences

3.5.2.1 Alternatives A and B

Prescribed Fire

Prescribed fires are usually low-severity fires by design because they are conducted when fuel loads, fuel moisture, and weather conditions are favorable for a low-intensity fire (Neary et al. 2005). Wildfires, on the other hand, are usually high-severity fires because they typically occur when temperature, wind speed, and fuel loading are high, and humidity and fuel moisture are low (Neary et al. 2005). Due to these burning conditions, wildfires often have greater effects on ecosystems than do prescribed fires.

Water. Fire can have either beneficial or adverse effects on the physical, chemical, and biological structure of aquatic systems. The effects of fire on water quality are dependent upon the fire size, intensity, and severity. Low-intensity fires have had little effect on stream water quality (Neary et al. 2005). Even where sedimentation and dissolved nutrients increase in stream water in response to burns, the amounts are often negligible.

Fire effects also depend on the proximity of fires to streams and other water sources as well as the timing of fires in relation to precipitation events. The effects of fire on aquatic ecosystems can be divided into direct and indirect effects. Direct effects may include increases in temperature, ash, nutrients, and

charcoal. The indirect effects of fire may include increases in sediment deposition and turbidity, and alterations channel morphology (Neary et al. 2005).

The main effect that burning can have on water quality is the potential for increased runoff of rainfall. Runoff may carry suspended soil particles, dissolved inorganic nutrients, and other materials into adjacent streams and lakes, reducing water quality and degrading fish habitat (Wade and Lundsford 1988). However, most studies indicate that adverse effects of prescribed fire on water quality are minor and of short duration.

Soils. Prescribed fire, as proposed in this EA, would be used to reduce fuel loads. However, a secondary beneficial effect of prescribed fire, regardless of the management goal, is site preparation to modify existing vegetation or physical site conditions to improve germination, survival, and subsequent growth of desired seedlings. One purpose of site preparation is to cause scarification, which modifies soil surface layers to loosen upper soil, to break up the organic layer, to expose mineral soil by removing undecomposed litter and humus; or to mix surface organic materials with mineral layers. The beneficial effects of scarification are improved seedbed conditions and increased root penetration and infiltration. Mixing organic materials with mineral soil increases decomposition, nutrient release, and moisture-holding capacity (Nyland 1996).

Fire may alter several physical soil properties, such as soil structure, texture, porosity, wetability, infiltration rates, and water holding capacity. The extent of adverse fire effects on these soil physical properties varies considerably, depending on fire intensity (a measure of the rate of heat released by a fire), fire severity, and fire frequency. In general, most fires do not cause enough soil heating to produce significant changes to soil physical properties (Hungerford et al. 1991). This is particularly true for low-intensity prescribed fires. Even where fires do cause direct changes to soil physical properties, their indirect effects on soil hydrology and erosion will vary greatly, depending on the condition of the soil, forest floor, topography, and climate.

The long-term adverse effects of fire on soil physical properties range from a single season to many decades, depending on the fire severity, rate of recovery as influenced by natural conditions, post-fire use, and restoration and rehabilitation actions. Persistent soil degradation following fire is more common in the cold and/or arid climates typical of the western United States.

The use of prescribed fire at the refuges would result in no effect or negligible adverse effects on soil properties but beneficial effects

Mechanical Treatments

Water and Soils. The use of chainsaws and other hand-held equipment to remove fuels, such as dead and downed black and white spruce, would not result in adverse effects on soils or water quality.

Fire breaks are generally created and maintained with mechanical treatments through the use of heavy equipment to remove heavy fuel concentrations, mow “green” firebreaks, grade two-track roads to remove vegetation, and to remove single or small groups of trees by hand. These activities would result in temporary or short-term minor to moderate adverse effects on soils that are directly disturbed but no effects beyond the treated area. There would be no long-term adverse effects on soil compaction. There would be no adverse effects on water quality.

Mechanical treatments are often used prior to or in conjunction with prescribed fire to both remove the cut material and prevent sapling trees from encroaching onto the treated site. These types of treatments would continue in order to prevent the further encroachment of invasive plants (such as black spruce) into grasslands and shrublands. These activities would result in temporary or short-term minor to moderate adverse effects on soils that are directly disturbed but no effects beyond the treated area. There would be no adverse effects on water quality.

Fire Suppression

Water and Soils. The effects on soils and water would be the similar to those described above for mechanical treatments.

Fire retardants and foams will not be used within 300 feet of any waterway, so there is little to no potential for adverse effects on water quality.

The commonly used foams all contain surfactants, foaming, and wetting agents. The foaming agents affect the rate at which water drains from the foam and how well it adheres to the fuel. These retardants lose their effectiveness once the water has evaporated or drained from them (Adams and Simmons 1999), thus there would be no adverse effect on soils.

3.6 Air Quality

In 1970 the Congress of the United States created the U.S. Environmental Protection Agency (EPA) and promulgated the *Clean Air Act* (CAA). Title I of the CAA established National Ambient Air Quality Standards (NAAQS) to protect public health. The NAAQS were developed for six criteria pollutants: sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, and lead.

Subsequent revisions to the particulate matter (PM) standard resulted in two new standards: PM_{10} and $PM_{2.5}$. The first revision (1987) reduced the PM size that was considered harmful to humans, measuring for particles less than 10 micrometers (or microns) in diameter (PM_{10}). That standard was later revised (1997) to separate the PM_{10} size particles into two size fractions: coarse and fine. The coarse PM fraction represents particles between 10 and 2.5 microns and fine PM represents particles 2.5 micron and smaller in diameter ($PM_{2.5}$). Thresholds limits established under the NAAQS to protect health are known as primary standards. The primary health standards are set to protect the most sensitive of the human population, including those people with existing respiratory or other chronic health conditions, children, and the elderly. Secondary standards established under the NAAQS are set to protect the public welfare and the environment. Table 3-5 lists the NAAQS.

Table 3-5. National Ambient Air Quality Standards

Pollutant	Average Time	Federal Primary Health Standard (NAAQS) Exceedance Level	State Standard Exceedance Level
Carbon monoxide	1-hour	35 ppm[1]	35 ppm
	8-hour	9 ppm	9 ppm
Lead	Calendar Quarter	1.5 µg/m[2]	1.5 µg/m
Nitrogen dioxide	Annual	0.053 ppm	0.053 ppm
Ozone	8-hour	0.075 ppm	0.08 ppm
$PM_{2.5}$	24 hour	35 µg/m	
	Annual Average	15 µg/m	
PM_{10}	24 hour	150 µg/m	150 µg/m
	24 hour	150 µg/m	150 µg/m
Sulfur dioxide	Annual Arithmetic Mean	0.03 ppm	0.02 ppm
	24 hour	0.14 ppm	0.10 ppm
	3 hour	**0.50 ppm* secondary standard	0.50 ppm

Notes:

1. ppm = parts per million
2. µg/m = micrometers

3.6.1 Affected Environment

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. Potential 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), fires, and volcanoes. The Refuge does not have air-quality or visibility-impairment data.

The Refuge is designated as a Class II air quality area under the CAA because it was established prior to 1977. The CAA 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 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 NAAQS or prevention of significant deterioration Class II increments in these areas. Wilderness areas that are Class II air-quality areas receive additional protection under 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 areas.

The state of Alaska has been conducting air quality monitoring in the Kenai Peninsula Borough at a site in Soldotna since October 2011. Monitoring was initiated in response to staff observations of dust events and summer wildland fires on the Peninsula. The Soldotna location is designated as a special purpose monitoring (SPM) site. The Soldotna monitoring site EPA Air Quality System ID number is 02-0122-0008.

The Soldotna monitoring site shows that the major sources of PM_{10} impacting this site are wind-blown glacial silt from the Kenai River and other stream beds, open unvegetated ground, and vehicular traffic, especially from unpaved roads. Major sources of $PM_{2.5}$ matter includes wood smoke from residential heating, vehicular exhaust, and especially wildland fires. The Kenai Borough may also be subject to high levels of both PM_{10} and $PM_{2.5}$ following volcanic eruptions.

3.6.2 Environmental Consequences

3.6.2.1 Alternative A

Prescribed fire conducted at the Refuge would not contribute to nonattainment of the NAAQS. Adverse effects on local air quality and visibility would be negligible to minor and temporary from prescribed fire. The effects from wildfire are generally greater, depending on the type of fuels burning, weather conditions, size of the fire, and location.

Mechanical treatments and fire suppression actions would not contribute to nonattainment of the NAAQS.

There would be no cumulative effects from treatments on the Refuge when considered with present or future fuel reduction treatments that may be conducted on lands adjacent to Service lands.

3.6.2.2 Alternative B

The potential increase in prescribed fire conducted on the Refuge and CWPP and COI areas under this alternative would not contribute to nonattainment of the NAAQS. Adverse effects on local air quality

and visibility would be negligible to minor but temporary from prescribed fire. The effects from wildfire could be greater, depending on the type of fuels burning, weather conditions, size of the fire, and location.

Mechanical treatments and fire suppression actions would not contribute to nonattainment of the NAAQS.

There would be beneficial cumulative effects from treatments on the Refuge when considered with present or future fuel reduction treatments that may be conducted on lands adjacent to the Refuge.

3.7 Cultural Resources

3.7.1 Affected Environment

Archeological studies on the Kenai Peninsula began in the 1930s. Since then, only intermittent and nonsystematic 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 (such as 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.

There are 104 known prehistoric sites on 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 in 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 the 1971 *Alaska Native Claims Settlement Act*.

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.

3.7.2 Environmental Consequences

3.7.2.1 Alternatives A and B

Implementing the mitigation measures listed in Section 2.5 and Table 2.4 would serve to protect known cultural resources during fuel reduction activities. The mitigation measures do nothing to prevent damage to unknown resources because there would always be the likelihood of affecting unknown cultural resources, even with careful planning of prescribed burns and mechanical treatments. There could potentially be moderate to major adverse effects on cultural resources during a wildland fire, depending on the cultural resource and fire response. Reducing fuel loads in the vicinity of cultural resources would help protect valuable resources.

3.8 Service Values

3.8.1 Affected Environment

The purpose and need section in Chapter 1 explains that there is a need to protect significant values and assets at Kenai NWR. The estimated replacement cost of government-owned assets is $102,909,849. The replacement cost includes assets such as administrative buildings (including furnishing and fixtures), public use cabins, government vehicles, heavy equipment, campgrounds, fences, information kiosks, signs, pedestrian boardwalks and bridges, observation decks, parking areas, public use comfort stations, utilities (gas and electric—piping, wiring, poles), and the Moose Research Center. This list is a sampling of the type of Service assets that could be at risk from a devastating wildfire.

3.8.2 Environmental Consequences

3.8.2.1 Alternatives A and B

There would be no adverse effects on Service assets from the proposed fuel-reduction treatments under both alternatives. Prescribe fire and mechanical treatments would result in beneficial effects by reducing fuel loads and creating fuelbreaks and buffers to protect Service assets and the natural and cultural resources on the Refuge. Suppression efforts would be conducted to protect assets, which would result in long-term beneficial effects.

Alternative A would not contribute to cumulative effects. There would be no cumulative adverse effects from treatments under Alternative B when considered with present or future fuel reduction treatments that may be conducted on lands adjacent to the Refuge. There would be beneficial cumulative effects when fuel reduction treatments conducted on and off refuge complement each other to increase effectiveness of all treatments.

3.9 Public Health and Safety

3.9.1 Affected Environment

The Kenai NWR lies within the Kenai Peninsula Borough (Borough), which is comprised of the Kenai Peninsula, Cook Inlet, and a large, mostly unpopulated area on the west side of Cook Inlet and northeast of the Alaska Peninsula. In addition to Kenai NWR, the Borough includes portions of Chugach National Forest and three national parks: Lake Clark, Katmai, and Kenai Fjords.

The total population of the Borough is 55,400 as of the 2010 census (USDC 2010). 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.

The Refuge averages more than 300,000 visitors per year. There are approximately 35-40 permanent Service employees at the Refuge, and during the summer, seasonal employees and volunteers can raise the staff total to more than 100. There are approximately 80 guides, outfitters and river guides operating on the Refuge, and one concessionaire that operates the Russian River Ferry on the Kenai River, near Cooper Landing.

Within the boundaries of the Refuge, private lands account for 525 acres. There are 46,041 acres of Alaska Native Corporation Lands and 385 acres of Native allotments. There are hundreds of structures (homes, cabins, and outbuildings) on these privately and Native-owned lands within the Refuge. During the summer fire season, there can be hundreds of visitors recreating in the back-country of the Refuge on the Swanson River and Swan Lake Canoe Trails, the Kenai River, any of the hundreds of lakes in the Refuge, in the Skilak Lake Wildlife Recreation Area, in one of the three Refuge wilderness units, or on any of 110 miles of Refuge trails. Of the more than 1,900 lakes in the Refuge, as many as 580 are potentially accessible by floatplane, though some of the accessible lakes in wilderness are seasonally closed to airplane access to protect nesting swans. Other facilities within the Refuge where people work and reside include the Moose Research Center, the Swanson River Oil Field, and the Beaver Creek Oil Field.

3.9.2 Environmental Consequences

3.9.2.1 Alternatives A and B

Prescribed Fire

There would be no long-term adverse effects on public health and safety under these alternatives. There could be temporary negligible to moderate adverse effects on sensitive individuals from smoke during prescribed fires.

Smoke from fires (particularly wildfires) increases particulate and gaseous emissions, particularly PM_{10}, $PM_{2.5}$, and carbon monoxide. Prescribed fires could briefly reduce air quality in the immediate vicinity of the Refuge. Any adverse effects from the prescribed fires would be temporary and could range from negligible to minor because the burns would be conducted according to the mitigation measures (Table 2-4) and additional guidance contained in the Fire Management Plan for the Refuge. Off-site adverse effects are expected to be negligible given the relatively small units that would be burned at one time and the relatively isolated location of the Refuge.

Smoke emissions during prescribed fires may temporarily reduce visibility in some locations, but implementation of smoke management practices and plans (such as burning during favorable weather conditions when smoke is carried away from sensitive areas) and using the best available fire and emission control measures would minimize visibility impairments. Thus, emissions can be directed away from sensitive receptors, minimizing health hazards.

The mitigation measures and additional guidance contained in the Fire Management Plan and prescribed fire plans would help ensure that personnel conducting the burns will take all necessary safety precautions to protect themselves, staff, and visitors at the Refuge and CWPP and COI areas. Risks to human safety would be negligible.

The treatments would result in beneficial effects by reducing fuel loads and creating fuel breaks and buffers to protect Service staff, visitors, and communities.

Mechanical Treatments

There would be no adverse effects on public health and safety from implementation of mechanical treatments. There would be long-term minor to major beneficial effects from creation and maintenance of fuel breaks and reduction of hazardous fuels on the Refuge and in the CWPP and COI areas.

Fire Suppression

There would be no adverse effects on public health and safety from fire suppression actions.

3.10 Short-term Uses and Long-term Productivity

The *National Environmental Policy Act* requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by Congress under the Act, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare; to create and maintain conditions under which man and nature can exist in productive harmony; and fulfill the social, economic, and other requirements of present and future generations of Americans.

Short-term uses and their effects are those that occur within the first few years of project implementation. Long-term productivity refers to the capability of the land and resources to continue producing goods and services long after the project has been implemented. Long-term productivity would be maintained through the application of the mitigation measures described in Section 2.5 (Chapter 2).

None of the proposed alternatives would affect short-term uses or alter long-term productivity of resources at Kenai NWR.

3.11 Unavoidable Adverse Effects

Unavoidable adverse effects would occur during implementation of prescribed fire. Some wildlife species may temporarily be displaced during prescribed fires. There would be some unavoidable temporary negligible adverse effects on staff and visitors and on private landowners from smoke during prescribed fires. These activities are necessary to achieve long-term beneficial effects from the management activities, and although there may be potential adverse effects, they would not be significant. Table 2-4 presents the mitigation measures designed to minimize or eliminate potential adverse effects.

3.12 Irreversible and Irretrievable Commitment of Resources

An *irreversible* commitment of resources is a permanent or essentially permanent loss of nonrenewable resources, such as mineral extraction, heritage (cultural) resources, or to those factors that are renewable only over long time spans or at great expense (for example, soil productivity), or to resources that have been destroyed or removed. No irreversible commitments of resources would result from any of the alternatives.

Irretrievable commitment applies to losses that are not renewable or recoverable for future use. The loss of production would be irretrievable, but it would not necessarily be irreversible. None of the alternatives constitutes an irretrievable commitment of resources.

3.13 Cumulative Effects

Cumulative effects are discussed in the individual resource sections earlier in this chapter.

3.14 Energy Requirements, Conservation Potential, Depletable Resource Requirements

Consumption of fossil fuels by vehicles and equipment would occur with the action alternatives during management activities. No unusual energy requirements are included nor do opportunities exist to conserve energy at a large scale.

3.15 Prime Farmland, Rangeland, and Forest Land

As designated by the United States Department of Agriculture–National Resource Conservation Service and described in the National Soil Survey Handbook (USDA-NRCS 2010), the Kenai NWR does not contain prime farmlands and rangelands and does not manage for prime forest land.

- Prime forest land is described as a land cover/use that is at least 10% stocked by single stemmed forest trees of any size, which will be at least 4 meters (13 feet) tall at maturity. When viewed vertically, canopy cover is 25% or greater. Also included are areas bearing evidence of natural regeneration of tree cover (cutover forest or abandoned farmland) and not currently developed for nonforest use. For classification as forest land, an area must be at least 1 acre and 100 feet wide.

- Prime farmland is defined as a Land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses. It has the soil quality, growing season, and moisture supply needed to produce economically sustained high yields of crops when treated and managed according to acceptable farming methods, including water management. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.

- Prime rangeland is defined as a land cover/use category on which the climax or potential plant cover is composed principally of native grasses, grass-like plants, forbs or shrubs suitable for grazing and browsing, and introduced forage species that are managed like rangeland. This would include areas where introduced hardy and persistent grasses, such as crested wheatgrass, are planted and such practices as deferred grazing, burning, chaining, and rotational grazing are used, with little or no chemicals or fertilizer being applied. Grasslands, savannas, many wetlands, some deserts, and tundra are considered to be rangeland. Certain communities of low forbs and shrubs, such as mesquite, chaparral, mountain shrub, and pinyon-juniper, are also included as rangeland.

3.16 Possible Conflicts with Other Land Use Plans

The land management actions proposed under the FMP would take place entirely on Service lands and are designed to complement, rather than conflict with fuel and fire management actions under any

community's CWPP. As described in previous sections, through interagency and community cooperation: the Refuge FMP, adjacent land management agency fire management plans, the Alaska Interagency Wildland Fire Management Plan and the referenced Community Wildfire Protection Plans are developed, reviewed and administered, collaboratively. The All Lands All Hands Committee, on which the Refuge is and has always been an active charter member, provides the forum for collaborative planning among all of the Kenai Peninsula land and fire management agencies and the area communities. Planned agency project work plans and CWPPs, are reviewed annually by the committee. Possible conflicts between project plans and other land use plans are mitigated through interagency negotiations.

3.17 Other Required Disclosures

There are no federally listed wildlife species on the Refuge, but there is a federal candidate species (Kittlitz's murrelet) (refer to Section 3.4.4 above for effects on wildlife species on the Refuge). There are no federally listed plant species on the Refuge.

There are no properties on the Refuge that are listed in the National Register of Historic Places. However, the 2010 Comprehensive Conservation Plan for the Refuge (page 2-146, "Objective 8.8: Facilities," states:

> 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.

Chapter 4. Preparers, Coordination, and Distribution of the Final EA and FONSI

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4.2 Fire Management Coordination

4.2.1 Internal Partnerships

- Kenai NWR Management Team — an interdisciplinary team comprised of the Refuge Manager, the Deputy Refuge Manager, and Refuge Program Managers from Administration, Visitor Services, Biology, Facilities and Maintenance, Law Enforcement and Fire Management
- Service Alaska Region Fire Management Branch
- Service Alaska Region Fire Management Officers

4.2.2 External Partnerships

- Alaska Wildland Fire Coordinating Group
- Kenai Interagency Dispatch Center (KIDC)
- The 02/12/2010 Memorandum of Understanding (MOU) for the Development of a Collaborative Forest, Wildfire Protection and Fuels Treatment Program, among the USDA Forest Service – Alaska Region and the State of Alaska Division of Forestry and the USDI Kenai NWR, the BLM Anchorage Field Office, Kenai Fjords National Park, the BIA, and the Kenai Peninsula Borough, reestablished the Kenai Forest, Wildfire Protection and Fuels Management Coordinating Committee and the All Lands All Hands 5-Year Action Plan.
- Kenai Peninsula Fire Chiefs Association
- Local Emergency Planning Committee

4.2.2.1 Alaska Wildland Fire Coordinating Group

The Alaska Wildland Fire Coordinating Group (AWFCG) group provides coordination and recommendations for all interagency fire management activities in Alaska. Membership, procedures, and guidelines are documented in the AWFCG Memorandum of Understanding and Standard Operating Procedures available at http://fire.ak.blm.gov/administration/awfcg.php. The Region 7 Fire Management Coordinator represents the Service on this group.

4.2.2.2 Alaska Multi Agency Coordinating Group

The Alaska Multi-Agency Coordination Group (AMAC) provides a forum to discuss actions to be taken to ensure that an adequate number of resources are available to meet anticipated needs and to allocate those resources most efficiently. When activated and as warranted, the AMAC is tasked with the following: incident prioritization; resource allocation; coordination of state and federal disaster responses; political interfaces; media and agency information; anticipation of future resource needs; and the identification and resolution of issues. The *AMAC Operations Handbook* is available at http://fire.ak.blm.gov/administration/mac.php The Region 7 Fire Management Coordinator represents the Service on this group.

4.2.2.3 Interagency Agreements and Planning Documents

Several important agreements and planning documents include the following:

- Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement 2010 (Alaska Master Agreement)
- Alaska Statewide Annual Operating Plan
- Alaska Interagency Wildland Fire Management Plan 2010

4.3 Availability of the Final Environmental Assessment and Finding of No Significant Impact

This EA and Finding of No Significant Impact (FONSI) are available on the Kenai NWR website at http://www.fws.gov/refuge/Kenai/what_we_do/resource_management/plans.html. News releases announcing the availability of these two documents were published in local newspapers.

Requests for a hardcopy of the EA and FONSI can be emailed to doug_newbould@fws.gov.

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Appendix A:

Fire Ecology and Fire Regime Shift Due to Climate Change

Appendix A

Fire Ecology and Fire Regime Shift Due to Climate Change

Historic Fire Regime

The historic fire regime has been well studied on the Kenai Peninsula (Berg and Anderson 2006, Anderson et al. 2006). Prior to this past century, major fires of unknown origin took place in 1871, 1883, 1891, and 1910 (Lutz 1960), burning much of the Tustumena Benchlands. In 1947 and 1969, two large human-caused fires burned 310,000 acres and 86,000 acres, respectively, in the Kenai Lowlands, converting much of the mostly mature black spruce forest to birch and aspen. Since the 1990s, ~ 140,000 acres of mature and beetle-killed white and Lutz spruce have burned in several fires around Skilak Lake and south of Tustumena Lake.

Historically, two distinct fire cycles occur in spruce on the Kenai landscapes. Black spruce forests, primarily in the Kenai Lowlands, increase in flammability with age (DeVolder 1999). A revised estimate of the mean fire return interval over the entire study area for the past 300 years is 89 ± 43 years (1 SD) years (range 25-185 years) based on 1,022 basal cross-sections and 771 increment cores of lowland black spruce (Berg, pers. comm.). Twelve fires were dated as occurring in 1708, 1762, 1801, 1828, 1883, 1834, 1849, 1867, 1874, 1884, 1888, and 1898.

In contrast, white, Lutz and Sitka spruce forests on uplands 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 for the past 2,500 years was estimated to be 515 ± 355 (1 SD) years (range 105–1642 years); the mean time-since-fire was estimated at 605 ± 413 years (median 444 years, range 90–1518 years). These estimates are based on a sample size of 112 radiocarbon dates of soil charcoal at 22 sites from Anchor Point to Nikiski (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 ~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 north of Kachemak Bay, there are no spruce forests more than 200 years old, even though some of those forests have not burned for at least 1,500 years. It appears that spruce bark beetle outbreaks recycle these forests much more frequently than does fire (Sherriff et al. 2011). It is rare to find spruce trees more than 300 years old, although these species typically live to be 500 - 600 years in other parts of their range.

In mixed white and black spruce and hardwoods forests, the mean fire return interval for the Paradox Lake area ~10 km north of Sterling was estimated at 130 ± 66 years (1 SD) years with 35 fires separated by intervals of 40 to 270 years occurring during the last 4,600 years since the arrival of black spruce on the landscape. This estimate is based on sedimentary charcoal in a 9m core taken from Paradox Lake (informal name) at a depth of 15.8 m, supplemented with a 70-cm short core of near-surface sediments. The total charcoal fire history record spanned ~13,000 calendar years; mean fire return intervals were longest during the shrub-herb tundra

phase (138 ± 65 yr), decreased after expansion of *Betula kenaica*, *Salix* and *Populus* (77 ± 49 yr) and *Picea glauca* (81 ± 41 yr), and increased again with the arrival of *P. mariana* (130 ± 66 yr)(Anderson et al. 2006).

The presence of almost 1 million 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. On average, 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).

Wildland-Urban Interface

The western and southern boundary of Kenai National Wildlife Refuge is quickly becoming 175 miles of WUI, stretching from the subdivision at Point Possession, past the communities of Nikiski, Kenai-Soldotna, Sterling, Funny River, Kasilof-Clam Gulch, Ninilchik and Anchor Point-Happy Valley, to the cabins in Caribou Hills near the headwaters of Kachemak Bay. Portions of this developing WUI have shared boundaries that both delineate refuge administrative boundaries and Congressionally-designated Wilderness. These areas, in particular, will become increasingly more problematic because of the juxtaposition of lands managed under critical and full fire management options with those that are limited. Additionally, the three wilderness units nested within the administrative boundary of the refuge makes for a strange geometric artifact: there is actually more wilderness boundary (760 km) than refuge administrative boundary (660 km)!

The ecological effects of managing the WUI will almost certainly become more pronounced as lands outside the refuge become developed. Indeed, Dibari and Morton (2006) examined the fire history along the refuge boundary during 1937-2005 and found that a greater area of black spruce and white/Lutz/Sitka spruce burned in the portion of the 2 km buffer inside the refuge than the portion of the 2 km buffer outside the refuge. Additionally, a greater percentage white/Lutz/Sitka spruce burned inside the refuge than would be expected given the percentage of land in that land-cover type, suggesting that increasing parcelization and associated fire suppression outside the refuge may already be creating a discontinuity in vegetation composition on either side of the administrative boundary.

In general, the 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 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; and

- impacts to animal and plant populations due to increased legal and illegal harvest, increased brown bear mortality in defense of life or property (DLP), and increased moose-vehicle collisions.

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 risks 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 2005 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, we 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 (Morton et al. 2006).

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.

Naturalness and BIDEH

Wildfire is a natural landscape process. In forests of the Kenai Peninsula, historical fire return intervals 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. Human-caused ignitions have 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 (Morton et al. 2006):

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); and
4. to mimic (long-term) or restore (short-term) a significantly altered natural fire regime.

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 which conflicts with the primary purposes of Wilderness. Locally, reduced air quality from prescribed fires continues to concern the Alaska Department of Environmental Conservation, the fire management community, 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.

On the other hand, only 28,000 acres have been treated either mechanically or with prescribed fire since the 1960s. This relative lack of success is due in part to lack of access and to the fact that when fire conditions are good for prescribed burns, they are also good for wildfires (and so fire management resources are unavailable). Consequently, we will move away from attempting to use prescribed fire in a landscape context (e.g., enhancing moose habitat), and consider using it for more local-scale issues like reducing WUI in a strategic manner (to create more decision space to allow wildland fire to run), creating vegetative corridors to move wildlife towards highway mitigation structures, or for treating invasive plants (see discussion below).

Invasive Exotic Plants and Fire

Over 110 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 still relatively pristine, Kenai Refuge is one of only two refuges in Alaska on the highway system and hosts more than 300,000 annual visitors. The Peninsula has been the site of commercial oil and gas activities since the early 1960s. With 56 square miles of anthropogenic footprint (the area removed from habitat or ecological productivity by human activities), exotic flora are well established in certain areas of the Refuge. Most locations of the 70+ exotic species that have been documented on the Refuge are associated with roads, trails, seismic lines, utility rights-of-way, oil and gas infrastructure, campgrounds, and cabins. Several of these species are relatively invasive, including scotchbroom (*Cytisus scoparius*), white sweetclover (*Melilotus alba*), bird's vetch (*Viccia cracca*), and reed canary grass (*Phalaris arundinacea*).

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). The concern is that there is a positive feedback between invasive plants and fire: invasive plants can increase and change fire risk, and fire operations can increase the risk of invasive spread, and both are likely to increase along the WUI.

Fire has been demonstrated to contribute to invasive plant population increases in Alaska (Villano and Mulder 2008). Burned areas provide competition-free establishment areas as well as corridors for spread through undisturbed ecosystems (Conn et al. 2003). Increases in air temperature with a warming climate may lengthen the fire season and increase fire probability in Alaska (Randerson et al. 2006). Climate change is also known to increase invasion risk (Bradley et al 2010). Although fire management activities may contribute to spread of invasive populations by creating human and equipment movement vectors, prescribed burning may have positive effects on invasions as a control tool.

Prescribed burning can be used as a tool to control known populations of certain invasive plant species. Invasive control burns must take into account timing, fuel type, fire type, pre-treatments (such as

herbicide application, mastication or thinning), and particular plants targeted (DiTomaso & Johnson 2006). Post-fire native vegetation success in Alaska depends on a variety of conditions, including climate and weather conditions, burn severity, pre-burn vegetation composition, fuel load, and burn season (Boucher 2003).

Late winter and early spring prescribed burns have been most effective in reducing non-native plant populations (Potts & Stephens 2009, Meekins & McCarthy 2001). Species that responded best to prescribed control are those with highest above and belowground mortality, including herbaceous forb species such as garlic mustard (*Alliaria petiolata*). However, most control efforts required post-burn monitoring and may require additional treatments such as herbicide application (DiTomaso & Johnson 2006, Meekins & McCarthy 2001, Nuzzo 1991).

Fire operations as introduction and spread vectors

Invasive plant species populations on the Refuge may increase through fire management activities. Although only four percent of the Refuge contained invasive species in the LTEMP systematic inventory , a focused anthropologically disturbed area invasive inventory revealed that major invasions were located in developed areas (access points, buildings, campgrounds, oil-gas wells, roads, seismic lines, trails, and a transfer station) (Barnett & Simonson 2007). Fire management activities frequently utilize these developed areas to conduct and stage activities and personnel.

Specific Refuge incidences with invasive plant introduction and spread include the 2004 Kings Court Fire. Numerous field crews and aircraft were based in and near the existing campground and parking lots of the upper boat launch on Skilak Lake, as well as in a gravel pit further east along Skilak Lake Road. Following fire operations, new populations of oxeye daisy (*Leucanthemum vulgare*), quackgrass (*Elymus repens*), and tansy ragwort (*Senecio jacobaea*) (previously unrecorded in this region) were observed immediately within the operations area and the gravel pit. Subsequent tracking post-fire revealed a substantial increase in both oxeye daisy and quackgrass along the side access road to the boat launch and along the main road. Another incidence includes the Shanta Creek fire in 2009, on the northern shore of Tustumena Lake. Following fire operations, a half-acre population of orange hawkweed (*Hieracium aurantiacum*) was discovered along a dozer line, though it seemed apparent the infestation existed prior to the fire.

Fires or back fires may create new colonization habitat adjacent to developed sites, including private inholdings, historical cabins, and recreational cabins. While most inventoried non-native species at these sites have a low invasion risk value (Carlson et al. 2008), populations of wind-dispersed species may be undesirable in proximity to sensitive ecological areas such as glacial outwash plains.

Many graminoid species are well adapted to fire (USFS 2012). Species of specific potential concern in post-fire Refuge landscapes include:

meadow foxtail *(Alopecurus pratensis*) - resprouts from rhizomes in low to moderate intensity fires, rapid colonization post-fire

orchardgrass (*Dactylis glomerata*) - resprouts from rhizomes in low to moderate intensity fires, increases or remains stable post-fire

quackgrass (*Elymus repens*) – resprouts from rhizomes in low to moderate intensity fires, can spread quickly by rhizomes in early spring seasonal fires. Late spring fires can reduce populations.

foxtail barley (Hordeum jubatum) – rapid sprouting and dominant colonization post-fire

perennial ryegrass (*Lolium perenne*) - resprouts from rhizomes in low to moderate intensity fires, increases post-fire

timothy (*Phleum pretense*) – resprouts from rhizomes in low to moderate intensity fires, rapid colonization post-fire

reed canarygrass (*Phalaris arundinacea*) - resprouts from rhizomes in low to moderate intensity fires, fire-tolerant seed bank, will rapidly germinate and dominant colonization post-fire

Kentucky bluegrass (*Poa pratensis*) – fire intolerant, prescribed burns may be used for control in early spring. Other *Poa* species respond similarly.

Forb species of potential concern include:

garlic mustard (*Alliaria petiolata*) – fire may kill all above and belowground material; potential to control by prescribed burning.

spotted knapweed (*Centaurea stoebe* spp. *micranthos*) – taproot can survive fire, fire tolerant seeds, colonization post-fire with seed source.

orange hawkweed (*Hieracium aurantiacum*), meadow hawkweed (*H. caespitosum*), tall hawkweed (*H. piloselloides*), and narrowleaf hawkweed (*H. umbellatum*) – rhizomes may survive, rapid colonization with seed source (wind dispersal).

Oxeye daisy (*Leucanthemum vulgare*) – rhizomes survive post-fire, can resprout post-fire, neutral colonization ability post-fire.

toadflax, butter-n-eggs (*Linaria vulgaris*) – deep root system survives fire, ready dispersal and colonization post-burn with seed source.

white sweetclover (yellow sweetclover) (*Melilotus alba* or *M. officinalis*) – second-year plants may survive fire, heat tolerant seeds, germination stimulated by fire. increased colonization post-fire with seed source.

tansy ragwort (*Senecio jacobaea*) – fire kills plants and seeds; prescribed fire may be a control tool.

perennial sowthistle (*Sonchus arvensis*) – cans survive and persist in burned areas, establishment and colonization post-fire with seed source, wind-dispersed seeds.

common tansy (*Tanacetum vulgare*) – rhizomes survive post-fire, resprouting post-fire, seedling colonization with seed source.

Some operational changes that we will consider to reduce the likelihood of spreading invasive plants include:

- Prepare and maintain weed-free helicopter staging areas strategically located around the refuge.
- Spray down heavy equipment in advance of a fire; consider purchasing portable washers (http://s-k-enviro.com/index.htm) for deployment at helo/staging areas.

- Prepare HACCP plans for general fire operations (Hazard Analysis & Critical Control Point Planning).
- BAER funding for post-fire restoration.

Climate Change

Mean annual temperatures on the Kenai Peninsula have warmed several degrees since 1977. Much of this increase is due to warmer winters, with December and January having warmed by an average 9° and 7° F, respectively. Summers began to warm most noticeably with the drought of 1968–69, 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), an almost 60% decline. The following changes on the Kenai landscape appear to be related to an increasingly warmer and dryer climate:

- The Kenai Peninsula was the epicenter of a spruce bark beetle outbreak that lasted over a decade through much of the 1990s and caused high mortality of Sitka, Lutz, and white spruce on four million acres in southcentral Alaska (including 1 million acres on the Kenai Peninsula). 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.

- With warmer summers, more water is transpired from vegetation and evaporated from the soil and water bodies; 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). 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 (Berg et al. 2009). The drying of wetlands and fens 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. 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. 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 (Anderson et al. 2006).

- Many Kenai Peninsula glaciers began retreating in the 1850s, but their retreat has greatly accelerated in recent years. The rapid retreat of the Skilak and Grewingk glaciers, and of the nearby Portage glacier, in the last 20–30 years is especially striking. The Harding Icefield lost an average of 21m in thickness (Adageirsdottir et al. 1998) and 5% in surface area (Rice 1987) in the latter half of the 20th century. Areas exposed by receding glaciers will not be vegetated for many decades. However, the hydrology of glacially-fed streams will likely change as glacial input in the warming summer increases in the near term.

- During the past five decades, tree line in the Kenai Mountains has risen an average of 1m per year (Dial et al. 2007), approximating a 300,000 acre loss of alpine tundra. For example, mountain hemlock normally 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 a ground-hugging *krummholz* to a more normal upright stance, indicating a general moderation of the climate at higher elevations. Increased fire at higher elevations is one likely outcome of this afforestation of alpine tundra.
- Over 1,000 lightning strikes in 2005 on the Kenai Peninsula, an area of Alaska in which lightning ignitions were once considered unusual, suggest that local meteorological conditions may be changing (Morton et al. 2006).

The effects of climate change on vegetation composition have been modeled for the Kenai Peninsula using two different approaches. Rupp and Mann (2002) simulated fire-induced vegetation change using ALFRESCO and refuge biologists have used a climatic envelope approach with RandomForest™. Although very different assumptions underlie these two approaches, both models suggest the following salient outcomes:

1. conversion of softwood to hardwood presumably due to more frequent and hotter fires;
2. rising treeline (primarily mountain hemlock) with concomitant loss of alpine tundra;
3. increasing herbaceous cover (grasslands) particularly south of Caribou Hills (note: parcelization and the resulting deforestation will also increase grasslands along the WUI); and
4. loss of old growth softwood forests (note: Berg suggests consecutive above-average summer temperatures will keep spruce bark beetles sustained metabolically and thereby Sitka, white and Lutz spruce from maturing in the foreseeable future).

In addition, Global Climate Change (CGM) model projections of future boreal forest climates suggest that fire burn area will increase as fire regimes change (Podur & Wotton 2010, Amiro et al. 2006). Altered fire regimes may cause a synergistic increase in invasion potential. Greater fire frequency may create more habitat for invasions, and invasions in turn can contribute to more frequent fires. Although the interaction of climate, fire regime, and invasions is not well understood in Alaska, there are well-documented examples of established invasive plants increasing fire frequency. Cheatgrass (Bromus tectorum) invasions in the western US has resulted in native vegetation loss, less predictable livestock and wildlife forage crops, and higher fire control costs (Epanchin-Neill et al. 2009). Before cheatgrass invasion, shrub-regenerating fire occurred every 60 to 110 years; major fires now occur every three to five years (ELI 2002). Buffelgrass (Pennisetum ciliare) causes higher intensity, lower interval fires that decrease native plant richness (McDonald & McPherson 2011).

Although there is no empirical evidence yet to suggest that the historic mean fire return interval in spruce is changing in response to rapid climate change, it is apparent that the fire regime may be altering in unexpected ways. In the aftermath of spruce bark beetle-induced deforestation, grassland (Calamagrostis canadensis) fires have burned in April on the southern part of the Peninsula in recent years. Lightning caused the 2005 Irish Channel fire that burned 1,100 acres of mountain hemlock

(Morton et al. 2006), an event so rare in this forest type that charcoal evidence of a historic fire regime has not been detected.

Fire Monitoring

Long-term monitoring of fire activity and its effects on vegetation and fuel loads are supported by both plot-based and remote-sensed approaches.

Plot-based monitoring

Kenai NWR has three long-term plot-based data sets for monitoring the effects of wildfire: NPS Fire Monitoring Handbook (FMH) plots, Hakala plots, and the Forest Inventory & Analysis (FIA) plots. The FMH plots were established in areas where prescribed fires were planned and in areas recently burned by wildfires using established National Park Service FMH protocols (USDI National Park Service, 1992) to quantify the effects of fire on vegetation and fuel loading within the study areas. A report (Bowser & Berg, 2005) and protocol (Bowser, 2010) are available for the Kenai NWR FMH plots.

Most of the 68 FMH plots are located within five study areas: Mystery Creek (42 plots), Lily Lake (4 plots), Windy Point Fire (4 plots), Pothole Lake Fire (6 plots), and Hidden Creek Fire (4 plots). The remaining plots were located at East Road (2 plots) and in the vicinity of moose exclosures (6 plots).
Temporal Distribution

The majority of the plots were installed and simultaneously surveyed between 1994 and 1998 (Figure 2). The Mystery Creek plots burned in 2002 and were resurveyed in 2004. After the Windy Point Fire, the Windy Point plots were sampled in 1997, 1999, and 2004.

Fuel loadings and vegetation data collected as listed below:

- mass per unit area (tons/acre) of woody fuels 0 - ¼ in. diameter (1 hr. fuels)
- mass per unit area (tons/acre) of woody fuels ¼ in. - 1 in. diameter (10 hr. fuels)
- mass per unit area (tons/acre) of woody fuels 1 in. - 3 in. diameter (100 hr. fuels)
- mass per unit area (tons/acre) of live woody fuels > 3 in. diameter (1000 hr. fuels)
- mass per unit area (tons/acre) of dead woody fuels > 3 in. diameter (1000 hr. fuels)
- mass per unit area (tons/acre) of litter
- mass per unit area (tons/acre) of duff
- brush density (individuals/m^2) for each shrub species
- herbaceous density (% cover) for each herbaceous species
- herbaceous density (point-intercept density) for each herbaceous species
- seedling tree density (individuals/m^2) for each tree species
- seedling tree heights (categorical) for each tree species
- pole-size tree density (individuals/m^2) for each tree species
- pole-size tree heights (categorical) for each tree species
- pole-size tree diameter at breast height (DBH) (cm) for each tree species

- burn severity of vegetation (categorical)
- burn severity of litter and duff (categorical)

Figure 1. Kenai NWR FMH plot locations.

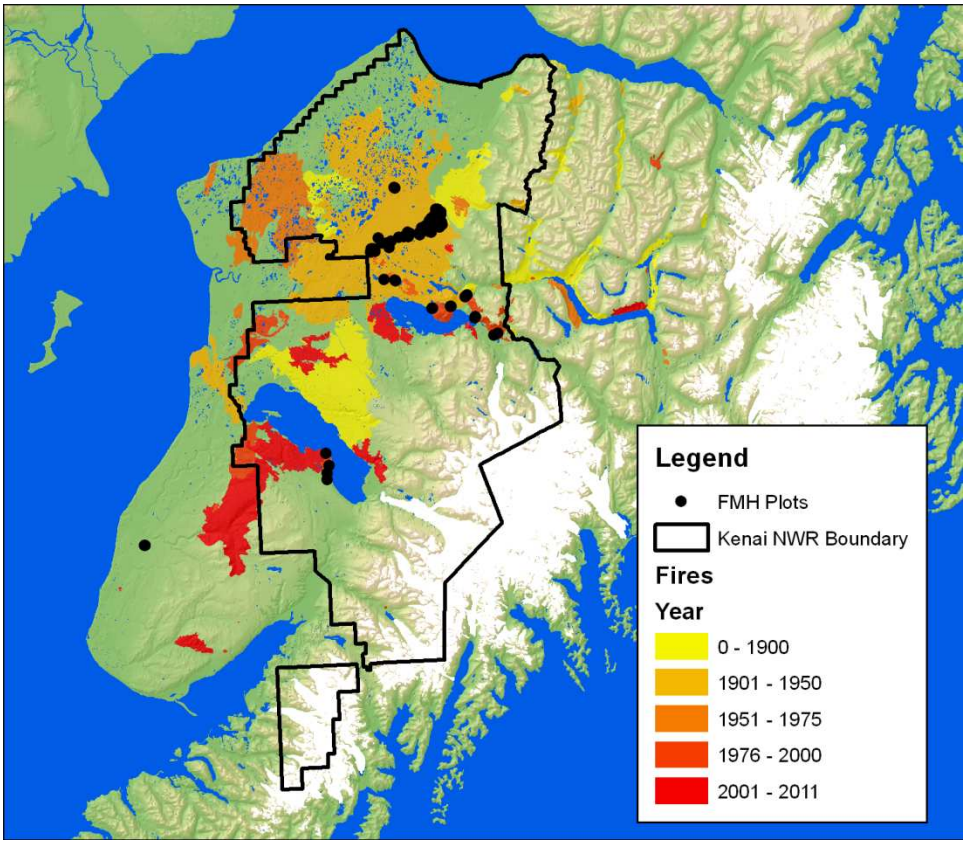
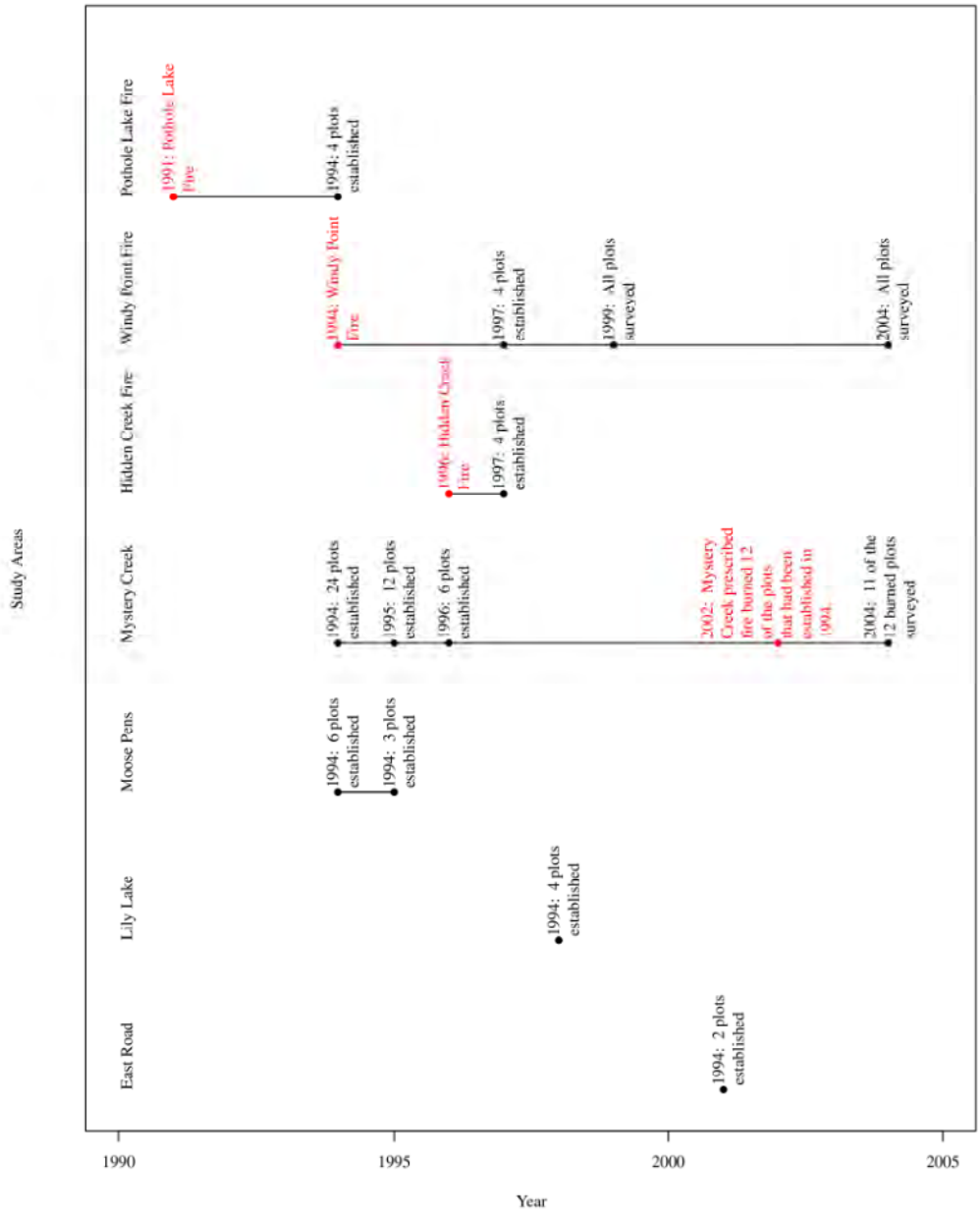


Figure 2. Timeline of establishment and sampling of KNWR FMH plots from Bowser (2010). The Lily Lake plots were established in 1998.

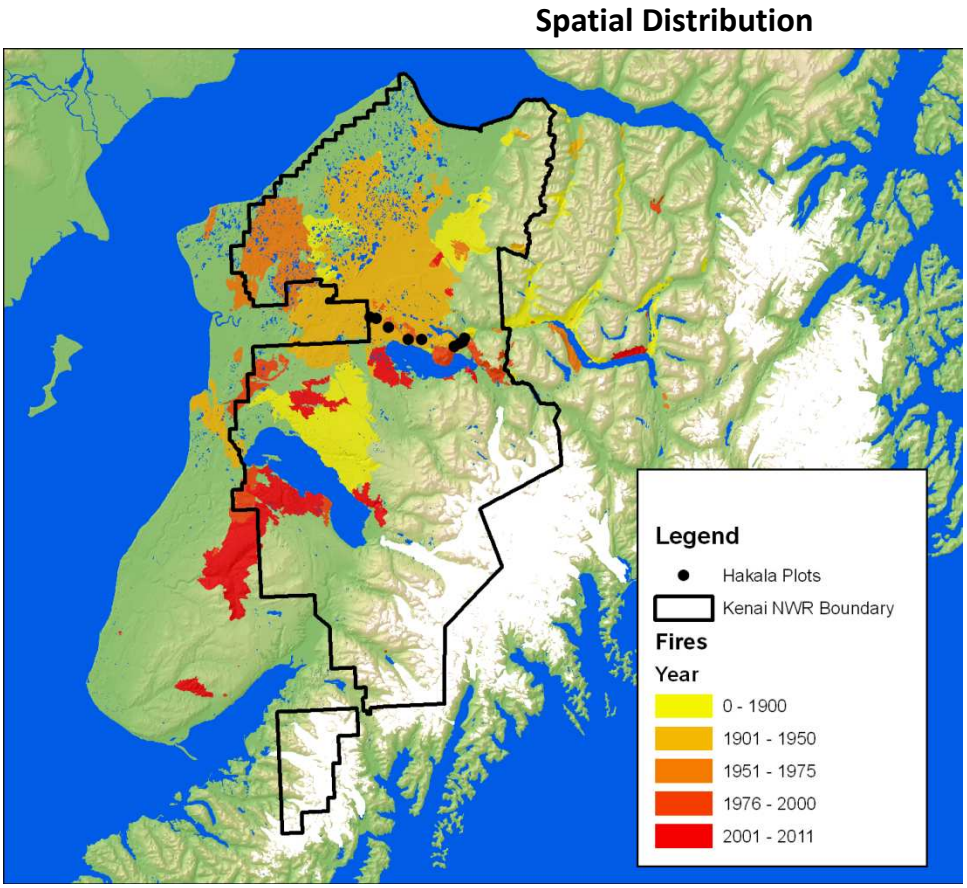


The Hakala plots were established in 1950 within the 1947 burn to monitor the succession of vegetation post-fire. The nine Hakala plots are spread along Skilak Lake Road from its western end to the vicinity of Bear Mountain. The plots were established and surveyed in 1950. They were resurveyed in 1955, 1961, 1965, 1995, 2000, 2005, and 2010. Data collected include the following:

- Basal area of all tree species and larger shrubs (ft^2/acre)
- DBH of trees and tall shrubs (cm)
- Heights of trees and tall shrubs (cm)

- Stem (stems/acre) densities of herbaceous plants and small woody plants (stems/unit area)
- Frequencies of occurrence of all non-tree species
- Cover estimates of ground cover classes (% cover)
- Burn severity (categorical)

Figure 3. Hakala Plot locations.



The FIA plots are monitored by the US Forest Service and are considered part of the Refuge's Long Term Ecological Monitoring Program (LTEMP). Plots were initially established during 1999-2002 and include 215 P2 plots and 21 P3 plots on the refuge; 20% of these plots are resampled on even years every decade. Data collected at the P2 and P3 levels include the following:

P2 plots

Plot/stand level metrics

- Condition class (categorical, related to basal area & stem density)
- Stand age (years)
- Seedling stocking, regeneration, and biomass information for all tree species

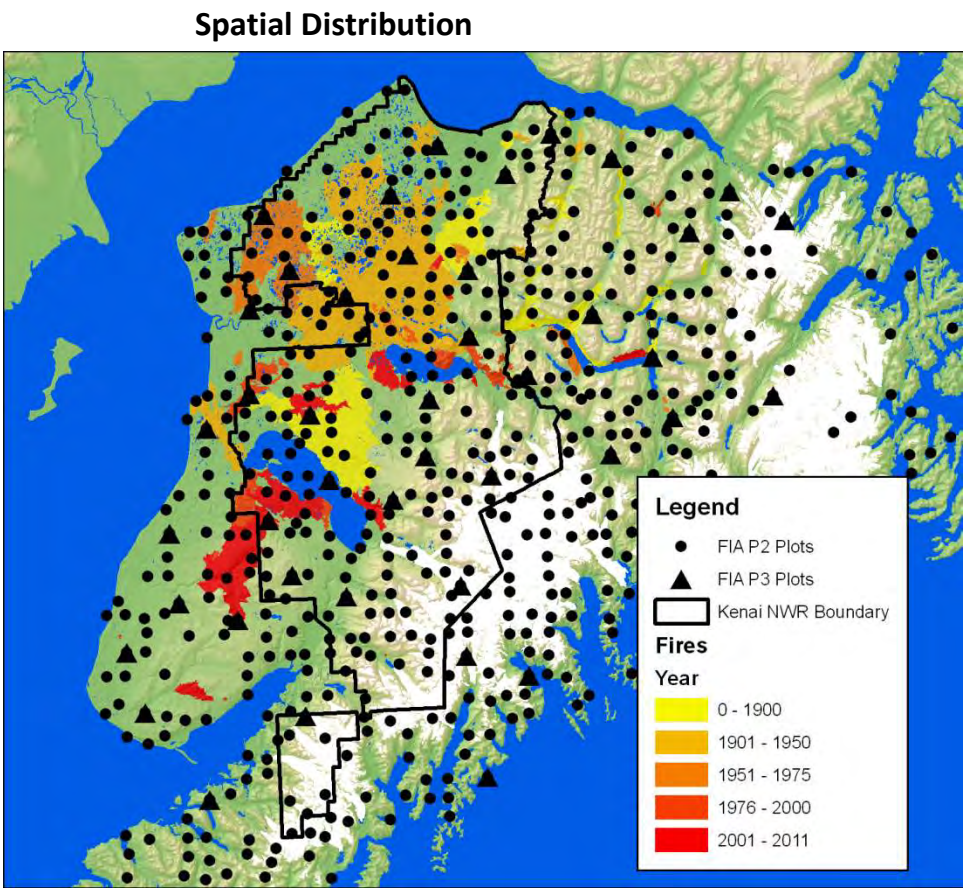
- Seedling condition (categorical)
- Seedling density (seedlings/acre)
- Tree and sapling data for all tree species
- Tree condition (categorical)
- Tree status (categorical)
- Standing dead tree (categorical)
- Tree diameter at breast height (DBH) (in.)
- 10 year growth rate, from core (in.)
- Tree heights (ft.)

P3 plots

Down woody material

Figure 4. Kenai Peninsula FIA plot locations. These are the "fuzzed" coordinates.

Remote sensed



Historic fire perimeters have been reconstructed using natural features (lakes, wetlands, and rivers) and dendrochronology (fire scars, stand-age) from 1708 (De Volder 1999). In Alaska, systematic fire reporting began in the 1940s after the Alaska Fire Control Service was organized (Gabriel and Tande 1983). Fires over 1000 acres from 1940-1987 and fires over 100 acres after 1987 are included in a spatial database hosted by the Alaska Interagency Coordination Center. In 1999, the Moderate Resolution Imaging Spectroradiometer (MODIS) was launched to collect remotely sensed data. MODIS provides daily images used to detect and map the spread of active fires (Justice et al. 2002). Fire perimeters are also documented at field sites using GPS and uploaded into a database at the Alaska Interagency Coordination Center (www.fire.ak.gov). Therefore, the occurrence and extent of future fires on the KENWR will be accurately recorded. The KENWR also maintains a fire history geodatabase for the Kenai Peninsula.

In addition, refuge staff monitor landscape vegetation and land-use with change-detection analysis of classified LANDSAT imagery. The first landcover classification has been completed using 2002 LANDSAT images. Twenty-six land cover classes were identified and mapped across the Kenai Peninsula (O'Brien 2006). Classification and change detection analyses will occur in 10 year intervals as Forest Inventory and Analysis (FIA) data become available for training.

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Appendix B:

Fire Management Units, Management of Wildfires, and Alaska Interagency Wildland Fire Management Plan

Appendix B
Section B.1 Fire Management Units at Kenai NWR

Elements Common to All Four FMUs

There are four Fire Management Units (FMUs) at Kenai NWR — these are shown on Figure B-1. The fire management options are depicted on Figure B-2, and the special values to protect at the Refuge are shown on Figure B-3. Each of the FMUs is described in detail below. Some values to protect and fire management and safety considerations are common to all FMUs and are listed below. Concerns and considerations specific to a particular FMU are described in the individual FMU sections.

Values to Protect Common to All FMUs

- Hunting and recreation, subsistence use (notably in Alaska): large and small game and waterfowl hunting, fishing, camping, canoeing and subsistence uses occur in all FMUs

- Historic and Archeological resources (such as structures and sites) and historic and cultural resources are common throughout the Refuge, especially along major waterways where salmon populations occur. To protect known cultural and historical resources the Refuge keeps the locations of known sites secure. The Refuge provides Resource Advisors to fire protecting agencies or incident management teams as necessary to protect known sites from damage due to fire management activities.

Fire Management Considerations Common to All FMUs

- Hazardous fuels projects and treatments will focus on the highest risk areas. Typically these are adjacent to or included in current CWPP areas where FMUs about Refuge boundaries. Collaborative projects including a mix of Refuge, State, and private lands is the optimal desired project design. Treatment types may range from thinning with power tools, mastication, biomass removal, chemical treatments, and landscape-scale prescribed fire treatments. Habitat treatments should occur where altered fire return intervals are occurring or vegetation manipulation using hazardous fuels treatment techniques are desired. All treatment types will minimize effects on Refuge values while reducing risk from Refuge wildfires spreading into adjacent communities. Minimizing the effects on Refuge values can be achieved by:

  - Avoiding hard edging (straightline) treatment areas (a wandering edge with occasional screening strips is desired).
  - Limiting periods of treatment activity to times of least visitor use.
  - Developing standard treatment prescriptions and monitoring outcomes.

Figure B-1. Fire Management Units, Kenai NWR

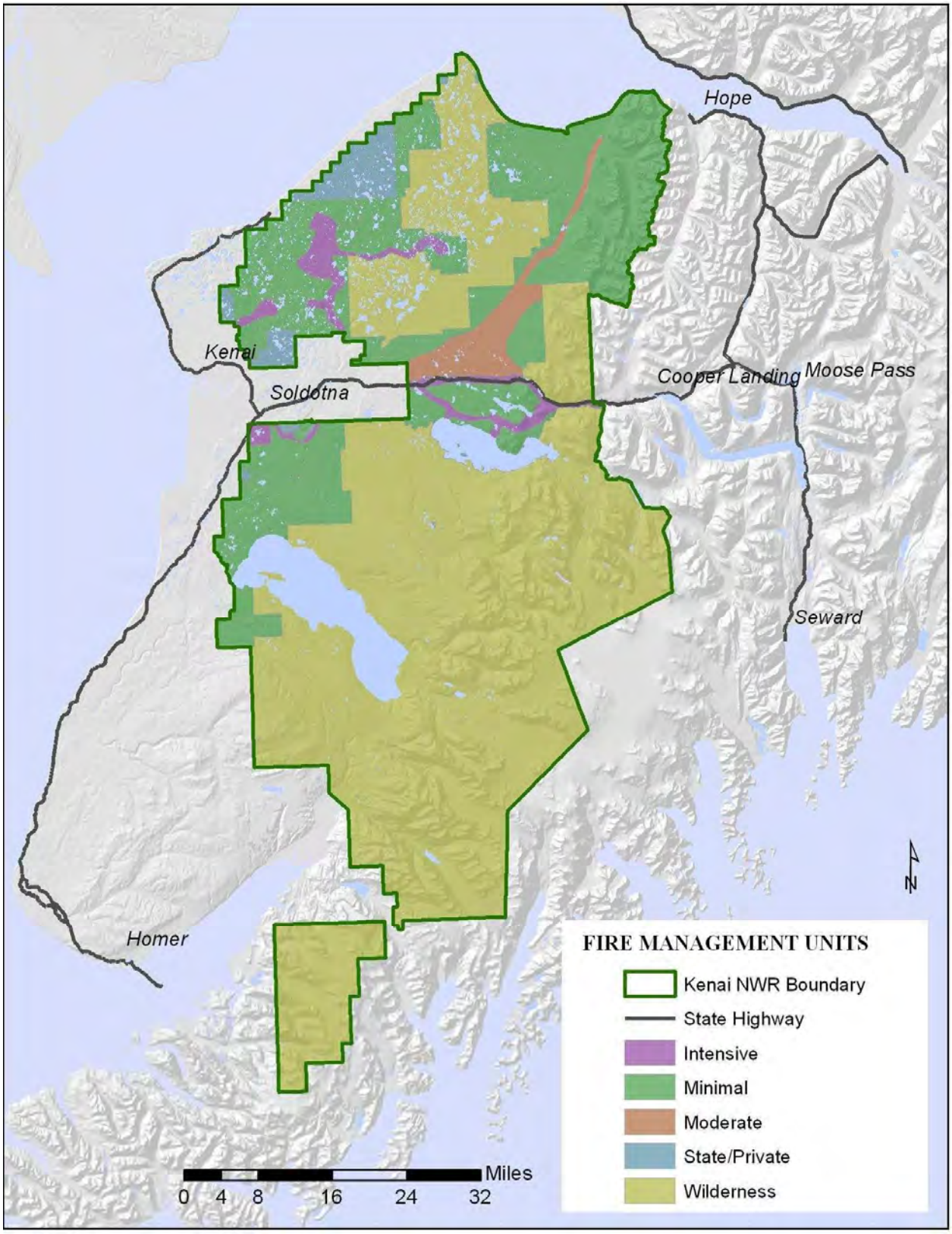


Figure B-2. Fire management options, Kenai NWR

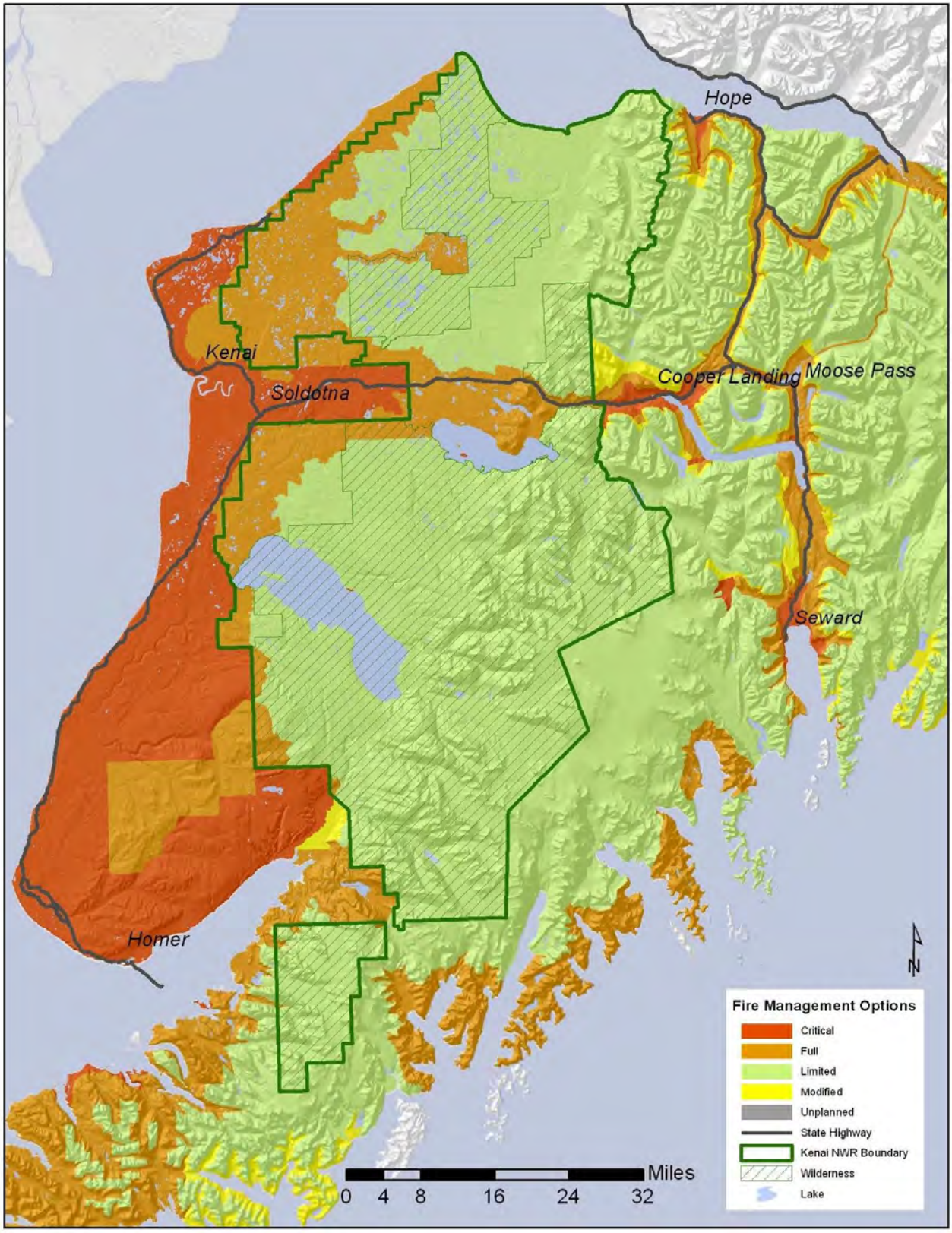
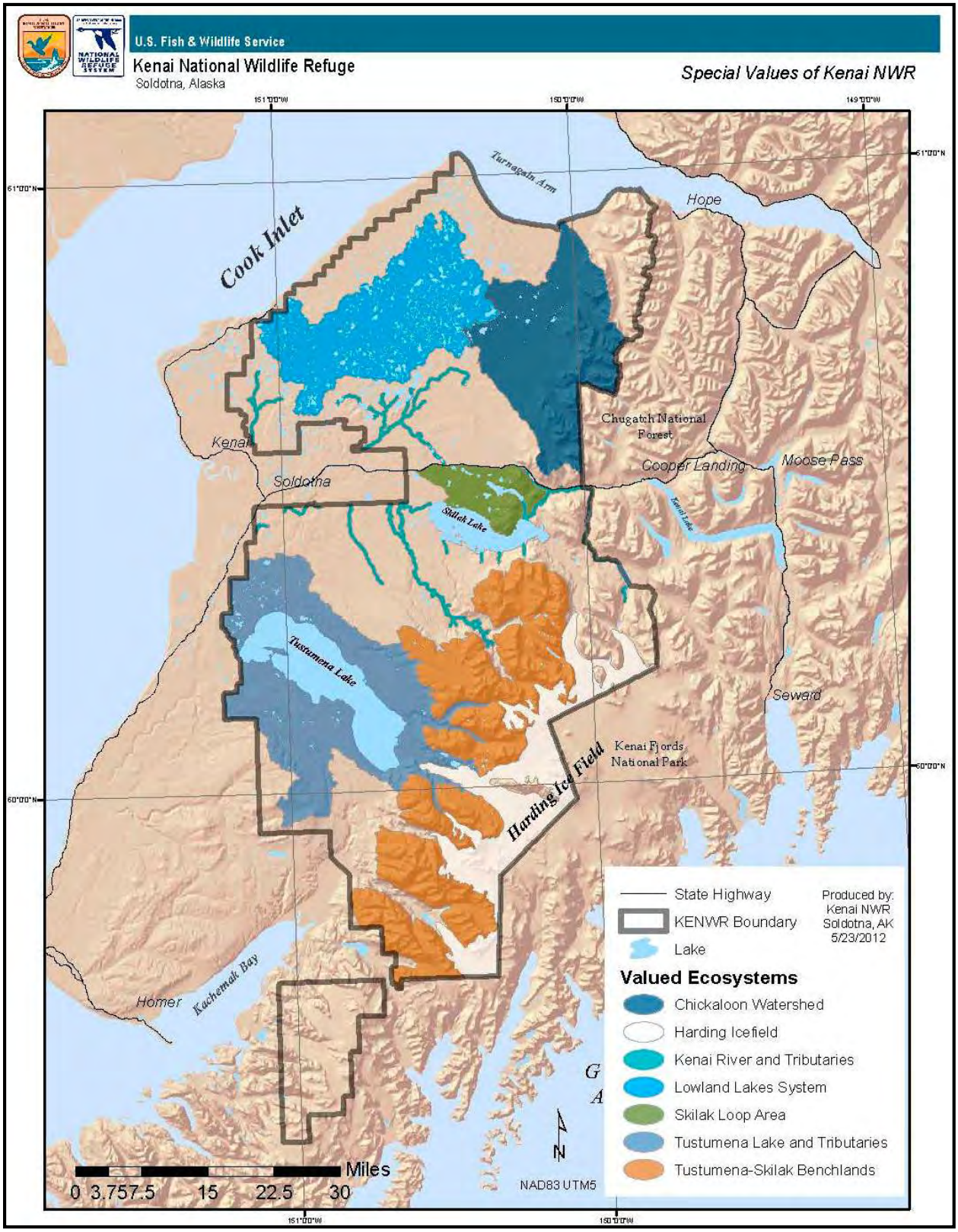


Figure B-3. Special values to protect, Kenai NWR



In addition to informing the Regional Historic Preservation Officer (RHPO) and/or Regional Archaeologist it should be standard procedure to check for the presence of known cultural resources within the unit

- Acreage targets and/or limits by habitats/cover types: There are no specific acreage targets and/or limits by habitats/cover types in any FMU.

- Retardant or foam use restrictions/constraints: The Refuge Manager or designated Agency Administrator must approve retardant or foam use prior to use except in the case of imminent threat to life, safety or loss of homes, facilities, or infrastructure.

- Equipment and aircraft use limitations/application of Minimum Impact Suppression Techniques (MIST):

  – Do not use aerial retardants and foams within 300 feet of waterways or water bodies.

  – Do not allow more than 40 people in a single fire camp in designated Wilderness.

  – Repair ground disturbed by suppression activities to pre-incident condition.

  – The Refuge Manager must approve heavy equipment use (dozers), prior to use.

  – Inform the RHPO / Regional Archeologist of cultural resources or historic properties are discovered during fire operations.

  – Use MIST to the greatest extent possible on all Refuge lands.

- Staff or monitor wildfires during active burning periods until controlled.

- In this FMU, the default management strategy is to monitor wildfires by aircraft (and by ground when needed), until a season-ending event. Management Action Points (MAPs) will be established for incidents with potential to spread to, and impact values to protect and management actions defined and initiated to mitigate fire impacts.

- The FMP and a delegation of authority provide a general strategy to an IC, who has discretion to select and implement appropriate tactics within the limits for the FMU(s), including when and where to use MIST unless otherwise specified.

- Natural recovery is the preferred choice for recovery following wildfires. However, when natural recovery is not likely, Emergency Stabilization (ES) treatments may be needed to prevent further degradation of cultural and natural resources in the burned area. Any seeding will use seeds from natural sources whenever feasible.

Fire Management Guidance Common to All FMUs

- Response to wildfires – preferred strategies and tactics: The default management response to human-caused wildfires is initial attack fire suppression. A human-caused fire that escapes or exceeds the initial attack response will be managed according to an incident management plan prepared by the designated Incident Commander or Incident Management Team, and as documented in the Wildland Fire Decision Support System (WFDSS). The default fire management response to lightning-caused wildfires is to allow them to burn freely until they go out, cross into another FMU with different strategies, or

become a threat to safety or values at risk. Changes in response will be managed according to an incident management plan and documented in WFDSS.

Safety Considerations Common to All FMUs

- Difficulty of movement in marshes/wetlands: marshes, peat bogs, lake and river margins and other riparian/wetland habitats are common throughout the Refuge.

- Entrapment in flashy fuels: *Calamagrostis canadensis* (aka, Canada bluejoint or bluejoint reedgrass) meadows and grasslands are the most common and hazardous flashy fuel type on the Refuge.

- Public evacuation/closures during fire operations: during wildfire or prescribed fire operations, it might be necessary to close affected areas within FMUs and/or evacuate Refuge visitors. During past wildfire incidents, trails, roads or other access points in the Refuge have been temporarily closed in the interest of public safety.

- Smoke impacts on highway safety: smoke from large wildfires or prescribed fires in any FMU could impact local highways, communities and air traffic, depending upon fire location, intensity, wind direction and atmospheric conditions. Smoke management objectives need to be identified in incident management plans and prescribed fire plans and air quality/smoke conditions should be monitored. The Alaska Department of Environmental Conservation is the point of contact for all air quality and smoke-related issues.

- Repeater locations/radio dead spots: The Refuge maintains four radio repeaters, from north to south along the western slope of the Kenai Mountains: the Trapper Joe Repeater on a ridge just east of Trapper Joe Lake; two repeaters on Hideout Hill (the Hideout and Swanson Repeaters), just north of Hidden Lake; and, the Tustumena Repeater on a ridge just south of the southeastern end of Tustumena Lake. All of the repeaters are above the tree-line and powered by batteries with solar panel charging systems. All four provide both narrowband digital and analog radio communications capabilities to the Refuge. The Hideout Repeater is the primary repeater for most Refuge radio communications. The Swanson Repeater is located on the same site to provide redundancy for the Refuge Radio System and an alternate repeater for emergencies. The Tustumena Repeater is the only one located within designated Wilderness (Andrew Simons). Despite this very reliable radio communications infrastructure, there are radio dead spots across the Refuge, especially in deep canyons and depressions or low-lying areas distant from any repeater. There is no Service radio coverage in areas of the Refuge south of Kachemak Bay.

- Unexploded ordnance (UXO): it is possible that unexploded ordnance exists in any FMU, especially discarded small arms ammunition from hunters or UXO left over from previous military exercises and/or seismic exploration activities. While it is also unlikely that UXO would be encountered on any given wildfire or prescribed fire, firefighters and fire managers should always be alert to possible UXO hazards, take steps necessary to control identified hazards and mitigate risks to fire personnel and the public.

- Hazards from poisonous plants, venomous animals, predatory animals, illegal dump sites, and illegal drug operations: while there are no poisonous plants like poison oak or poison ivy on the Refuge, there are poisonous mushrooms and berries that should not be consumed by humans. There are no snakes or other venomous animals but healthy populations of black and brown bear are present throughout the Refuge. Refuge employees are required to carry 12-guage shotguns with rifled slugs, and other bear deterrents like pepper spray and air horns, while working in bear country. Refuge employees receive bear safety training and firearms training and are annually certified to carry the shotgun. Refuge employees often provide bear guard services to visiting firefighters on large wildfire incidents. Occasionally, illegal dump sites are found along the road system, though the Refuge makes every effort to clean up those sites as soon as possible. Illegal drug operations such as marijuana plantations or Meth labs, though not common, are known to occur on the Refuge.

Wilderness FMU

This category applies only to areas designated by Congress as units of the National Wilderness Preservation System; areas proposed for Wilderness designation will be managed under Minimal management, consistent with section 1317(c) of Alaska National Interest Lands Conservation Act (ANILCA) and U.S. Fish and Wildlife Service (Service) policy. Designated Wilderness will be managed under the *Wilderness Act of 1964* and the exceptions provided by ANILCA. Because Wilderness units are part of a nationwide, multi-agency system, the Service recognizes that responsibilities for managing Refuge Wilderness go beyond the mission of the Service and that the purposes of the *Wilderness Act* are within and supplemental to the other purposes for which individual refuges were established.

The history and intent behind the *Wilderness Act* make Wilderness more than just another category of management. Wilderness encourages a broadened perspective of the Refuge landscape, one that extends beyond managing it solely as wildlife habitat. Wilderness is managed as an area “retaining its primeval character and influence.” In addition, Wilderness provides visitors with opportunities for solitude and a primitive and unconfined type of recreation that allows for discovery, self-reliance, and challenge.

Wilderness areas are managed to preserve their experiential, aesthetic, scientific, and other related values. Research has shown that some values of Wilderness extend beyond their boundaries to people who may never visit but who benefit from the protection of natural ecological processes--- benefits such as clean air and water and the simple knowledge that such places exist. In managing Wilderness, managers are encouraged to consider these off-site and symbolic values as well as tangible resource values.

The Wilderness Act provides a special provision allowing measures to be taken “as may be necessary in the control of fire, insects, and diseases, subject to such conditions as the Secretary deems desirable” [Section 4 (d)(1)] Actions such as prescribed fires or invasive species control may be conducted in wilderness in accordance with Service policy at 610 FW 2.23 and 610 FW 2.19, respectively. Prescribed fire and Non-fire applications such as manual thinning may be desirable options for protecting specific resource values by reducing fuel buildups and modifying forest structure to reduce

fire intensities if ignitions do occur. Management activities in Wilderness must be found to be the minimum requirements for the administration of the area as Wilderness.

Wilderness FMU — Description

With the passage of ANILCA in 1980, Congress designated 1.32 million acres or about two-thirds of the Refuge as Kenai Wilderness. There are three separate and distinct units of designated wilderness on the Refuge: the Dave Spencer Wilderness Area (187,228 acres), which includes the Swanson River and Swan Lake National Recreation Canoe Trails; the Mystery Creek Wilderness Area (46,086 acres), in the Mystery Hills area of the Kenai Mountains north of the Sterling Highway; and, the Andrew Simons Wilderness Area (1,087,094 acres), which covers most of the Refuge lands south of the Kenai River (refer to Figure B-1 above.).

The wildfire season in the Wilderness FMU is typically from the snow-free date in early April or May to the onset of fall rains in August or September, though exceptions exist. Fire intensity, fire size and complexity vary with fire weather and fuel conditions. There is no history of prescribed burning in Kenai Wilderness areas as it was not allowed prior to the CCP revision.

Wilderness FMU — Values to Protect

<u>Dave Spencer Wilderness — Values to Protect</u>

- WUI areas designated in Federal Register as Community at Risk (CAR) or designation as Community of Interest (COI) and key descriptors (location, access, etc.): the community of Sterling, Alaska abuts the southern boundary of the Dave Spencer Wilderness.

- Service structures, infrastructure and private lands (in-holdings): the Moose Research Center (MRC). Established in 1966, the MRC is a world-renowned, one-of-a-kind facility that continues to play a role in the understanding of the nutritional, physiological, and ecological aspects of moose. The Dave Spencer Wilderness encloses the 19,250-acre MRC on three sides. The only access to the MRC is via the Swan Lake Road from the west. There are four one-mile-square fenced moose pens and several buildings at the MRC. Two cabins in the compound house two or more State employees and family members, year-round. There is also a Private Inholding just northeast of Dipper Lake, along the northwest shore of Chickaloon Bay. There are no other structures, infrastructure or private in-holdings in the Dave Spencer Wilderness.

- Adjacent landownership, structure types, and land use: the wilderness area boundary abuts an area of State-selected and private lands at its far northwestern corner – between Point Possession and Miller Creek. There are a number of privately owned recreation cabins within a few miles of the Refuge boundary in this area.

- Threatened and Endangered (T&E) or special status species and habitats, critical habitat for other species of concern: while there are no known T&E or special status species and habitats, there are dozens of lakes in the wilderness that are designated as permanent nesting habitats for trumpeter swans.

- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): the CCP identifies three special value areas that partially intersect the Dave Spencer Wilderness: the

Chickaloon Watershed and Estuary, the Kenai River and its Tributaries, and the Lowland Lakes System (Figure B-3). The Lowland Lakes System includes the world-class Swanson River and Swan Lake Canoe Trails. Wilderness values include wilderness character where the earth and its community of life are untrammeled by man, primeval character and influence, natural and unimpaired conditions, and opportunities for solitude or a primitive and unconfined type of recreation.

- Mining, oil and gas wells and utility right-of-ways: while there are no mining, oil and gas wells or utility rights-of-way within the designated wilderness, the Swanson River Oil & Gas facilities are just west of the southern half of the wilderness area.

- Structures lacking defensible space, water supply issues: while there are no developed firefighting water sources at the MRC, there are accessible lakes near the structures.

Mystery Creek Wilderness — Values to Protect

- Adjacent landownership, structure types, and land use: the eastern boundary of the Mystery Creek Wilderness is shared by the Seward Ranger District of the Chugach National Forest. The southern boundary abuts the Sterling Highway right-of-way.

- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): Wilderness values include: wilderness character where the earth and its community of life are untrammeled by man, primeval character and influence, natural and unimpaired conditions, and opportunities for solitude or a primitive and unconfined type of recreation. The Chickaloon Watershed and Estuary is a special value area identified by the CCP that encompasses a large portion of the Mystery Creek Wilderness.

Andrew Simons Wilderness — Values to Protect

- WUI areas designated in Federal Register as Community at Risk (CAR) or designation as Community of Interest (COI) and key descriptors (location, access, etc.): Communities at Risk include Sterling, Alaska and Funny River, Alaska. Both communities are directly north of the northwest corner of the Andrew Simons Wilderness. Along the southern edges of these communities there are dozens of primary residences and businesses within one mile of the wilderness boundary. Sterling is accessed via the Sterling Highway and secondary roads. The only access into Funny River is via the Funny River Road. There is one Community of Interest: the Ninilchik Forties Subdivision, along the western boundary of the wilderness in the Caribou Hills area south of Tustumena Lake and north of Deep Creek. This community is accessed via Oilwell Road out of Ninilchik, Alaska on the Sterling Highway. There are more than 200 structures in this unincorporated community of residences and recreation cabins.

- Service structures, infrastructure and private lands (in-holdings): There are several Refuge Public Use and Administrative Cabins in the Andrew Simons Wilderness, some of which are also historic resources (see below: Historic and Archeological resources): Doroshin Bay, Emma Lake, Nurses, Pipe Creek, Andrew Berg's, Big Bay and Caribou Island. There is also a Refuge Radio System Repeater (the Tustumena Repeater) just south of the

southern end of Tustumena Lake on a point above the tree line. Private lands (in-holdings) in the Wilderness include:

- Romig Family Trust Parcels (1 modern cabin + historical structures) at the northern end of Upper Russian Lake (46.4 acres)
- Alaska Wildland Adventures Lodge and cabins at Cottonwood Creek on Skilak Lake (5 acres)
- Guff Sherman Cabin and other parcels with cabins at Douglas Point on Skilak Lake (5 acres)
- Dolchok Allotment and Cabins at Harvey Lake on the Tustumena Benchlands (100 acres)
- Bear Creek Subdivision Parcels on Tustumena Lake (38 acres)
- Jim Taylor Cabin on Tustumena Lake (4+ acres)
- Blake Cabin (historic) near Indian Creek on Tustumena Lake [T1S, R8W, Sec 2] (5 acres)
- Ptarmigan Head Parcel (no structures) north of Caribou Lake [T2S, R11W, Sec 24 & 25] (11.9 acres)

- Adjacent landownership, structure types, and land use: on its eastern side, the Andrew Simons Wilderness shares common boundaries with the Chugach National Forest – Rifle Ranger District and Kenai Fjords National Park. The western boundary abuts State and Private Lands from Crooked Creek south. The southern satellite unit also known as the Glacier Unit of the Andrew Simons Wilderness is surrounded by National Park lands to the east and State and Private Lands to the north and west.

- Threatened and Endangered (T&E) or special status species and habitats, critical habitat for other species of concern: the Kittlitz's murrelet (a candidate species for listing), likely nests on the southern unit of the Refuge, which is part of the Andrew Simons Wilderness.

- Historic and Archeological resources – structures, sites, etc.: historical cabins around Skilak, Emma, and Tustumena Lakes: Doroshin Bay, Emma Lake, Nurses, Pipe Creek, Andrew Berg, Big Bay and Caribou Island. Archeological resources are known to exist around Skilak and Tustumena Lakes and the Kenai and Kasilof Rivers and major tributaries, especially where salmon runs are present.

- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): Wilderness values include wilderness character where the earth and its community of life are untrammeled by man, primeval character and influence, natural and unimpaired conditions, and opportunities for solitude or a primitive and unconfined type of recreation. Special value areas identified in the CCP that intersect with the Andrew Simons Wilderness include the Skilak Wildlife Recreation Area, the Kenai River and its Tributaries, the Tustumena-Skilak Benchlands, Tustumena Lake and its Watershed, and the Harding Icefield (Figure B-3).

- Structures lacking defensible space, water supply issues: All known structures including private in-holdings have had at least basic defensible space work completed around the structures.

Wilderness FMU — Fire Management Guidance

Firefighter and public safety is always the first priority of fire management. This fire management plan and its activities reflect this commitment. Having provided for safety first, preserving the wilderness character of the three designated Wilderness Areas in the Refuge is the focus of fire management in the Wilderness FMU.

The following fire management guidance applies to all three Wilderness Areas in the Refuge:

- Allowance to manage wildfires to enhance/benefit resources: Naturally ignited wildfires may be managed to maintain/enhance/benefit wilderness resources or wilderness values.

- Actions such as prescribed fires or invasive species control may be conducted in wilderness in accordance with Service policy at 610 FW 2.23 and 610 FW 2.19, respectively. Fire management actions other than emergency response, as well as other administrative activities, must undergo a minimum requirements analysis. This two-step decision process involves determining if an activity should be conducted in the wilderness area and, if so, determining the strategy that would employ the least intrusive tool, equipment, device, force, regulation, or practice required to achieve the management objective.

Wilderness FMU — Safety Considerations

- During wildfire incidents, locating and evacuating Refuge visitors within this FMU could prove especially difficult, due to the remoteness and inaccessibility of the three Wilderness areas.

- Gas lines, power lines, mine shafts: there are no natural gas pipelines, power lines or mine shafts in any of the three Wilderness areas.

Minimal FMU

Minimal management is designed to maintain the natural environment with very little evidence of human-caused change. Habitats should be allowed to change and function through natural processes. Administration will ensure that the resource values and environmental characteristics identified in the CCP are conserved. Public uses, economic activities, and facilities should minimize disturbance to habitats and resources. Ground-disturbing activities are to be avoided whenever possible.

Management actions in this category focus on understanding natural systems and monitoring the health of Refuge resources. Generally, no roads or permanent structures are allowed (except cabins). Temporary structures may be allowed in situations in which removal is planned after the period of authorized use, and the site can be rehabilitated using plants native to the immediate area. Existing cabins may be allowed for administrative, public use, subsistence, or commercial or economic (e.g., guiding) purposes. New subsistence or commercial cabins may be authorized if no reasonable alternatives exist. Public use or administrative cabins may be constructed if necessary for health and safety.

Public use of the Refuge for wildlife-dependent recreation and subsistence activities is encouraged. Public use facilities are not generally provided. Mechanized and motorized equipment may be allowed when the overall impacts are temporary or where its use furthers management goals.

If a transportation or utility system, as defined in section 1102 of ANILCA, is proposed to cross an area in Minimal management, the authorization process would incorporate a corresponding CCP amendment to change the management category in the affected area from Minimal to Moderate or Intensive management, as appropriate.

Compatible economic activities may be allowed where the evidence of those activities does not last past the season of use, except as noted in the preceding discussion of cabins. The primary economic activities are likely to be guiding and outfitting of recreation activities such as hunting, fishing, hiking, river floating, and sightseeing. All economic activities and facilities require authorizations such as special use permits.

Prescribed fire and Non-fire applications such as manual thinning may be desirable options for protecting specific resource values by reducing fuel buildups and modifying forest structure to reduce fire intensities if ignitions do occur.

Minimal FMU — Description

As the second largest of the Refuge FMUs (514,550 acres or 25.9% of the 1.98 million Refuge acres), most of the lands in the Minimal FMU occur north of the Kenai River and are fragmented by lands in the Moderate, Intensive, and Wilderness FMUs (refer to Figure B-1 above). The remainder of the Minimal FMU occurs between the Kenai and Ninilchik rivers and west of the Andrew Simons Wilderness.

Land ownerships adjacent to the Minimal FMU include the Chugach National Forest to the east of the Chickaloon River watershed, and State, Borough, Municipal and Private lands along the western boundaries of the Refuge. Adjacent wildland fire management (Protecting Agency) jurisdictions include the USDA Forest Service and the Alaska Division of Forestry.

Access into the Minimal FMU is better than in Wilderness, but still limited. Road access to Minimal areas or to trails that access Minimal areas includes the Spur Highway, Marathon Road (and associated Beaver Creek Oil and Gas Field roads), the Swanson River Road (and associated Swanson River Oil and Gas Field roads), the Swan Lake Road (and associated Moose Research Center roads), the Mystery Creek Road (and associated pipeline access roads), the Sterling Highway, the Funny River Road and the Tustumena Lake Road. Trail access includes: the Seven Lakes Trail, the Skilak Overlook Trail and several other foot trails within the Skilak Wildlife Recreation Area, the Funny River Horse Trail and the Doc Pollard Trail. Navigable river access is via the Swanson, Kenai and Kasilof Rivers. Aviation access is via floatplane or helicopter.

The wildfire and prescribed fire season in the Minimal FMU is typically from the snow-free date in early April or May to the onset of fall rains in August or September, though exceptions exist. Prescribed fires (especially pile burning) can occur outside of the wildfire season. Fire behavior, fire intensity, fire size and complexity vary with fire weather and fuel conditions, but the threat of wildfires is likely limited to burnable fuels at lower elevations (below 1,000 feet above sea level). Hazardous fuel types or complexes include black spruce types, *Calamagrostis canadensis* grasslands, and areas of beetle-killed

spruce where grasses, forbs and shrubs mix with heavy downed dead fuels to elevate the potential for catastrophic fire behavior, fireline intensity and resistance to control.

Since the Refuge was established in 1943, a number of large fires have impacted portions of what is now the Minimal FMU: the 1947 Skilak Lake Fire (310,000 acres), the 1969 Swanson River Fire (79,000 acres), the 1974 Chickaloon River Fire (3780 acres), two large fires in 1996 – Hidden Creek (5200 acres) and Crooked Creek (11,940 acres), and the 2009 Shanta Creek Fire (13,221 acres). Prior to Refuge establishment, other known large fires in Minimal included one near Point Possession (1915) and another near Slikok Lake (1926).

Minimal FMU — Values to Protect

- WUI areas designated in Federal Register as Community at Risk (CAR) or designation as Community of Interest (COI) and key descriptors (location, access, etc.): From north to south…Gray Cliffs Subdivision (COI) – access via Spur Highway and coastal trail north from Captain Cook State Park; Nikiski (CAR) – access via Spur Highway; Kenai (CAR) – access via Spur Highway and Bridge Access Road/Kalifornsky Beach Road; Sterling (CAR) – access via Sterling Highway; Soldotna (CAR) – access via Sterling Highway, Spur Highway and K-Beach Road; Funny River (CAR) – access via Funny River Road from Sterling Highway; Kasilof (CAR) – access via Sterling Highway; and, Ninilchik Forties Subdivision (COI).

- Service structures, infrastructure and private in-holdings: There are a number of Refuge Public Use Cabins in the Minimal FMU, including cabins at Pincher Creek, Vogel Lake and McLain Lake. Private in-holdings include the Caribou Island Subdivision on Skilak Lake and a small private parcel on the Lower Chickaloon River about 2.5 miles northeast of Lonesome Lake. Refuge infrastructure in the Minimal FMU includes three radio repeaters: one east of Trapper Joe Lake and two on Hideout Hill, north of Hidden Lake.

- Adjacent landownership, structure types, and land use: Minimal FMU areas are adjacent to the Seward Ranger District of the Chugach National Forest, to State, Borough, Municipal and private lands and to ANCSA (22g) parcels owned by the Tyonek and Salamatof Native Village Corporations, along the western boundaries of the Refuge.

- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): areas of the Minimal FMU abut all three Refuge Wilderness areas so the potential impacts of fire management activities upon adjacent Wilderness values should be considered and mitigated as necessary. Special value areas identified in the CCP that intersect areas of the Minimal FMU include the Lowland Lakes System, the Chickaloon Watershed and Estuary, the Skilak Wildlife Recreation Area, the Kenai River and its Tributaries, and Tustumena Lake and its Watershed (Figure B-3).

- Mining, oil and gas wells, and utility right-of-ways: there are no mines, oil wells, gas wells, pipelines, or utility right-of-ways in the Minimal FMU.

Minimal FMU — Fire Management Guidance

Firefighter and public safety is always the first priority of fire management. All fire management plans and activities must reflect this commitment. Other fire management guidance that is specific to the Minimal FMU includes:

- Allowance to manage wildfires to enhance/benefit resources: Naturally ignited wildfires may be managed to maintain/enhance/benefit natural resources or accomplish Refuge management objectives.

- Allowance for hazardous fuels treatments and treatment types: the full range of hazardous fuels treatments and treatment types are allowed, especially in wildland-urban interface or intermix areas.

- In this FMU, prescribed fires will be used in conjunction with herbicide treatments as specified in other refuge plans to help control invasive species and reduce the build-up of hazardous fuels.

Minimal FMU — Safety Considerations

- Gas lines, power lines, mine shafts: there are no power lines or mine shafts in the Minimal FMU, but there are two natural gas pipe lines: the Enstar line from Chickaloon Bay to Sterling crosses a portion of the FMU along the east side of Chickaloon Bay, and the Wolf Lake to Beaver Creek natural gas pipe line.

Moderate FMU

Moderate management is meant to allow compatible management actions, public uses, commercial uses, and facilities that may result in changes to the natural environment that are temporary or permanent but small in scale and that do not disrupt natural processes. The natural landscape is the dominant feature of Moderate management areas, although signs of human actions may be visible.

Management actions in the Moderate management category will focus on maintaining, restoring, or enhancing habitats to maintain healthy populations of plants and animals where natural processes predominate. For example, large biomass removal and prescribed burning may be used to convert mature forests to earlier native seral stages to enhance browse for moose. In general, management facilities, both temporary and permanent, will be allowed for the purposes of gathering data needed to understand and manage resources and natural systems of the Refuge. Structures will be designed to minimize overall visual impact.

Public facilities provided in Moderate management will, while protecting habitats and resources, allow the public to enjoy and use Refuge resources in low numbers over a large area, or they will encourage the short-term enjoyment of the Refuge in focused areas. The emphasis is on small facilities that encourage outdoor experiences. Facilities such as public use cabins, rustic campgrounds, kiosks, viewing platforms, trails, and toilets may be provided. Facilities will be designed to blend with the surrounding environment.

Compatible economic activities may be allowed where impacts to natural processes and habitats are temporary (e.g., small-scale logging where an earlier seral stage meets management goals; facilities in

support of guiding and outfitting services such as tent platforms or cabins that encourage enhanced public use). All economic activities and facilities require authorizations such as special use permits.

Prescribed fire and non-fire applications such as manual thinning and biomass removal may be desirable options for protecting specific resource values by reducing fuel buildups and modifying forest structure to reduce fire intensities if ignitions do occur.

Moderate FMU — Description

The 49,450-acre Moderate FMU is a long, relatively narrow area of the Refuge north of the Sterling Highway and along the western foothills of the Kenai Mountains (Figure B-1). This FMU was established to encompass the Enstar Natural Gas Pipeline and its associated access roads. The Enstar pipeline connects natural gas facilities in Anchorage and Nikiski Alaska and crosses the Refuge between Chickaloon Bay and Sterling AK. Access into the FMU is from the Sterling Highway, Mystery Creek Road, and along the pipeline right-of-way.

Most of the lands in the FMU slope gently to the northwest, with numerous creeks and rivers crossing the unit. Soils in the unit tend to be well-drained except in the lowland bogs at the southern end of the unit, which drain into the Moose River watershed.

The wildfire and prescribed fire season in the Moderate FMU is typically from the snowfree date in early April or May to the onset of fall rains in August or September, though exceptions exist. Prescribed fires (especially prescribed pile burning) can occur outside of the wildfire season (if piles have been covered). Fire behavior, fire intensity, fire size and complexity vary with fire weather and fuel conditions, but the threat of wildfires is increased by wildlife-oriented recreation activities in the fall when the Mystery Creek Road is opened to the public. Lightning also plays a role in the fire regime of this FMU as thunderstorms typically build up along the western foothills of the Kenai Mountains. Hazardous fuel types or complexes include black spruce, *Calamagrostis canadensis* grasslands, and areas of beetle-killed spruce where grasses, forbs and shrubs mix with heavy downed dead fuels to elevate the potential for catastrophic fire behavior, fireline intensity and resistance to control. Two large fires have crossed this FMU since the Refuge was established; those are the 310,000-acre Skilak Lake Fire (1947) and the 3,780-acre Chickaloon River Fire (1974). Over its history, the Refuge has conducted a number of mechanical treatments and prescribed fires along Mystery Creek Road, to reduce hazardous fuels (black spruce) and improve moose browse.

Moderate FMU — Values to Protect

- WUI areas designated in the *Federal Register* as Community at Risk (CAR) or designation as Community of Interest (COI) and key descriptors (location, access, etc.): the only Community at Risk near the Moderate FMU is Sterling at the western end of the unit.

- Service structures, infrastructure and private in-holdings: there is one public use cabin at Trapper Joe Lake and a couple of remote landing strips along the pipeline corridor. There is a single-lane bridge across the Chickaloon River and a couple of primitive wooden bridges across creeks along the Mystery Creek Road and the pipeline access road. The Refuge owns the Kenai NWR Remote Automated Weather Station (RAWS), on the west side of Mystery Creek Road at Mile 6. There are no private in-holdings in the Moderate FMU.

- Adjacent landownership, structure types, and land use: the Moderate FMU is completely surrounded by Refuge lands and other FMUs, except for its extreme western end, where it interfaces with private lands and the community of Sterling AK. There is a subdivision with numerous private residences and a few businesses along Atkins Road near the Refuge boundary.

- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): areas of the Moderate FMU abut the Dave Spencer and Mystery Creek Wilderness areas so the potential impacts of fire management activities upon adjacent Wilderness values should be considered and mitigated as necessary. Two special value areas identified in the CCP that intersect with the Moderate FMU include the Chickaloon Watershed and Estuary and the Skilak Wildlife Recreation Area (Figure B-3).

- Mining, oil and gas wells and utility right-of-ways: there are no mines or oil/gas wells in the Moderate FMU. However, the reason for this FMU's establishment is the Enstar natural gas pipeline and associated access road system (Mystery Creek Road). A high-voltage electric transmission line traverses the southern end of this FMU.

- Structures lacking defensible space, water supply issues: there are no structures lacking defensible space in the FMU. Natural water supplies exist at several locations in the FMU, including Mystery Creek and the Chickaloon River and their tributaries. Accessible lakes are limited along the length of this FMU.

Moderate FMU — Fire Management Guidance

Firefighter and public safety is always the first priority of fire management. All fire management plans and activities must reflect this commitment. Other fire management guidance, specific to the Moderate FMU, includes the following:

- Allowance to manage wildfires to enhance/benefit resources: Naturally ignited wildfires may be managed to maintain/enhance/benefit natural resources or accomplish Refuge management objectives.

- Allowance for hazardous fuels treatments and treatment types: the full range of hazardous fuels treatments and treatment types are allowed, especially in wildland-urban interface or intermix areas.

- In this FMU, prescribed fires will be used in conjunction with herbicide treatments as specified in other refuge plans to help control invasive species and reduce the build-up of hazardous fuels.

Moderate FMU — Safety Considerations

- Normally, the Mystery Creek Road and pipeline access roads are closed to motor vehicles – except during moose hunting season. The Refuge usually closes the road when winter weather makes the road impassable. But when the road is open, this FMU is a very popular destination for recreationists. A late season fire in or adjacent to this FMU could result in evacuations and closure of the area.

- Gas lines, power lines, mine shafts: there are no power lines or mineshafts in the Moderate FMU, but there is one natural gas pipeline - the Enstar line between Chickaloon Bay and Sterling. The Enstar pipeline and its access roads are the reason this FMU exists. If/when the pipeline and its access roads are removed and the right-of-way is reclaimed, the Moderate FMU is slated to be reclassified as Minimal.). A high-voltage electric transmission line traverses the southern end of this FMU.

Intensive FMU

This category is designed to allow compatible management actions, public facilities, and economic activities that may result in alterations to the natural environment. In Intensive management areas, the presence of human intervention may be very apparent. Roads, buildings, and other structures are likely to be seen. Intensive management is applied to the smallest area reasonable to accommodate the intended uses. When Intensive management is proposed for an area, the specific purposes for its establishment will be described.

Natural processes or habitats may be modified through human intervention. Habitats may be highly modified to enhance conditions for one or more animal species. For example, water regimes may be artificially controlled to improve habitat for waterfowl.

High levels of public use may be accommodated and encouraged through modifications to the natural environment such as paving, buildings, developed campgrounds, and other facilities that could alter the natural environment in specific areas. Public facilities are designed to provide a safe and enjoyable experience of the natural environment and an increased understanding of Refuge resources for a wide range of visitors. Facilities may accommodate a large number of visitors while protecting refuge resources from damage through overuse.

Compatible economic uses of Refuge resources that result in alterations to the natural environment may be authorized in Intensive management areas. All economic uses are subject to the compatibility standard, must contribute to the purposes of the Refuge, and require official authorizations such as special use permits.

Intensive FMU — Description

There are five distinct, road-accessible administrative units or areas within the 54,500-acre Intensive FMU:

- Swanson River Road/Swan Lake Road (includes the Swanson River Oil and Gas Unit and the Moose Research Center)
- Marathon Road (Beaver Creek Oil and Gas Unit)
- Sterling Highway/Skilak Loop Road (Skilak Wildlife Recreation Area)
- Funny River Road
- Kenai National Wildlife Refuge Headquarters

Each of the areas encompasses one or more primary and secondary roads and all of the intensive management activities associated with access into areas of the Refuge. Wildfires within these areas are almost always aggressively suppressed to protect lives and other values at risk. Intensive hazardous fuels management activities are planned and implemented in this FMU, especially near wildland-urban interface and intermix areas.

The wildfire and prescribed fire season in the Intensive FMU is typically from the snow-free date in early April or May to the onset of fall rains in August or September, though exceptions exist. Prescribed fires (especially slash pile burns) can occur outside of the wildfire season (if piles have been covered). Fire behavior, fire intensity, fire size and complexity vary with fire weather and fuel conditions, but the threat of wildfires is increased by intense uses and human activities. Hazardous fuel types or complexes include black spruce types, *Calamagrostis canadensis* grasslands, and areas of beetle-killed spruce where grasses, forbs and shrubs mix with heavy downed dead fuels to elevate the potential for catastrophic fire behavior, fireline intensity and resistance to control. Large fires including the Skilak Lake Fire in 1947, the Swanson River Fire in 1969, and the Hidden Creek Fire in 1996 have historically impacted portions of this FMU.

Intensive FMU — Values to Protect

- WUI areas designated in the Federal Register as Community at Risk (CAR) or designation as Community of Interest (COI) and key descriptors (location, access, etc.): Communities at Risk adjacent to areas of the Intensive FMU include Kenai AK, Soldotna AK, Sterling AK and Funny River AK. Each of the five Intensive FMU areas involves a primary or secondary road that provides access/egress for Alaska residents, visitors and Refuge employees.

- Service structures, infrastructure and private in-holdings: there are many Service structures and infrastructure within the five areas of the Intensive FMU, including: the Moose Research Center, the Rainbow Lake and Dolly Varden Campgrounds, and the Dolly Varden Public Use Cabin (Swanson River Road/Swan Lake Road area); the Watson Lake, Kelly-Peterson Lakes, Hidden Lake, Upper Skilak, Lower Ohmer Lake, Engineer Lake and Lower Skilak Campgrounds, the Visitor Contact Station (VCS), the Skilak Guard Station, the Skilak GS RAWS (a State-owned weather station on Refuge lands near the Guard Station), the Swanson RAWS in the Swanson River Oil and Gas Unit, and Public Use Cabins at Upper Ohmer Lake and Engineer Lake (Sterling Highway/Skilak Loop Road area); and the Refuge Headquarters Compound with all of its buildings, vehicles and equipment. There are no private in-holdings within the areas of the Intensive FMU.

- Adjacent landownership, structure types, and land use: each of the five Intensive FMU areas abuts State, municipal and/or private lands with homes, businesses and public buildings.

- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): areas of the Intensive FMU abut all three Refuge Wilderness areas so potential impacts of fire management activities upon adjacent Wilderness values should be considered and mitigated as necessary. Special value areas identified in the CCP that intersect with areas in the

Intensive FMU include the Lowland Lakes System, the Skilak Wildlife Recreation Area, and the Kenai River and its Tributaries (Figure B-3).

- Mining, oil and gas wells and utility right-of-ways: there are no active or historic mining areas within the Intensive FMU, though gravel pits exist at several locations. The Swanson River and Beaver Creek Oil and Gas Units have changed ownership over their history on the Refuge, but both remain active with significant infrastructure and new oil and gas exploration and construction activities. Power lines, oil and natural gas pipelines and communications towers exist throughout the FMU.

Intensive FMU — Fire Management Guidance

Firefighter and public safety is always the first priority of fire management. All fire management plans and activities must reflect this commitment. Other fire management guidance specific to the Intensive FMU includes:

- Allowance to manage wildfires to enhance/benefit resources: while it is possible to manage naturally ignited wildfires to maintain/enhance/benefit natural resources or accomplish Refuge management objectives, the default fire management response within the Intensive FMU is full suppression. Use of wildfire to benefit resource values should only be allowed when life safety, infrastructure and other values can be protected.

- Allowance for hazardous fuels treatments and treatment types: the full range of hazardous fuels treatments and treatment types are allowed, especially in wildland-urban interface or intermix areas.

Intensive FMU — Safety Considerations

- Gas lines, power lines, and mine shafts: there are miles of natural gas and oil pipe lines and power lines within the Swanson River and Beaver Creek Oil/Natural Gas Fields, and there are power lines along the Sterling Highway and Funny River Road, and in the Refuge Headquarters administrative area. There are no mine shafts in the Intensive FMU.

Appendix B
Section B.2 Management of Wildfires

Guidelines for determining a standard wildland fire response are provided in the Alaska Interagency Wildland Fire Management Plan (AIWFMP). That plan provides for a range of fire management responses to wildland fires that protect human life and property and other identified resources and developments, balance fire response costs with values at risk, and are in agreement with Refuge resource management objectives. Initial actions on fires are usually pre-planned per the designated "wildland fire management option" described in the AIWFMP.

Evaluation and selection of a response to a wildfire will include consideration of risks to public and firefighter safety, threats to the assets or values to be protected, costs of various mitigation strategies and tactics, and potential resource benefits.

Protection responses will range from aggressive initial attack to surveillance/monitoring to indirect containment or any combination of the former. The level of suppression action will depend upon the fire management option pre-identified for the FMU, available resources, time of year, fuel type and conditions, cost, terrain and other factors related to the management of a fire.

Managers will use the WFDSS to guide and document wildfire management decisions. The Jurisdictional and Protecting Agencies will work together to develop strategic options to manage a fire, when the fire (1) escapes initial attack, (2) threatens to escape from a Limited fire management option area into a higher management option area, (3) warrants suppression actions but did not receive action due to resource shortages, (4) is beyond the capabilities of initial attack forces, or (5) fire and /or resource management objectives are not being met and a significant change in strategy/action is required.

The FMP and a written delegation of authority can provide a general strategy to an Incident Commander, who has discretion to select and implement appropriate tactics within the limits described for the FMU involved. All resources, including mutual aid resources, will report to the IC (in person or by radio) and receive an assignment prior to tactical deployment.

The default management response to a wildfire occurring in Limited fire management option areas is to place the fire in Surveillance and Monitoring status: AIWFMP protocols will be followed. Within the Limited fire management option areas of the Refuge, a detected ignition will initiate a monitoring response unless the Refuge Manager specifies otherwise. Ignitions within all other fire management option areas (Modified, Full, and Critical) will trigger a protection response as outlined in the AIWFMP. Non-standard responses (management responses other than the designated, pre-planned fire management option response) to wildland fires are also available to the Refuge Manager.

The AIWFMP Fire Management Options occur within each Refuge FMU (refer to Figures B-1 and B-2 above). The options delineate the default fire management (protection) responses. The selection of the appropriate fire management option and its respective response actions, for any given area of the Refuge, is based upon the values at risk, management objectives, and the management strategies selected

for various vegetation communities within the Refuge. Variables (such as time of season, fuel type, fuel loading, fuel moisture, weather and topography) are used to inform the decision-making process on wildfire incidents. However, the predetermined management direction for each FMU will be based on the threat to life, property, and resources of value.

In accordance with CCP direction, wilderness areas in the Refuge are generally designated with the Limited Fire Management Option, although there are exceptions. Where WUI or intermix areas abut Wilderness, a Full Fire Management Option buffer exists between Critical and Limited areas.

Evaluation and selection of a management response to a wildfire will include consideration of risks to public and firefighter safety, threats to the values at risk, costs of various mitigation strategies and tactics, and potential wildfire benefits.

Wildfires will be staffed or monitored during active burning periods as needed to ensure that appropriate mitigation actions are taken to protect threatened values.

Structural fire protection is the responsibility of local governments. Federal agencies may assist with exterior structural protection activities under formal fire protection agreements that specify the mutual responsibilities of the partners, including funding.

All lands within the Kenai NWR are designated by one of the Fire Management Options described below.

Critical Fire Management Option

Description

There are a total of 1,192 acres of land designated as Critical Fire Management Option areas within the Refuge boundaries. Critical areas are found inside or immediately adjacent to all four of the FMUs. These management option areas cover or border sections of land with a high intensity of public uses, management activities and/or communities. Substantial vegetation manipulation is allowed, including prescribed fire and mechanical treatment.

The acres in this fire management option are designated private lands with structures (potentially inhabited) within the Refuge boundaries. A variety of vegetation types and age classes are represented. Age classes vary from early growth (0-20 years) to intermediate growth (41-70 years).

Values to protect

The objective of the Critical Fire Management Option is to protect life and property by prioritizing Protecting Agency suppression actions for wildfires threatening human life, inhabited private property, and designated structures. Firefighter safety is always the first priority and wildfire incidents in Critical receive the highest priority in terms of suppression resource assignments.

Default Management Response

Fires occurring in or immediately threatening lands in Critical will receive the highest priority for protection by immediate and continuing aggressive actions dependent upon the availability of suppression resources.

An Initial Attack response by the Protecting Agency and its cooperators and/or closest Refuge fire-qualified personnel will occur as soon as possible. The Refuge Fire Management Officer (FMO) and Agency Administrator receive immediate notification from the Protecting Agency, upon fire detection. After the initial response, the Refuge and the Protecting Agency may select a response, ranging from full suppression to monitoring fire behavior, depending upon the values at risk and other considerations. These decisions are documented using the interagency WFDSS.

Full Fire Management Option

Description

The Full Fire Management Option covers the second largest area in the Refuge: 363,141 acres. The Full option is found in all four of the FMUs and it typically encompasses development, infrastructure or other areas with high natural resource value. The vegetation is mixed and age classes include areas of wetland, early, intermediate, mature (71-200 years), and sections of old growth (201+ years).

Values to protect

The Full option has high value natural resources, cultural, and historical sites. The protection of uninhabited structures, private property, and valuable natural resources, is addressed in this option. The Skilak Loop Wildlife Recreation Area, the Moose Research Center, the Swanson River Oil & Gas Unit, the Beaver Creek Oil & Gas Unit, and WUI and intermix areas around Peninsula communities are designated Full on the Refuge. Lands and structures in Full receive the second highest priority in terms of suppression resource assignments.

Default Management Response

Wildfires in Full should receive aggressive initial attack to minimize the acres burned. Initial attack suppression response by the Protecting Agency and its cooperators and/or closest Refuge fire-qualified personnel will occur as soon as possible. The Refuge FMO and Agency Administrator should receive immediate notification from the Protecting Agency upon fire detection. After the initial response, the Refuge and Protecting Agency may select a response ranging from full suppression to monitoring fire behavior, depending on the values at risk and other considerations. These decisions are documented using the interagency WFDSS.

Modified Fire Management Option

Description

The Modified Option currently covers the least acreage of all the fire management options on the Refuge — 11.9 acres. These acres are managed the same as the acres in the Full Option until the area converts to Limited after the *conversion date* (the first conversion date is July 10, annually). Before the conversion date, the Protecting Agency and Jurisdictional Agencies jointly decide if the situation warrants conversion from Full to Limited. If the decision is to remain in Full, a later date will be selected to re-assess the situation and decide for or against conversion. Once a Modified area is converted to Limited, it remains in Limited until the end of the fire season. The vegetation is mixed in this unit and age classes are early (0-20 years) and intermediate (21-40 years).

Values to Protect

The only Modified Fire Management Option area on the Refuge encompasses a parcel of land in the southwestern corner of the Andrew Simons Wilderness, in the Caribou Hills area, just north of Caribou Lake. It is known as the Ptarmigan Head In-holding by Refuge staff. Officially, it is designated as Patent #4722 at T2S, R11W, in Sections 24 and 25, Seward Meridian. There are no structures or other values at risk on the parcel. There is no road or trail access to this site. It can be accessed by snow machine in the winter.

Default Management Response

Fires in Modified Option areas receive an initial attack response depending on available resources, unless the Agency Administrator chooses otherwise and documents the decision through the WFDSS process. The Refuge FMO and Agency Administrator should receive immediate notification from the Protecting Agency, upon fire detection. After the initial response, the Refuge and the Protecting Agency may select a response ranging from full suppression to monitoring fire behavior, depending on the values at risk and other considerations. These decisions are documented using the interagency WFDSS.

Limited Fire Management Option

Description

The Limited Fire Management Option is the selected fire management option on about 82 percent (1,622,583 acres) of the Refuge, and 1,281,494 acres of designated Wilderness are in Limited. The Limited Option is found in all of the FMUs except Intensive. The vegetation is mixed, and all age classes are represented in this fire management option area.

Values to Protect

While natural resource values (such as wildlife, habitat, air quality, and water quality) and wilderness values exist in Limited areas of the Refuge, the presence of natural fires in these areas is deemed desirable in order to maintain natural conditions and ecological processes. Where Limited Option areas abut Modified, Full and Critical Option Areas, consideration must be given to the values at risk from wildfire in those areas, when making fire management decisions.

Default Management Response

The default fire management response for fires in Limited, which involves surveillance and monitoring, allowing natural fires to burn within predetermined areas. If this is not possible, a suppression response by the Protecting Agency or closest Refuge fire qualified personnel is initiated as soon as is feasible. The Refuge FMO and Agency Administrator should receive immediate notification from the Protecting Agency, upon fire detection. After the initial response, the Refuge and the Protecting Agency may select a response ranging from full suppression to monitoring fire behavior, depending upon the values at risk and other considerations. These decisions are documented using the interagency WFDSS.

An annual review of fire management options should be completed between September 30 and March 1. All fire management option changes will be coordinated with the Protecting Agency and recorded in the AIWFMP Map Atlas (maintained by the Protecting Agency) by April 1. Fire management option boundary changes are not encouraged during the fire season. However, if a change of the selected

management option is requested and can be accommodated by all affected land manager/owners and by the Protecting Agency, it may be accepted and documented in the Map Atlas.

Each year prior to the active fire season, the Refuge FMO will discuss fire management strategies for the upcoming fire season, with the Refuge Manager, the Deputy Refuge Manager and the Protecting Agency FMO.

The Refuge will adhere to regional and national preparedness levels. A Refuge Preparedness Plan, which would be prepared in collaboration with the Protecting Agency and based upon local fire danger, will be attached to the FMP. It will be updated periodically as historic weather data is accumulated and contact information changes.

Appendix B
Section B.3 Alaska Interagency Wildland Fire Management Plan

The 2010 Alaska Interagency Wildland Fire Management Plan (AIWFMP) provides for a range of suppression responses to wildfire that protects human life and property and other identified resources and developments, balances suppression costs with values at risk and is in agreement with Refuge resource management objectives. The result is that developed areas and other high resource value areas are protected and the natural occurrence of fire in the ecosystem is maintained in remote areas with minimal cost-effective intervention. Currently many special areas of concern (such as archaeological/cultural/ historic sites and administrative sites/cabins) have been identified and are protected through the selection/designation of the appropriate fire management option — one that provides for the suppression response necessary to protect the resource(s) at risk. As new values at risk are identified, the jurisdictional agency selects the appropriate fire management option, notifies the protection agency and provides the location and fire management option information to AFS.

Four wildland fire management options are established in the AIWFMP.

- ***Critical*** is the highest priority area/sites for suppression actions and assignment of available firefighting resources.
- ***Full*** is the second highest priority area/sites for suppression actions and assignment of available firefighting resources.
- ***Modified*** is a high priority for surveillance, suppression, and site protection during the peak of the fire season and less priority (often surveillance only) after a designated conversion date in the latter stages of the fire season, normally after July 10.
- ***Limited*** requires only a surveillance response as long as fires within this designation do not threaten to escape into higher priority areas; if a threat is ascertained, a suppression response may be initiated.

The **Critical** fire management option was specifically created to give the highest priority to suppression action on wildland fires that threaten human life, inhabited property, designated physical developments and to structural resources designated as National Historic Landmarks. Fires that threaten a critical site have priority over all other wildland fires. These areas are the priority for detection coverage. The initial response to wildland fire is to provide protection to the area/sites. Use of wildland fire would only be appropriate in extraordinary circumstances

The **Full** fire management option was established for the protection of cultural and paleontological sites, developed recreational facilities, physical developments, administrative sites and cabins, uninhabited structures, high-value natural resources, and other high-value areas that do not involve the protection of human life and inhabited property. Structures on or eligible for inclusion on the National

Register of Historic Places and non-structural sites on the National Register are placed in this category. Fires occurring within or immediately threatening this designation will be high priority for initial action depending on the availability of firefighting resources but are less priority than wildland fires within or threatening a Critical Management Option area. The intent is to control wildland fires at the smallest acreage reasonably possible.

The **Modified** fire management option is intended to be the most adaptable option available to land managers. Unlike the Full management option, the intent is not to minimize burned acres but to balance acres burned with suppression costs and to accomplish land and resource management objectives. After the conversion date (usually around July 10), the default action for all fires occurring within this option will be surveillance and assessment to ensure that identified values are protected and that adjacent higher priority management areas are not compromised.

In the **Limited** fire management option fire may be allowed to function in its ecological role while providing for the protection of human life and site-specific values. Most natural ignitions will be managed for the purpose of maintaining fire's natural role in the ecosystem. Low impact or indirect suppression methods will be used whenever possible, if suppression action is needed. The intent is to reduce overall suppression costs through minimum resource commitment without compromising firefighter safety.

Through the AIWFMP, the Jurisdictional land manager authorizes the Protecting Agency to provide an increased or decreased level of suppression action for a given wildfire, depending upon the situation (non-standard response). Additionally, the selected fire management option area should be re-evaluated during the next annual review period. The AWFCG may approve departures from the selected management options during periods of "unusual fire conditions" for a specific geographic area(s). These decisions will be based not only on fires and acres burning, but also on anticipated fire behavior and acreage likely to be burned, existing and anticipated smoke problems, probability of success, the experience and judgment of Service and Protecting Agency personnel, and decisions of the Multi-agency Coordinating Group (MAC Group).

The AIWFMP fire management objectives were developed to meet and support agencies' goals and to provide implementation guidance for fire operations. The objectives are:

- Protect human life.
- Prioritize areas for protection actions and allocation of available firefighting resources without compromising firefighter safety.
- Use a full range of fire management activities (fire suppression, monitoring, prescribed fire, thinning and other vegetation treatment projects, prevention and education programs, scientific studies, etc.) to achieve ecosystem sustainability including its interrelated ecological, economic, and social components.
- Use wildland fire to protect, maintain, and enhance natural and cultural resources and, as nearly as possible, enable fire to function in its ecological role and maintain the natural fire regime.

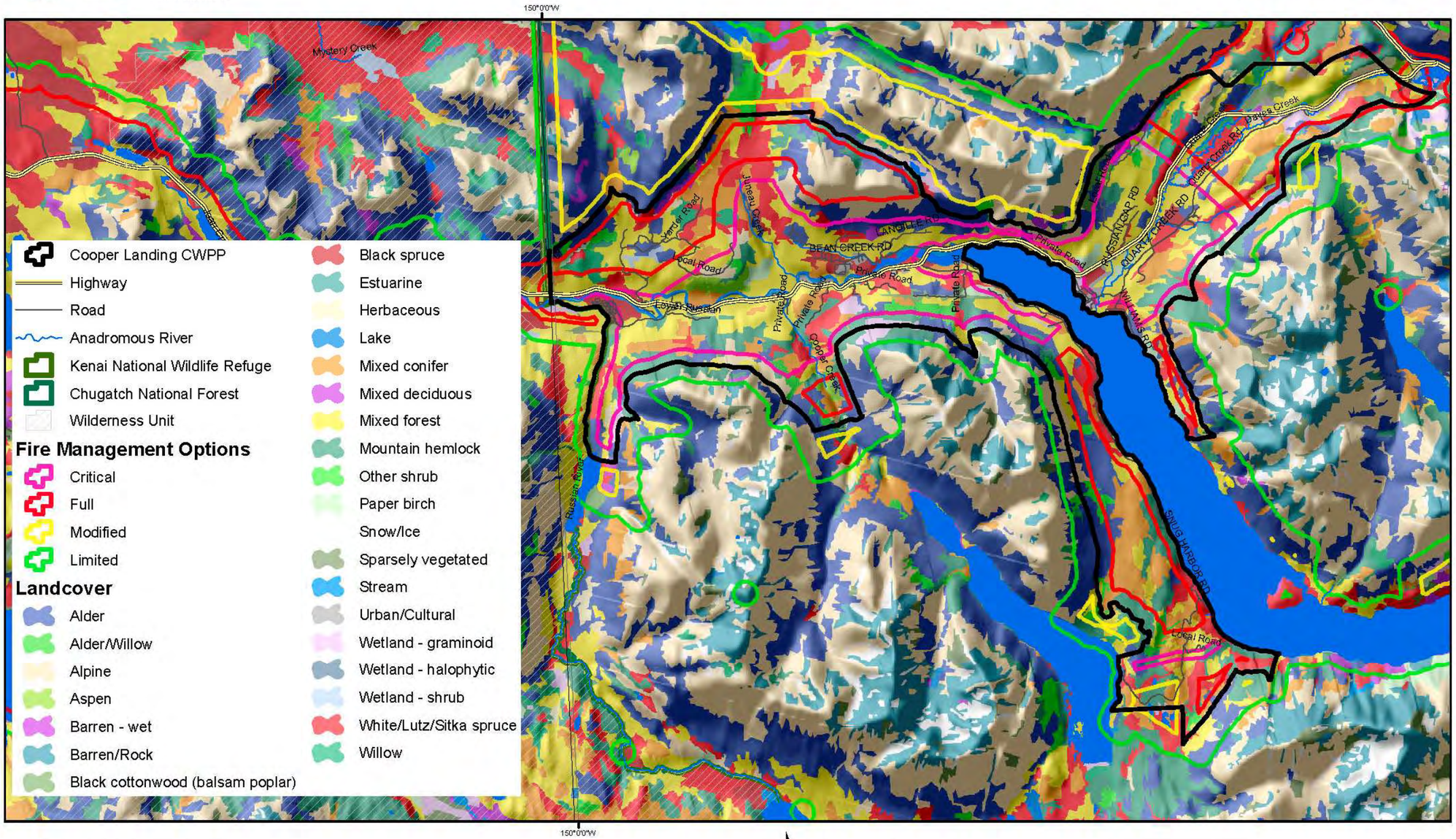
- Manage vegetation through various fuels treatment techniques to reduce and mitigate risks of damage from wildland fire.
- Balance the cost of suppression actions against the value of the resource warranting protection and consider firefighter and public safety, benefits, and resource objectives.
- Consider short and long-term cost effectiveness and efficiencies while maintaining responsiveness to Jurisdictional agency objectives and within the scope of existing legal mandates, policies and regulations.
- Minimize adverse environmental impact of fire suppression activities.
- Maintain each Jurisdictional agency's responsibility and authority for the selection and annual review of fire management options for the lands that they administer.
- Adhere to State and Federal laws and regulations.

Appendix C: Cooper Landing

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Cooper Landing CWPP Landcover



Produced By: Dawn Magness
11/28/2012

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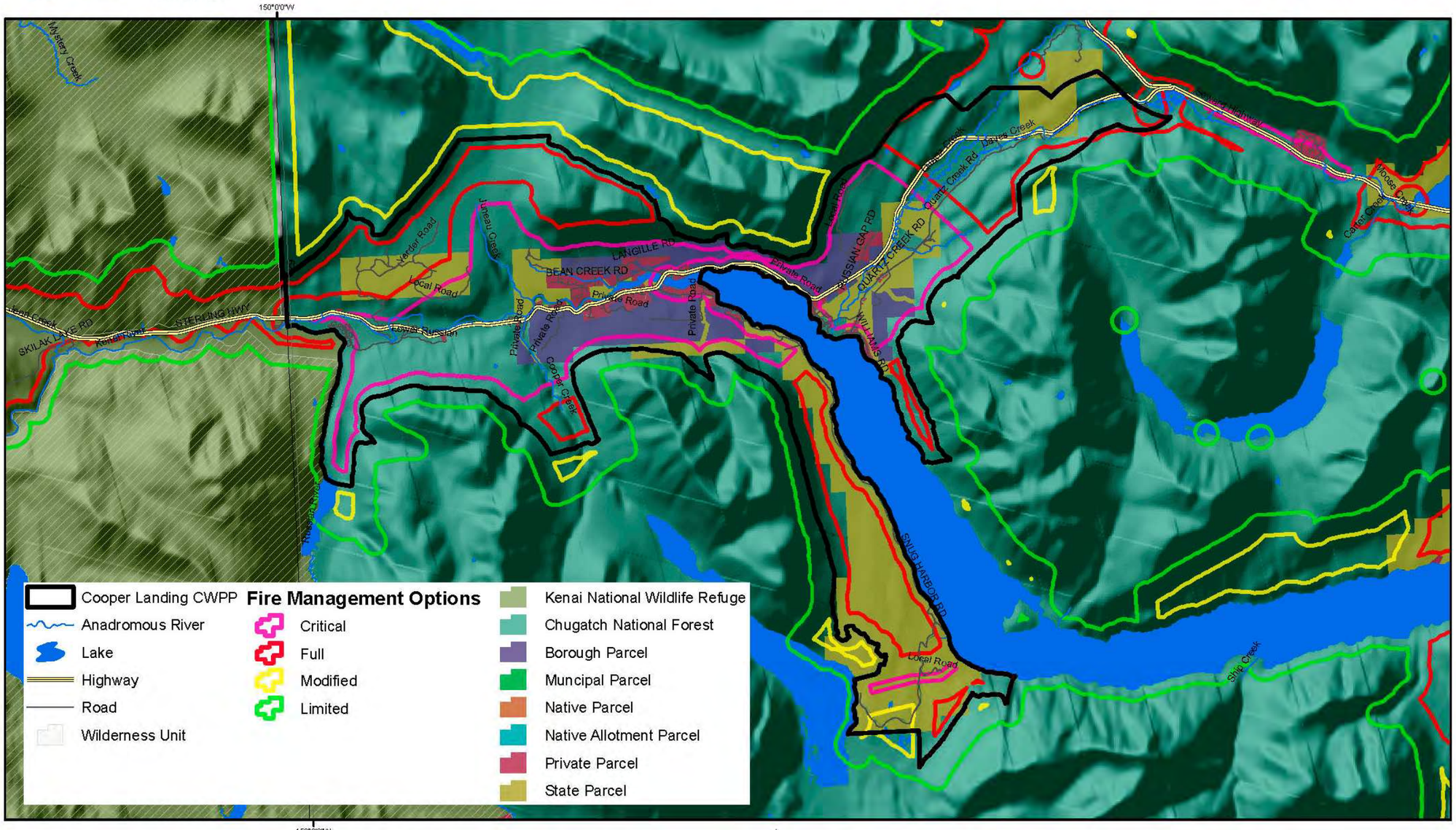
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Cooper Landing CWPP Landuse



Produced By: Dawn Magness
11/28/2012

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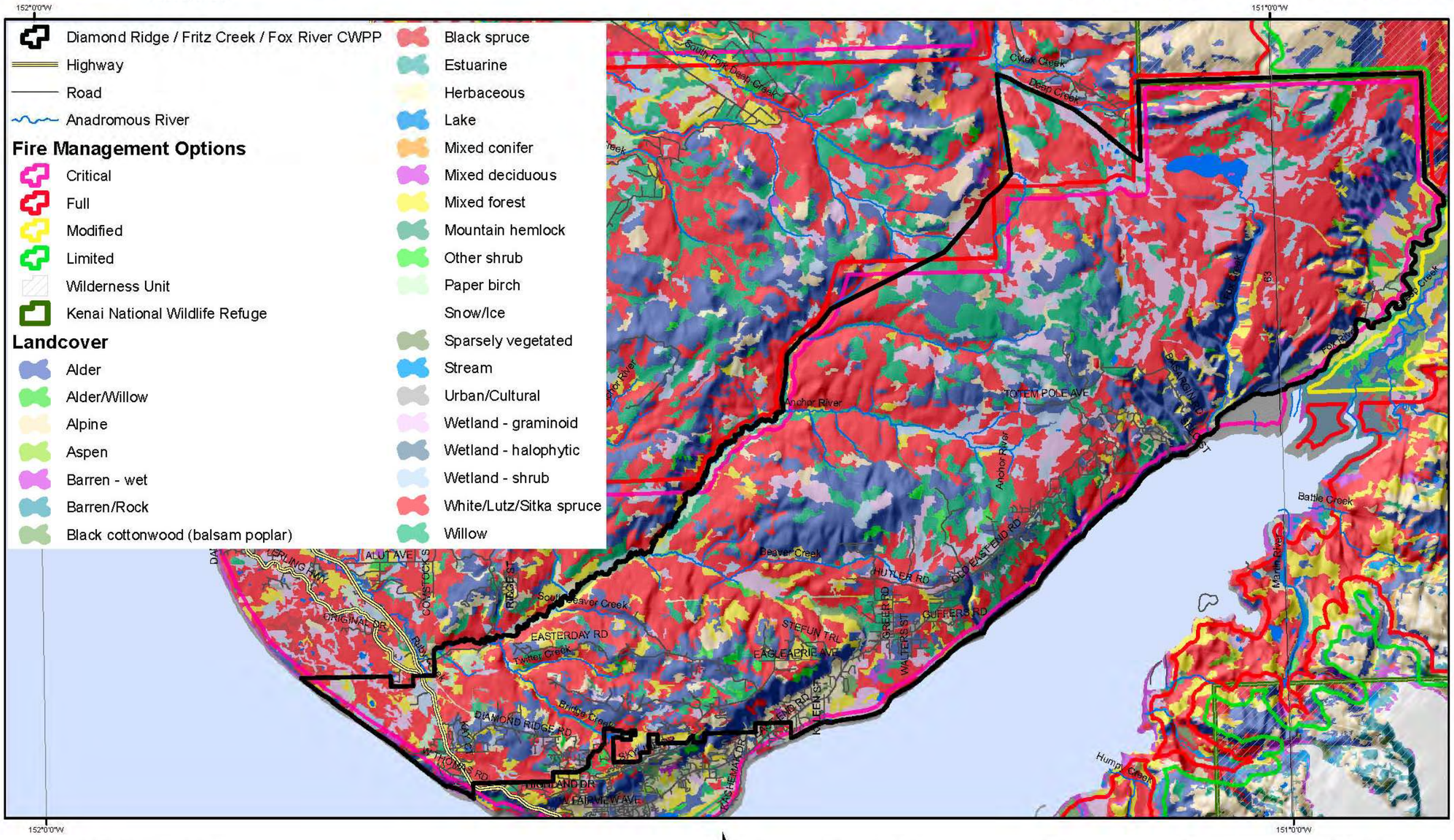
Appendix D: Diamond Ridge, Fritz Creek, and Fox River

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Diamond Ridge / Fritz Creek / Fox River CWPP Landcover



Produced By: Dawn Magness
11/28/2012

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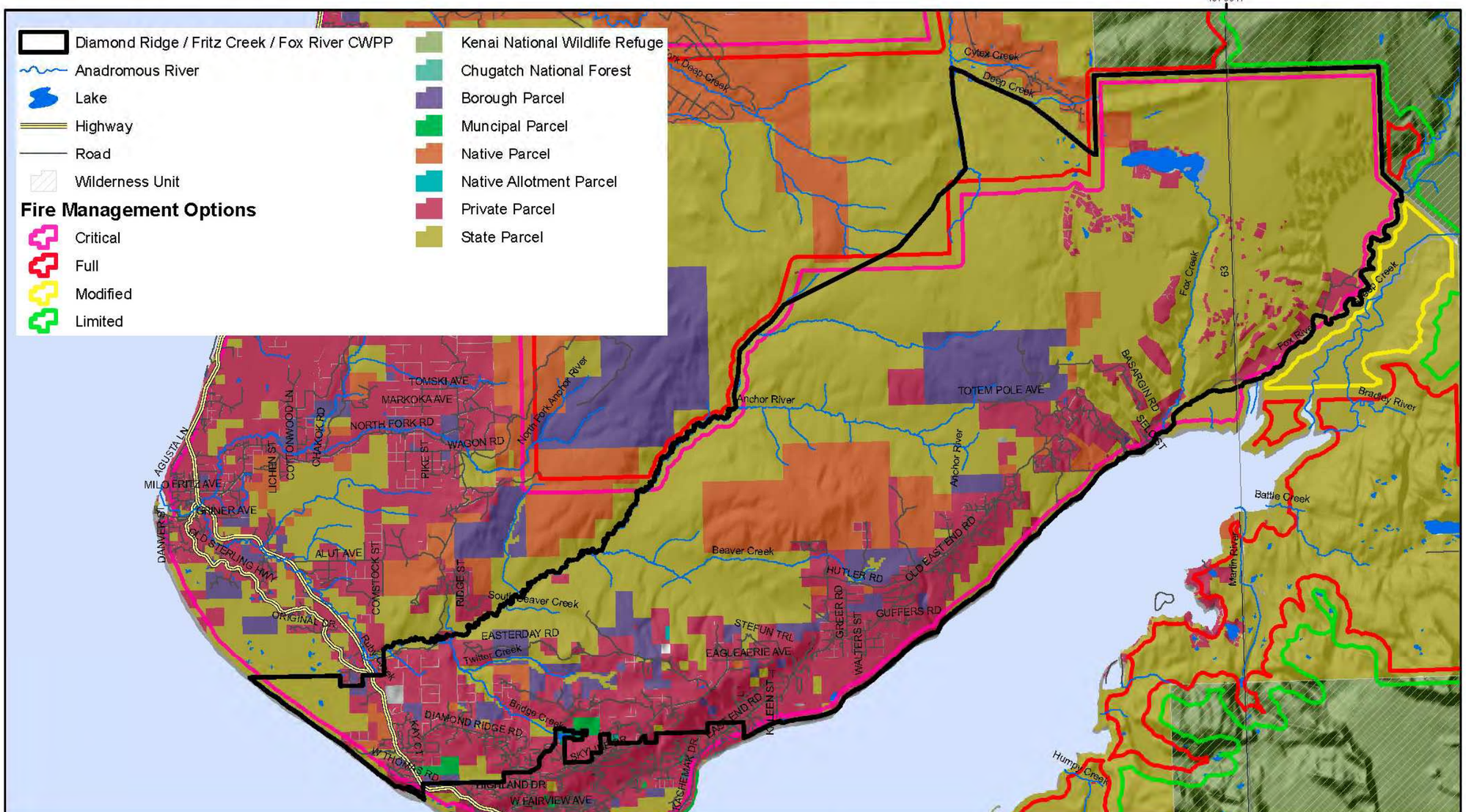
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Diamond Ridge / Fritz Creek/ Fox River CWPP Landuse



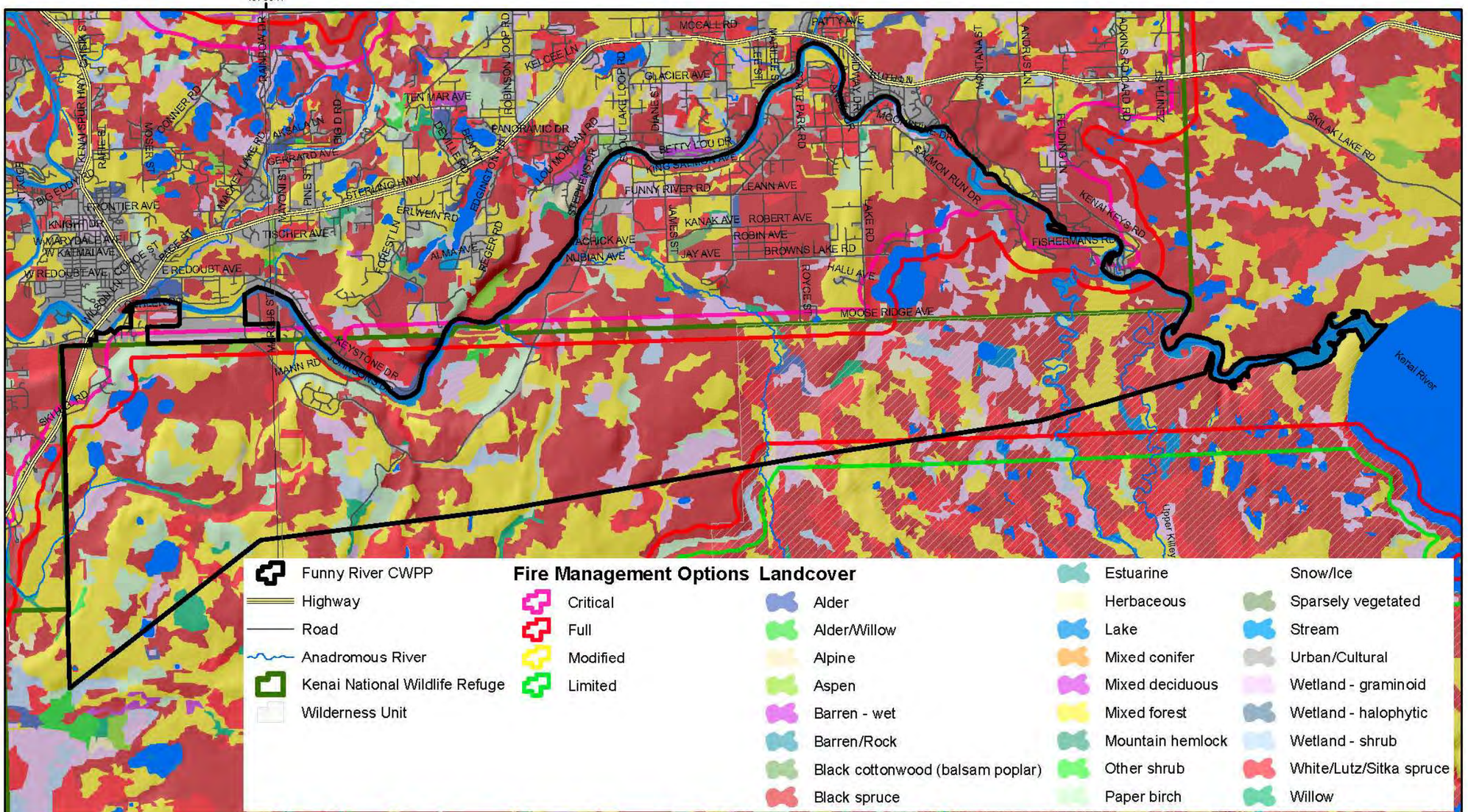
Produced By: Dawn Magness
11/28/2012

Appendix E: Funny River

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Funny River CWPP Landcover

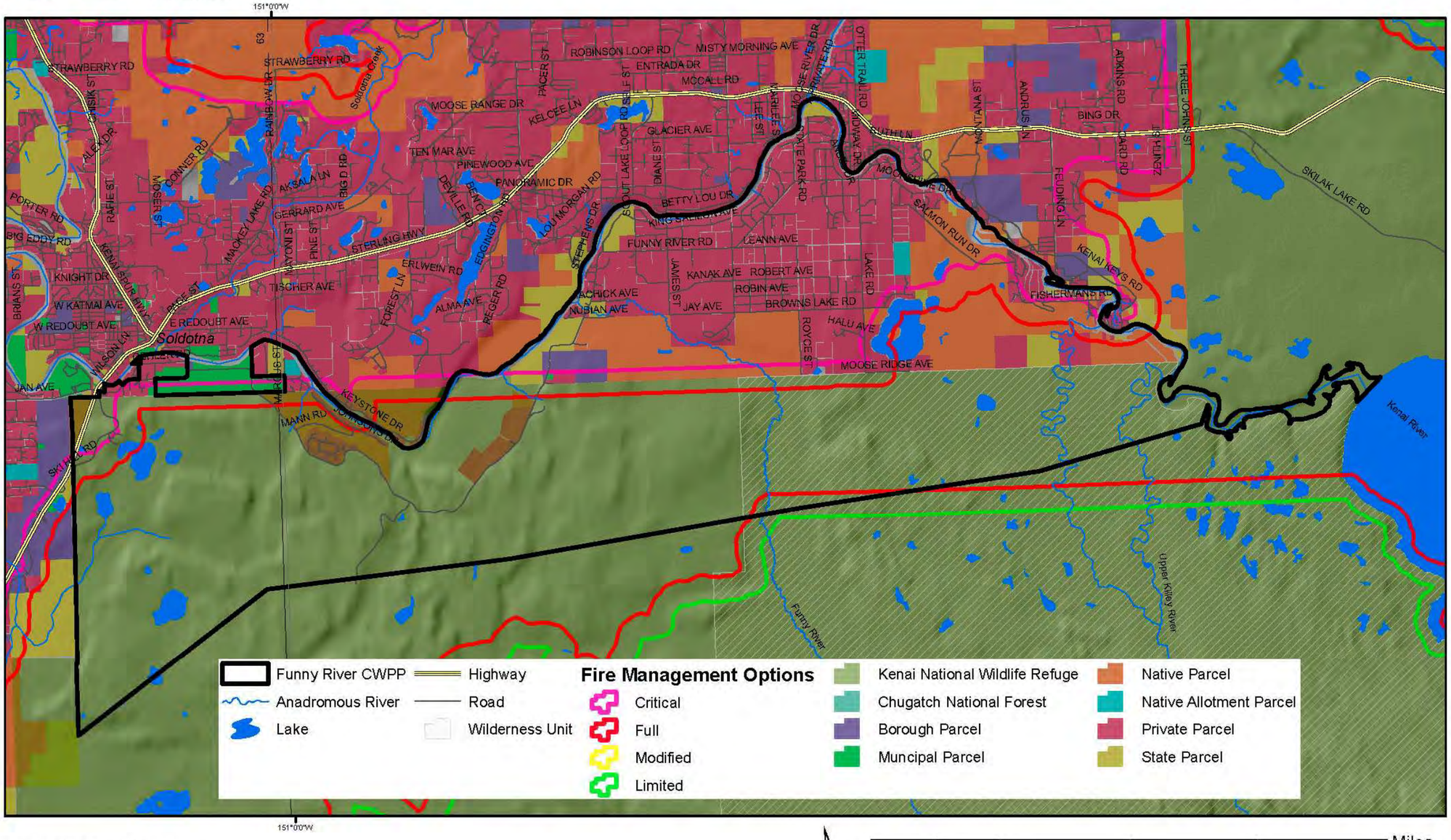


Produced By: Dawn Magness
11/28/2012

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Funny River CWPP Landuse



Produced By: Dawn Magness
11/28/2012

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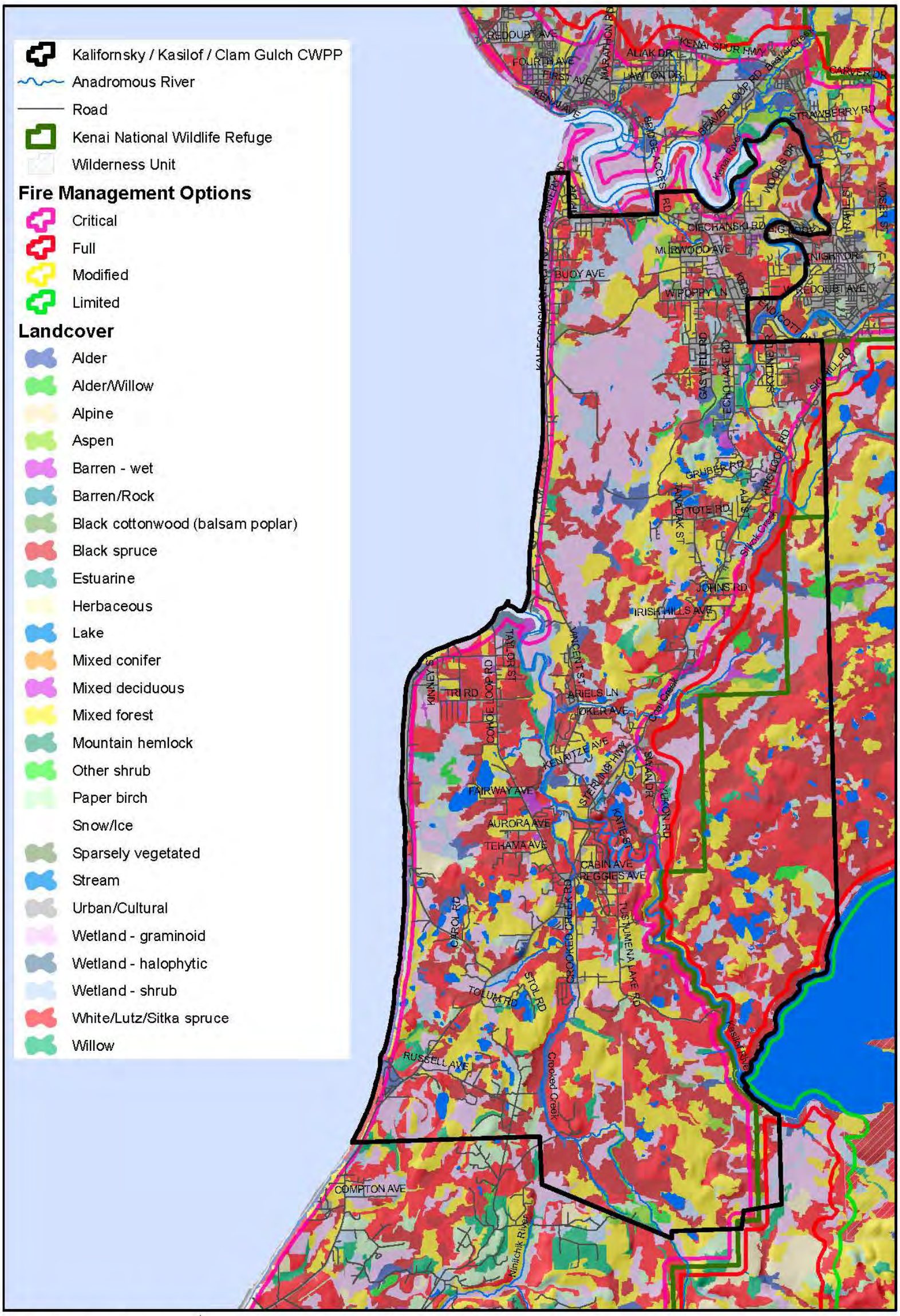
Appendix F: Kalifornsky, Kasilof, Cohoe, and Clam Gulch

Kalifornsky / Kasilof / Clam Gulch CWPP Landcover



Produced By: Dawn Magness
11/28/2012

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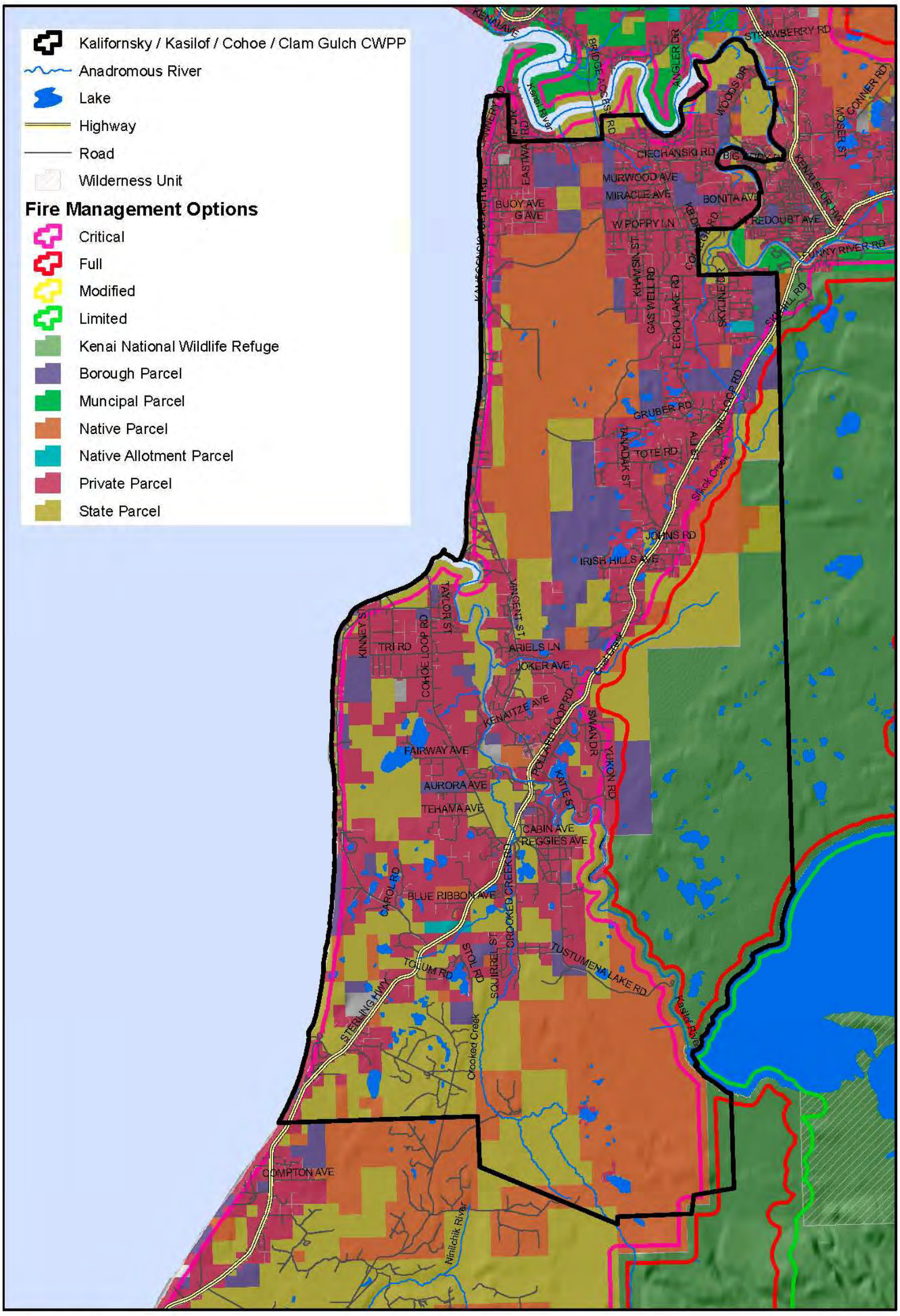
Kalifornsky / Kasilof / Cohoe / Clam Gulch CWPP Landuse



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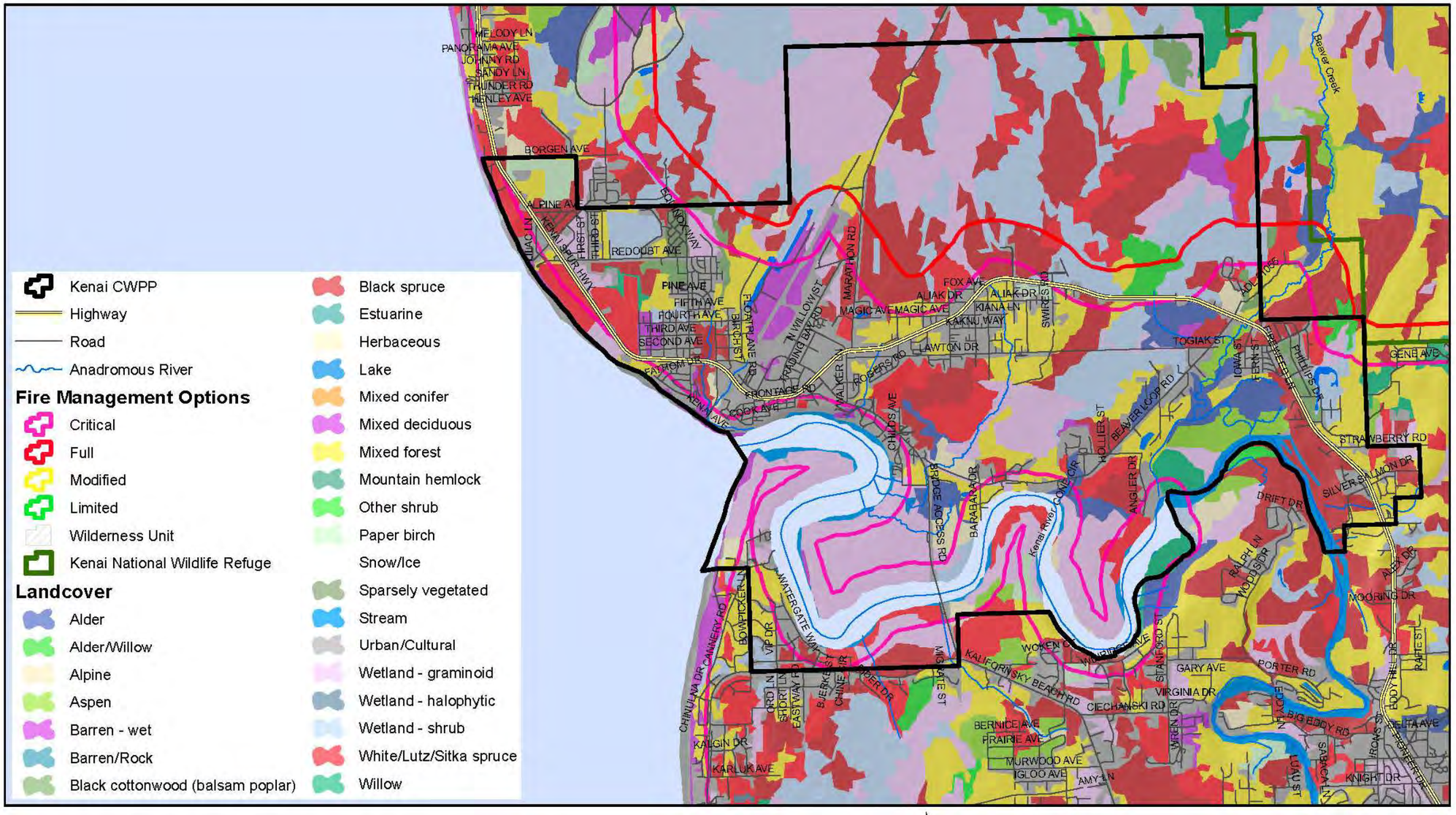
11/28/2012

Appendix G: Kenai

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Kenai CWPP Landcover



Produced By: Dawn Magness
11/28/2012

N

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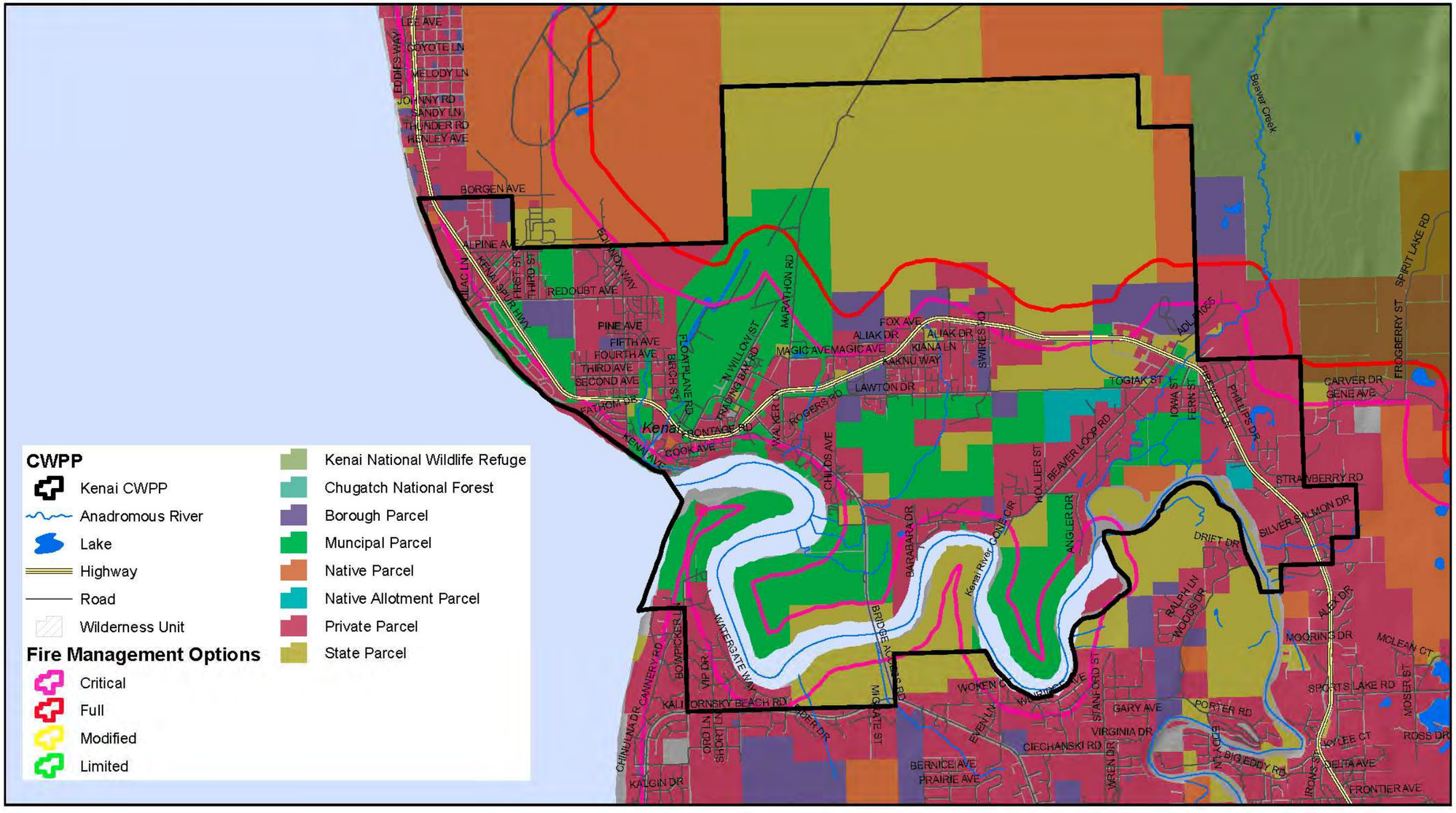
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Kenai CWPP Landuse



Produced By: Dawn Magness
11/28/2012

N

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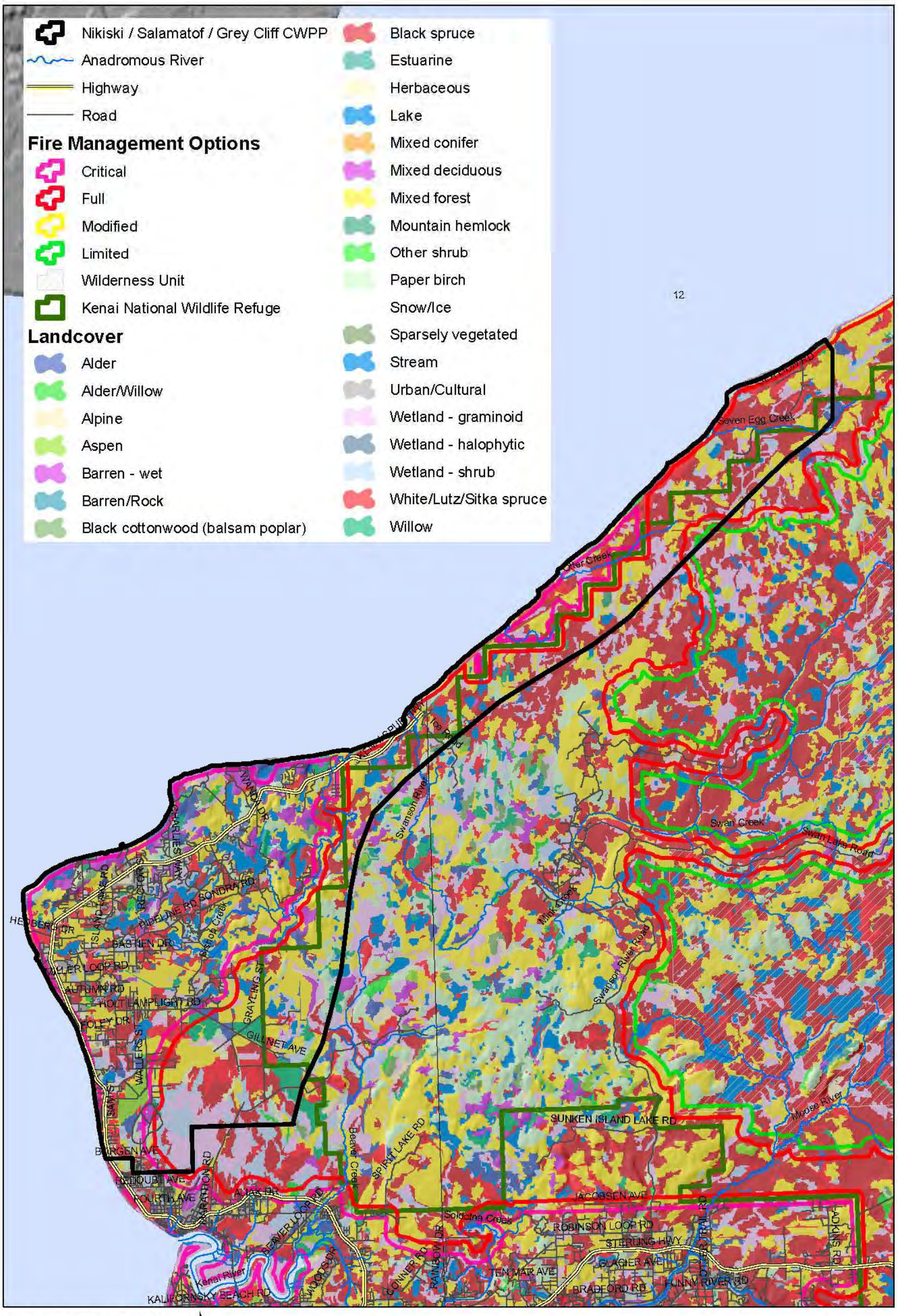
Appendix H: Nikiski, Salamatof, and Grey Cliffs

Nikiski / Salamatof / Grey Cliffs CWPP Landcover



Produced By: Dawn Magness
11/28/2012

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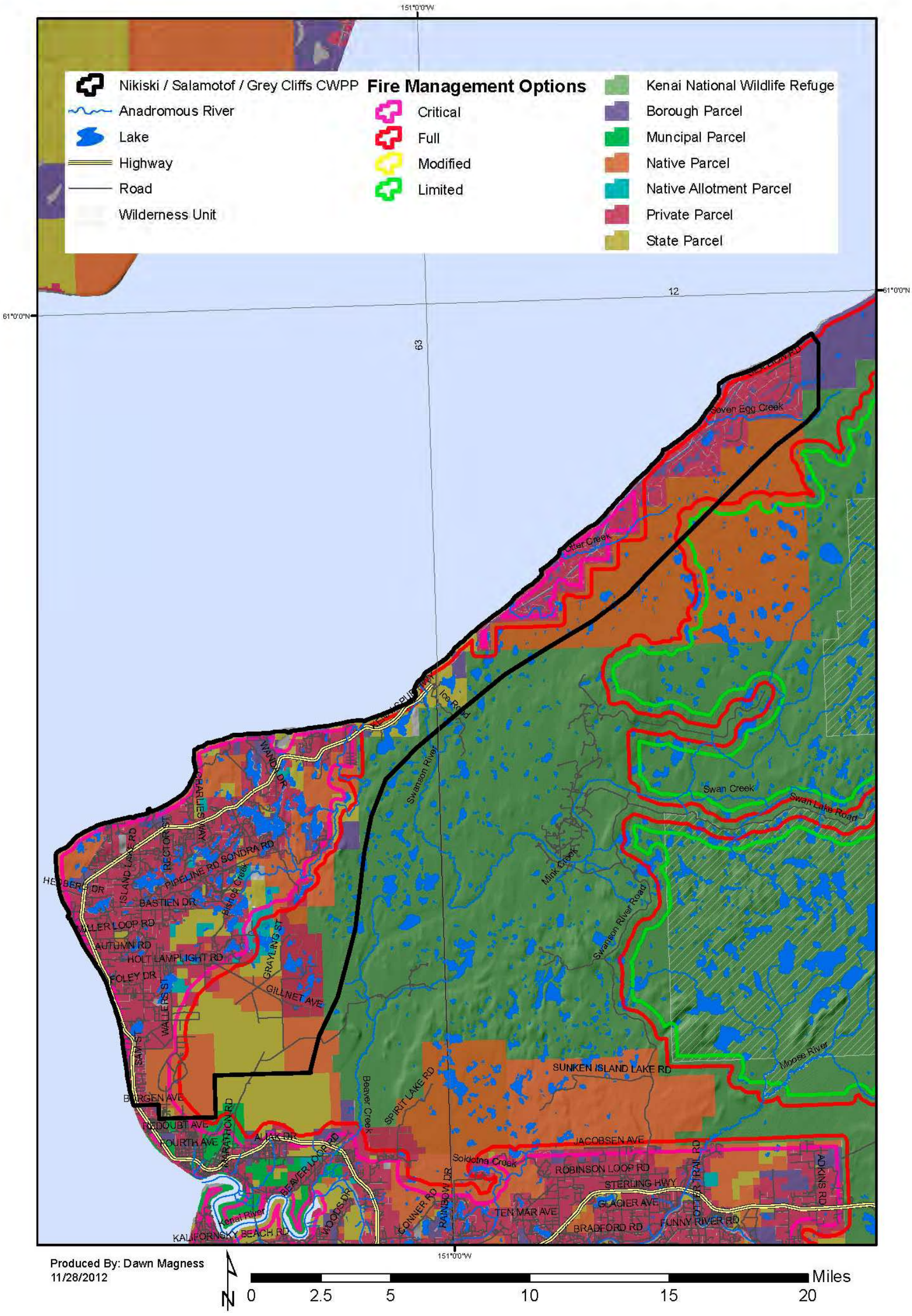
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Nikiski / Salamatof / Grey Cliffs CWPP Landuse

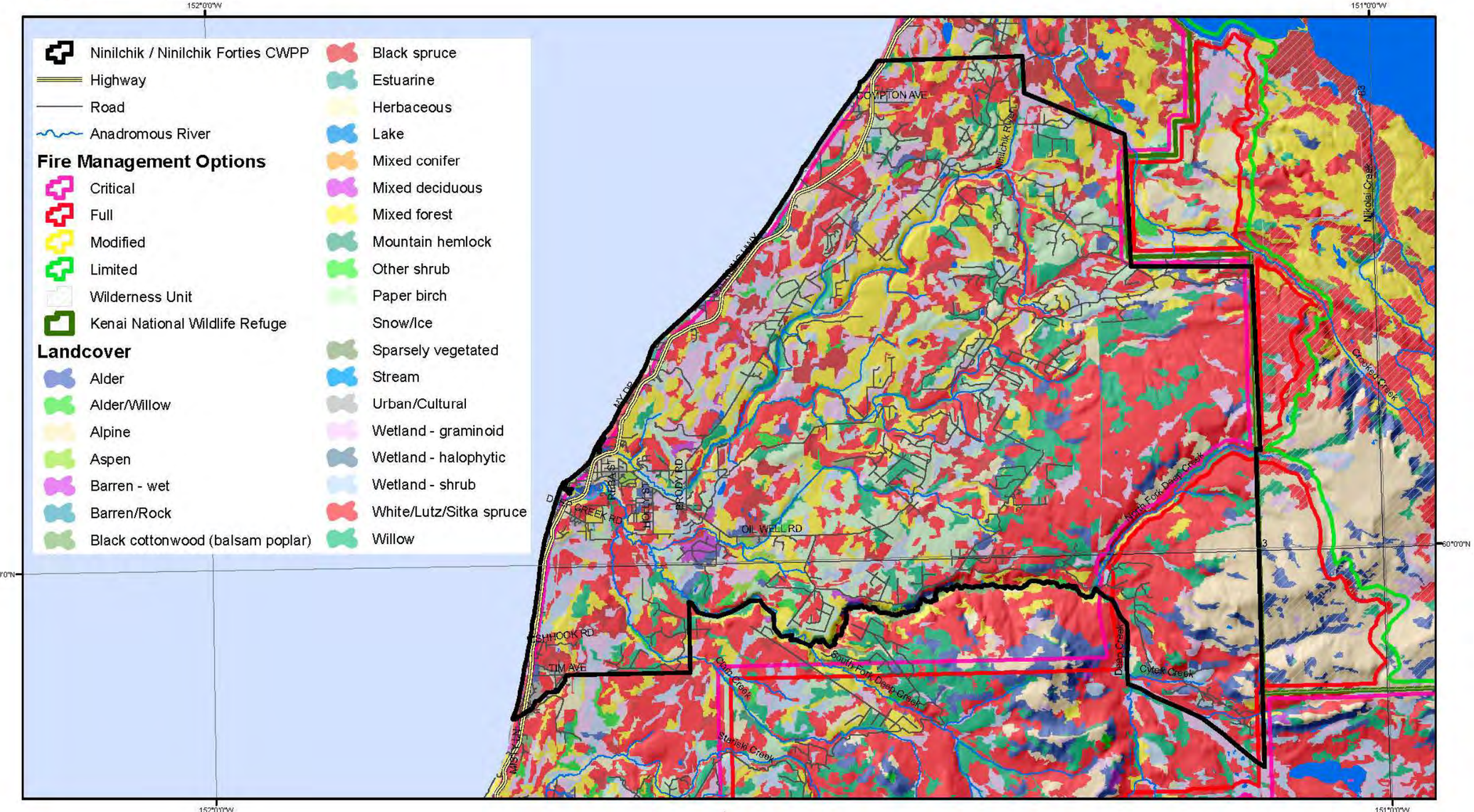


Appendix I: Ninilchik and Ninilchik Forties

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Ninilchik / Ninilchik Forties CWPP Landcover



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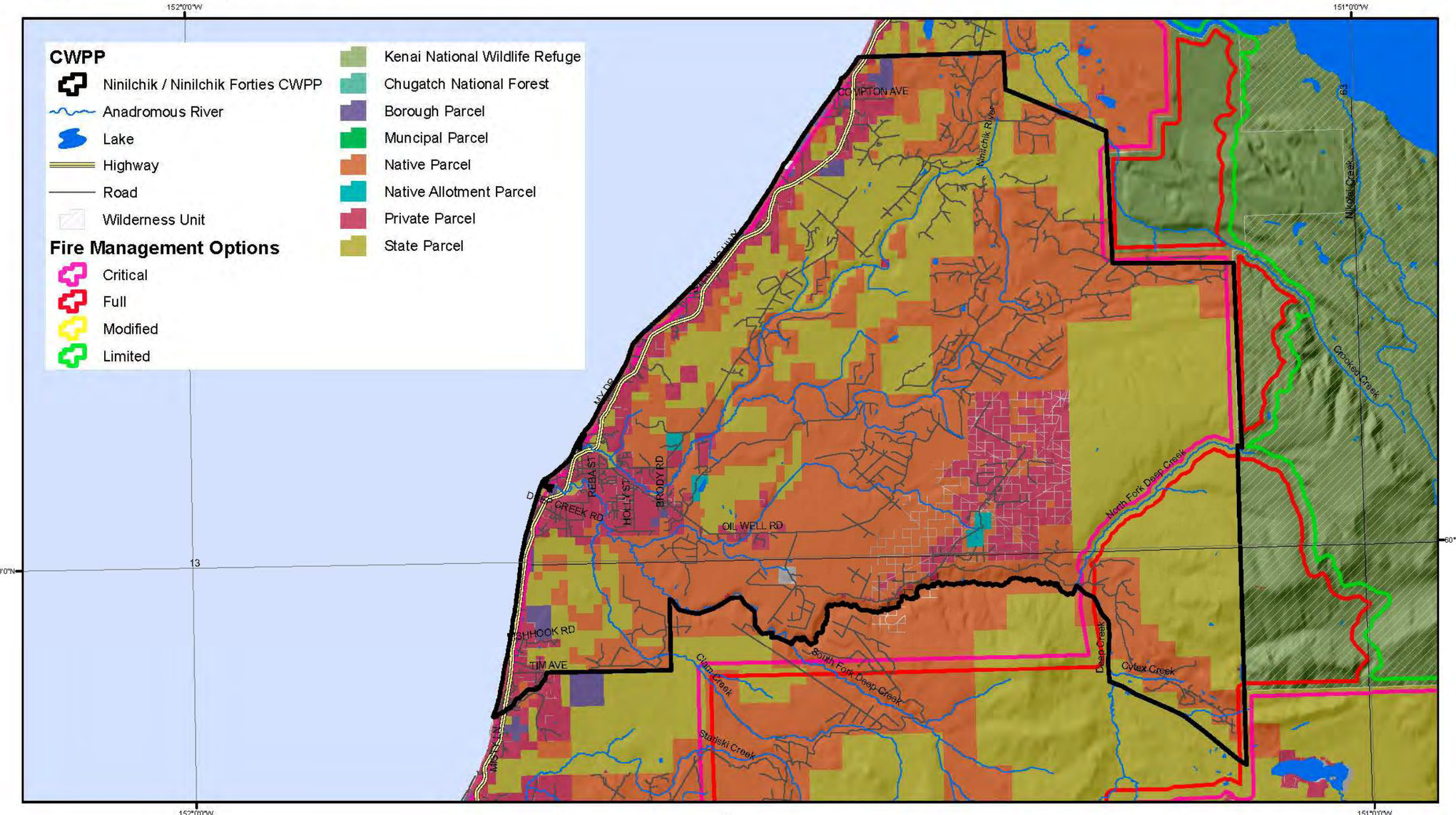
11/28/2012

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Ninilchik / Ninilchik Forties CWPP Landuse



Produced By: Dawn Magness
11/28/2012

N

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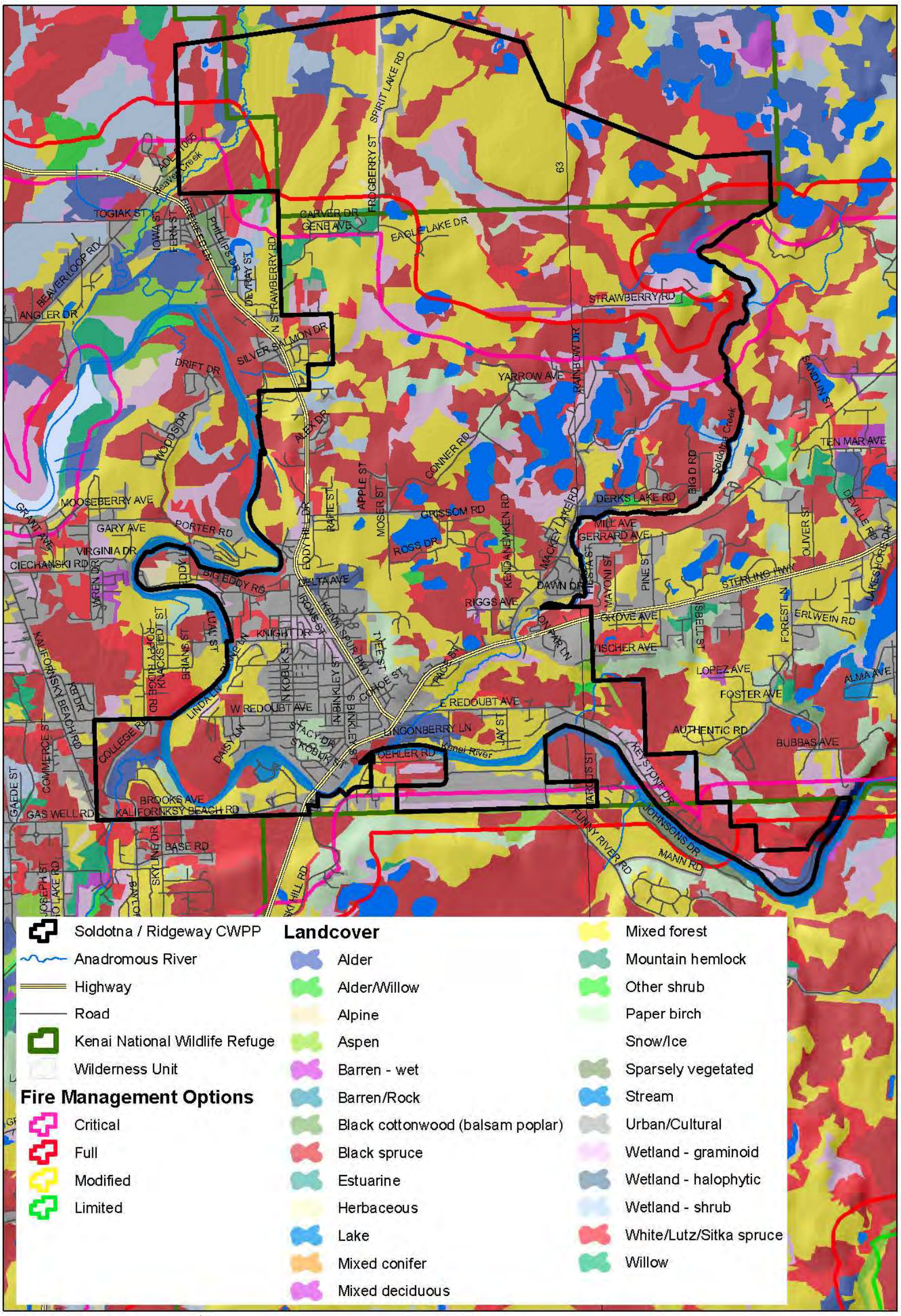
Appendix J: Soldotna and Ridgeway

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Soldotna / Ridgeway CWPP Landcover



Produced By: Dawn Magness
11/28/2012

N

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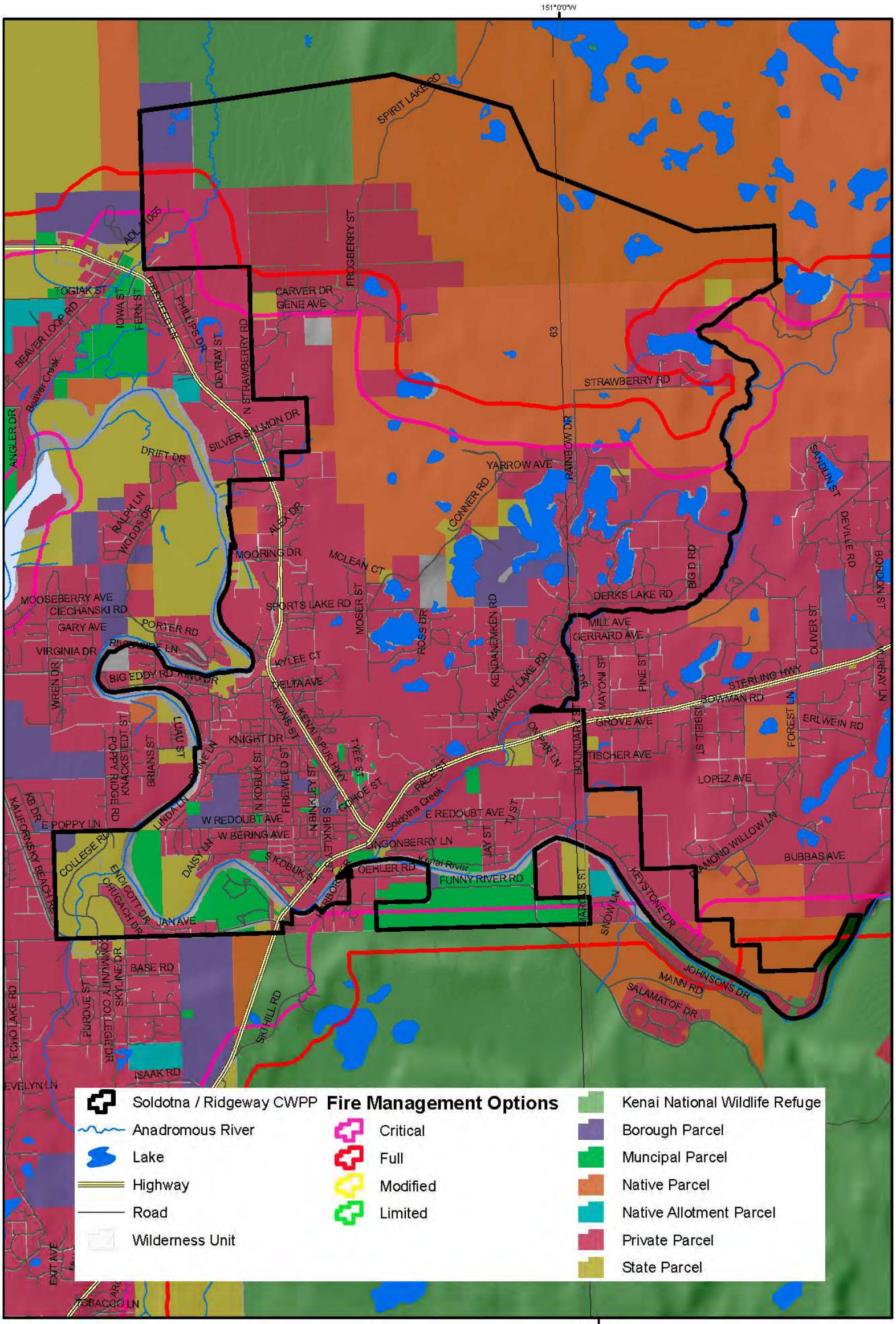
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Soldotna / Ridgeway CWPP Landuse



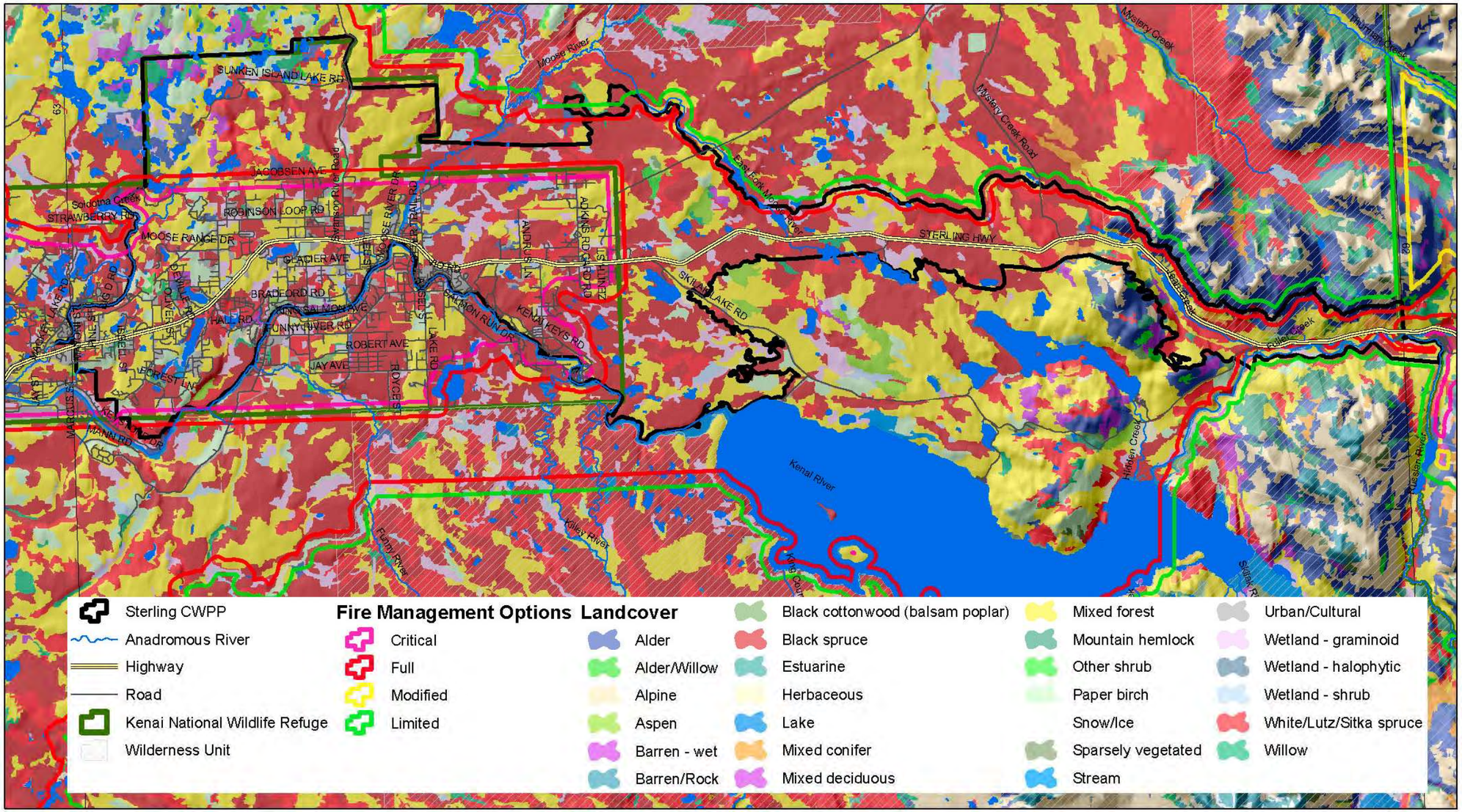
Produced By: Dawn Magness
11/28/2012

Appendix K: Sterling

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Sterling CWPP Landcover



Produced By: Dawn Magness
11/28/2012

N

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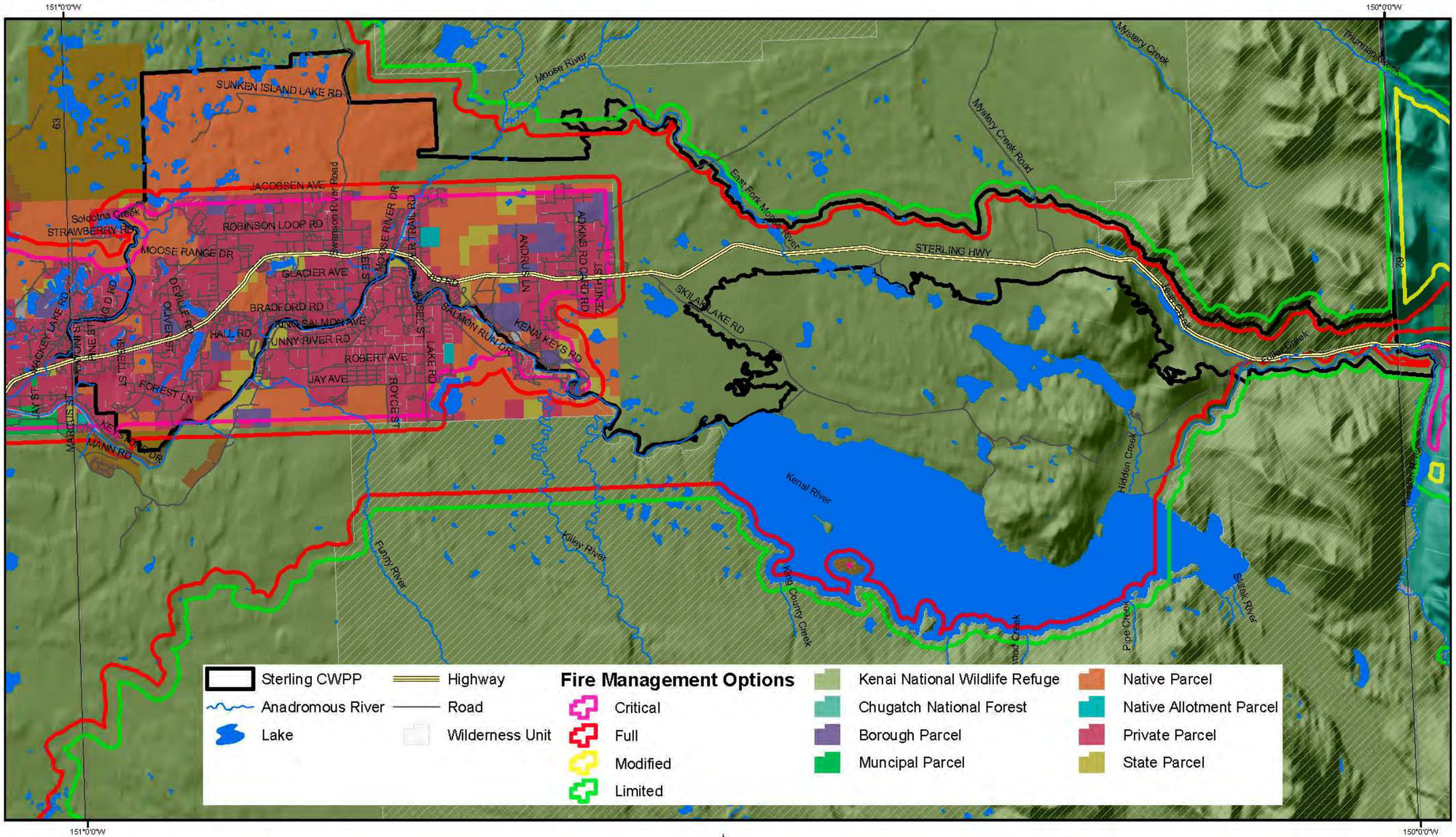
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Sterling CWPP Landuse



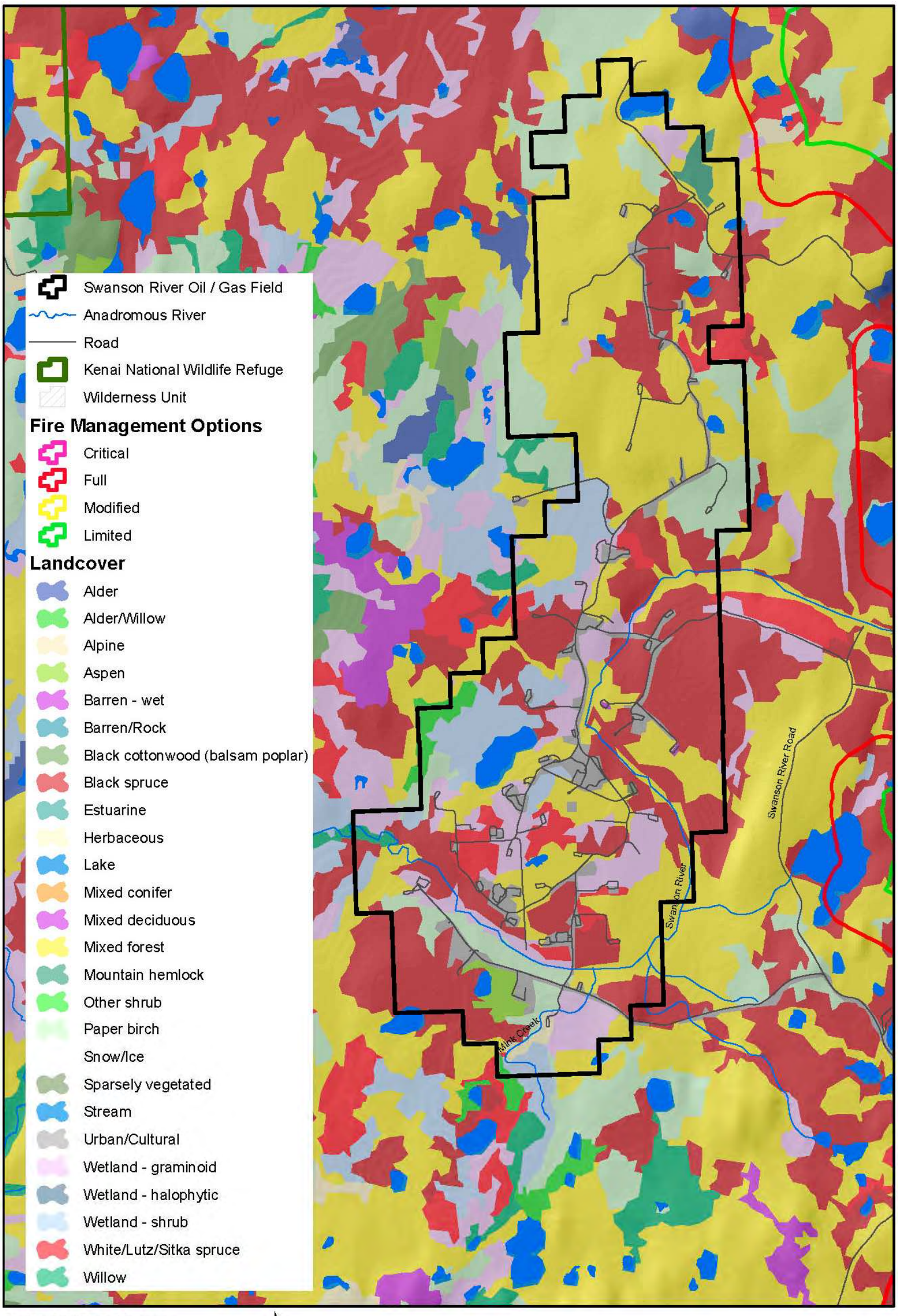
Produced By: Dawn Magness
11/28/2012

N

0 2 4 8 12 16 Miles

Appendix L: Swanson River Oil / Gas Field

Swanson River Oil / Gas Field Landcover



Produced By: Dawn Magness
11/28/2012

N

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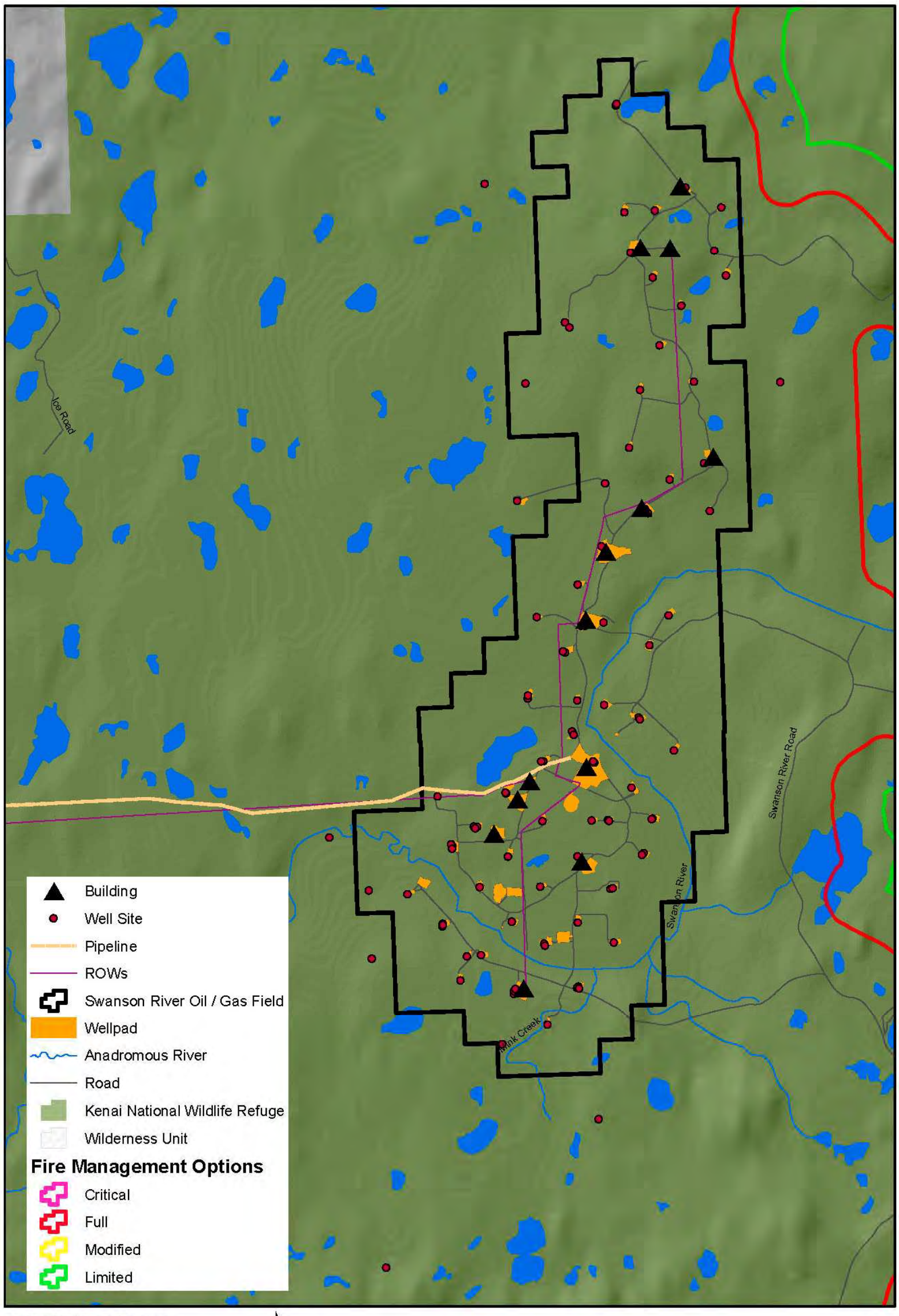
Swanson River Oil / Gas Field Assets



Produced By: Dawn Magness
11/28/2012

N

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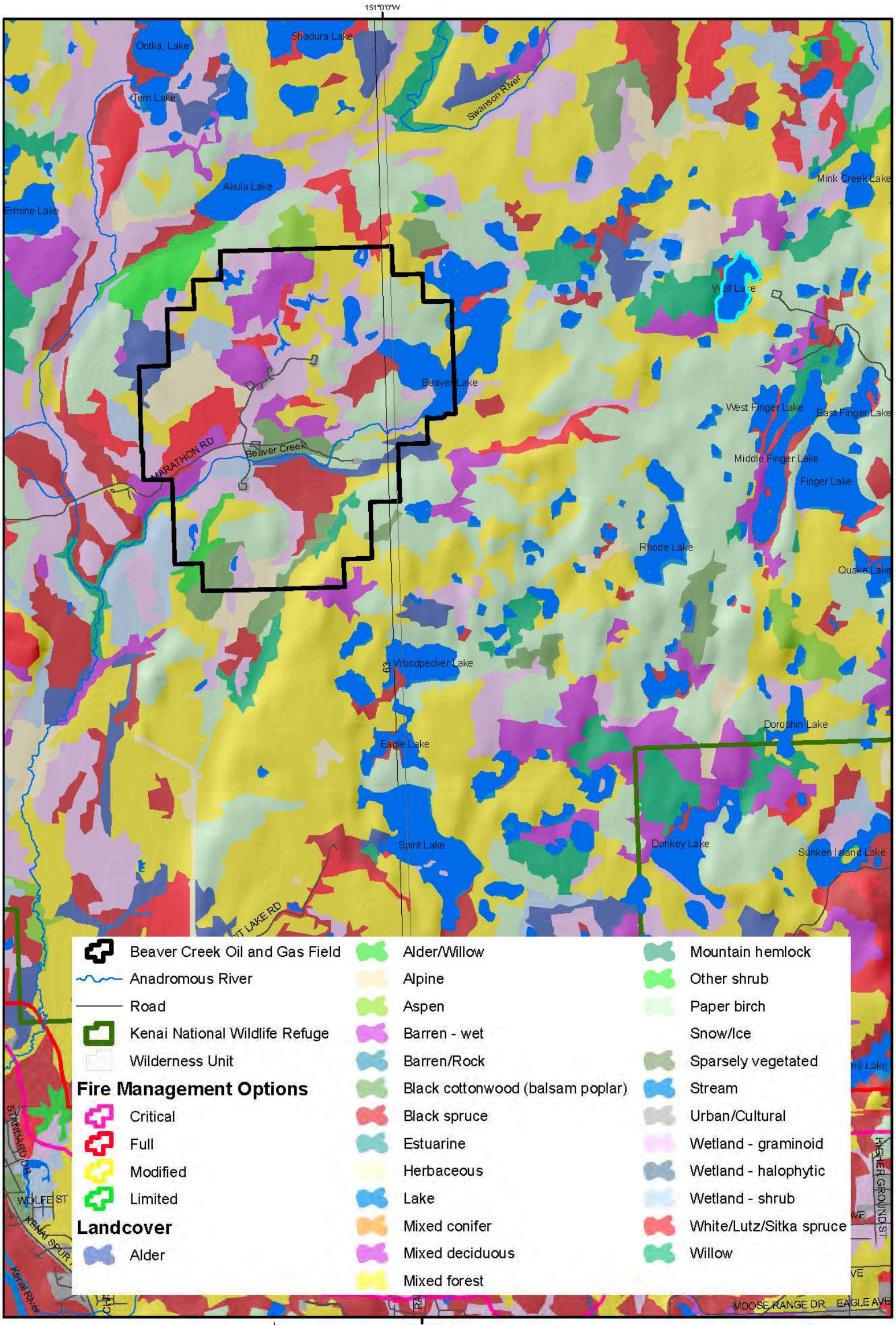
Appendix M: Beaver Creek Oil / Gas Field

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Beaver Creek Oil / Gas Field Landcover

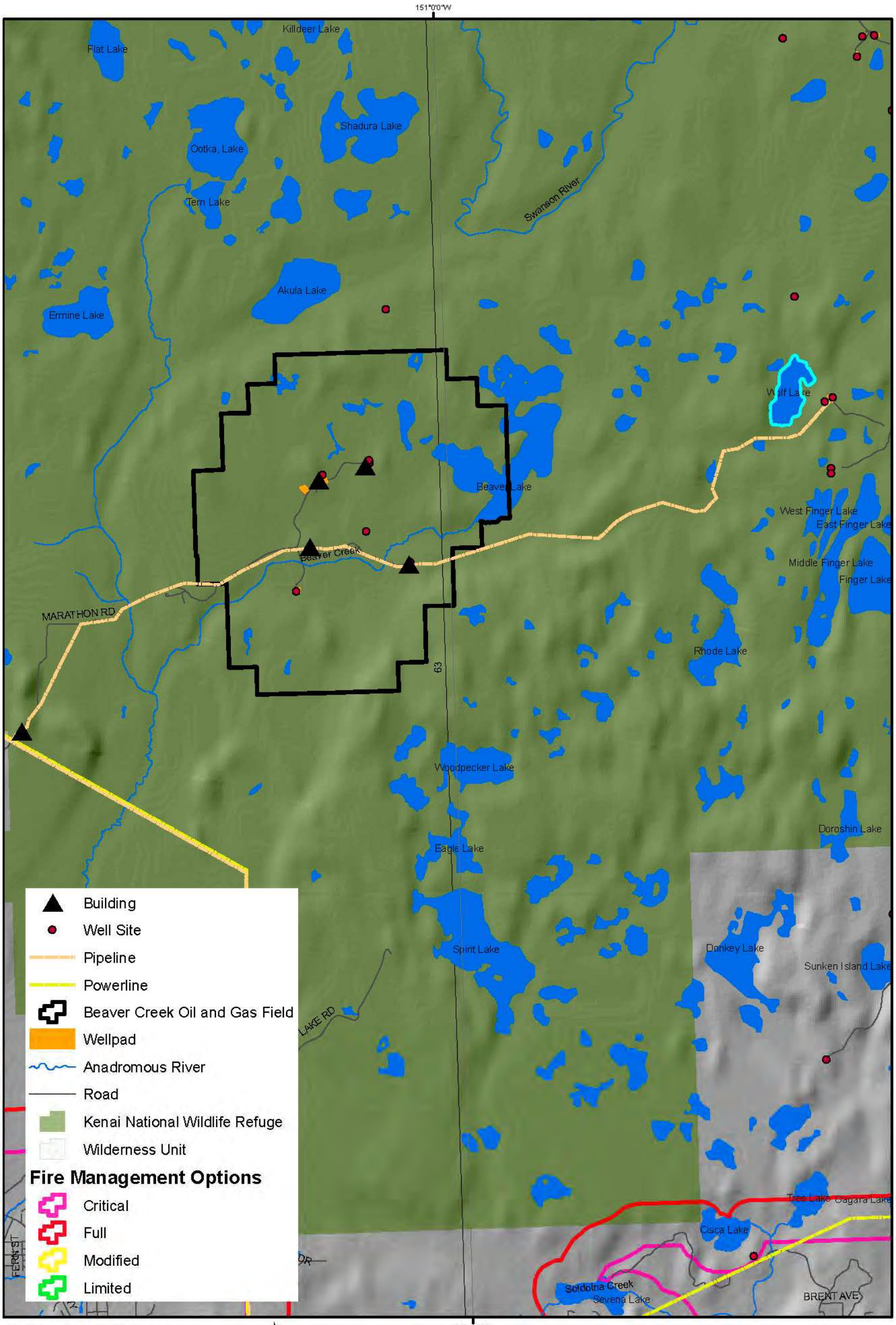


Produced By: Dawn Magness
11/28/2012

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Beaver Creek Oil / Gas Field Assets



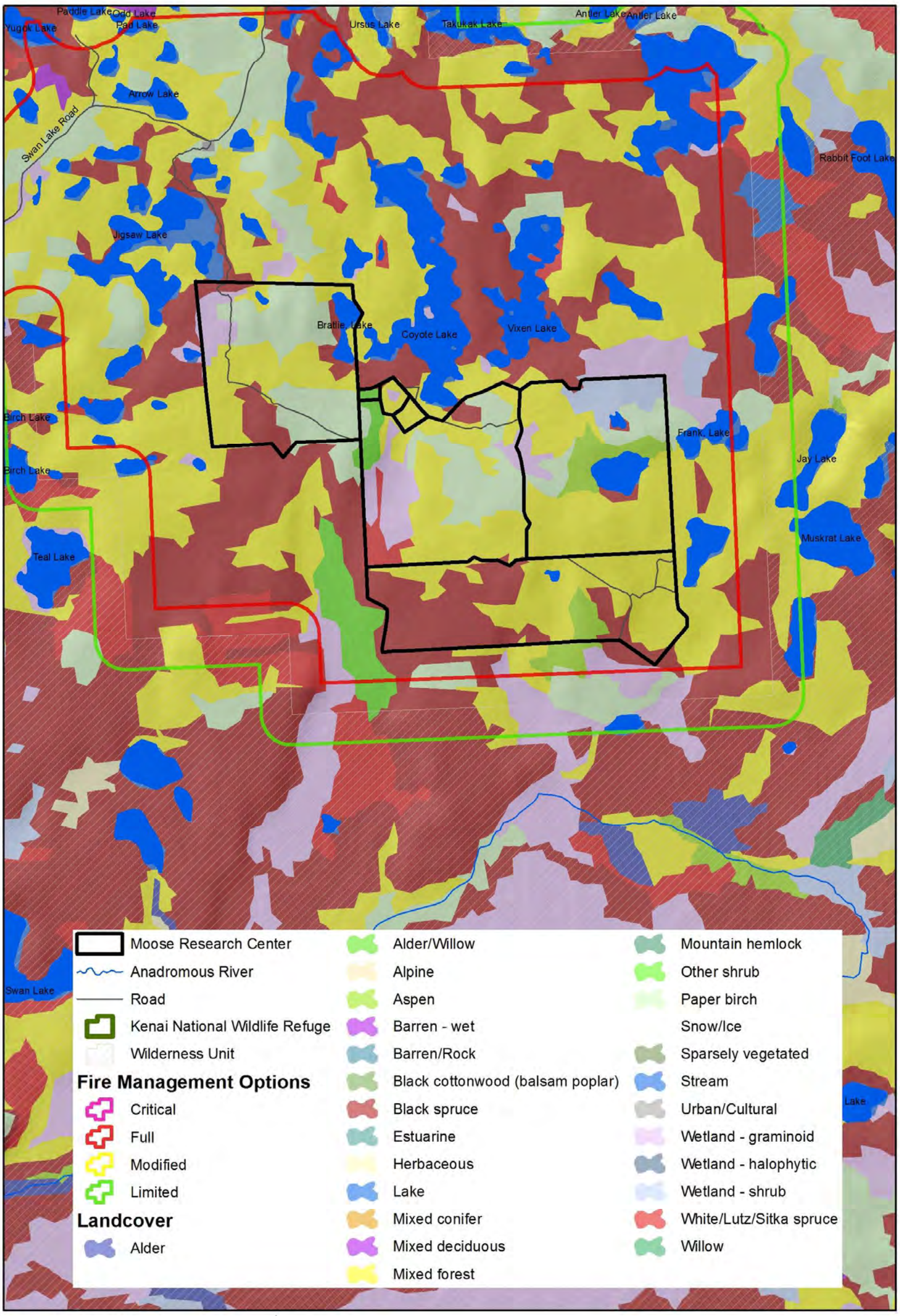
Produced By: Dawn Magness
11/28/2012

Appendix N: Moose Research Center

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Moose Research Center Landcover



Produced By: Dawn Magness
11/28/2012

N

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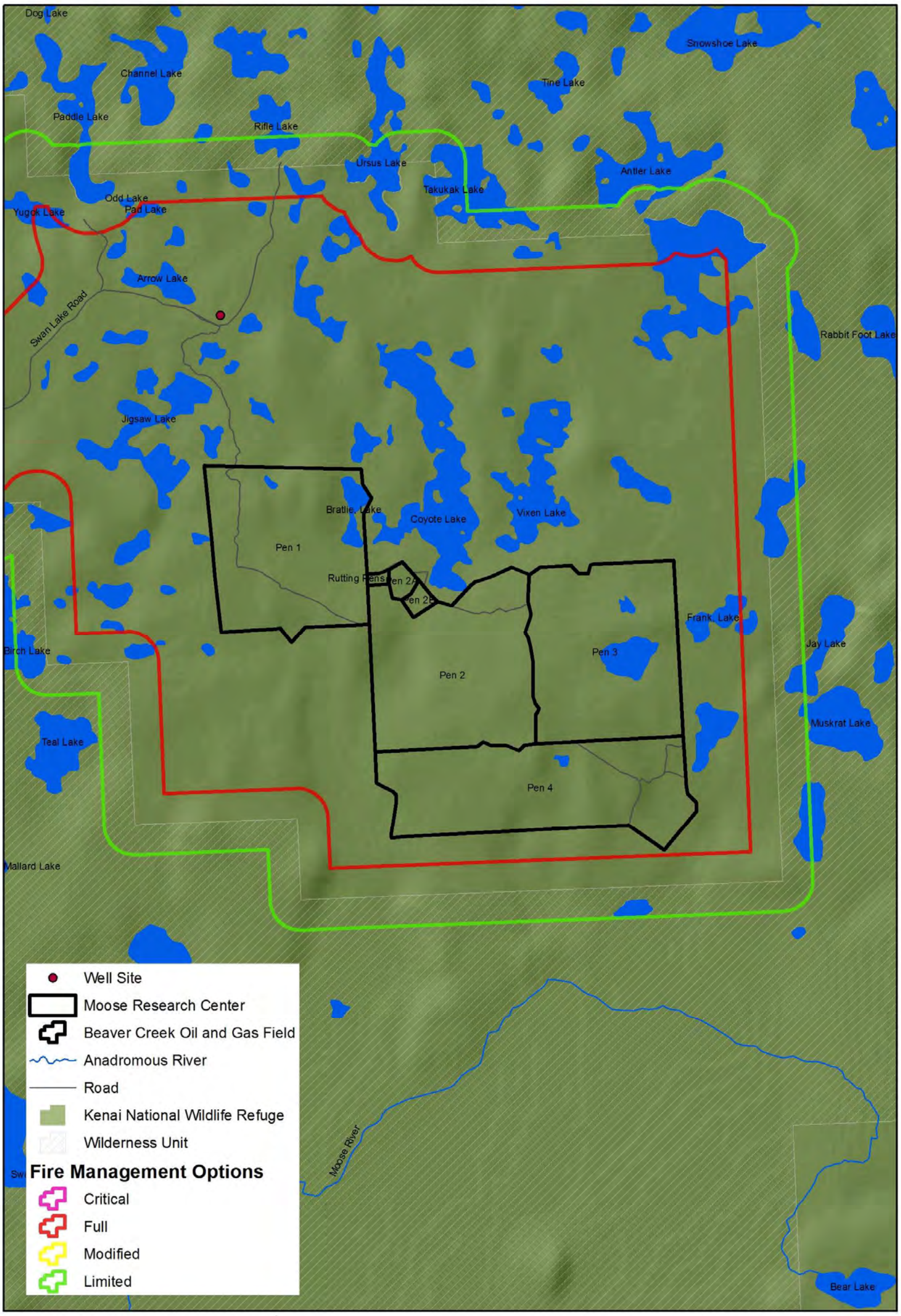
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Moose Research Center Assets



Produced By: Dawn Magness
11/28/2012

Appendix O: Moose Research Center Habitat Enhancement Plan 2013

Alaska Department of Fish and Game

Kenai Moose Research Center

Habitat Enhancement Plan 2013

The Kenai Moose Research Center (MRC) is the only captive animal research facility in Alaska that has the capacity to maintain moose on natural forage. Studying captive moose is needed to understanding the complex relationships between available forage, both quality and quantity, and intake.. The MRC has contributed vast amounts of research literature to help manage wild moose populations, publishing over 100 peer reviewed papers. Currently, habitat management has come to the forefront for managing moose populations on the Kenai Peninsula. Vegetation on the northern Kenai Peninsula lowlands, including the MRC, has been slowly maturing after large wildfires in 1947 and 1969. As forest succession slowly changes the available forage for moose on the Kenai Peninsula, moose populations have declined and are showing evidence of nutritional stress. In 2012, the state of Alaska Board of Game designated the Kenai Peninsula as an intensive management area for moose, and the state legislator has set aside funds specifically for habitat management. The MRC has conducted habitat management with various techniques, and is an ideal place to conduct controlled habitat enhancements with known moose density. Habitat management goals at the MRC, including maintaining moose on natural forage year round, can be used to evaluate habitat management techniques that can be applied on a large scale to the Kenai Peninsula. Understanding the history of the MRC and future management goals is essential before implementation of any habitat management plan.

History

The MRC was proposed in the early 1960's at the Alaska Interagency Moose meetings. The Alaska Department of Fish and Game (ADFG), along with Federal resource agencies

involved with land and wildlife management in Alaska (U.S. Fish and Wildlife Service, U.S. Forest Service, Bureau of Land Management, National Park Service, U.S. Army, and U.S. Air Force) agreed that a facility should be constructed to research the interrelationships between moose and their environment. The site for the MRC was selected on the northern Kenai Peninsula, located on the Kenai National Moose Range, administered by the U.S. Fish and Wildlife Service (FWS). Construction of four enclosures, approximately 1 square mile each (Figure 1 [note that all figures are at the end of this appendix]), of 8 foot high woven wire fence began in 1965, and the facility has operated continuously since 1969 as a cooperative venture between ADFG and FWS. In 1980 the Alaska National Interest Lands Conservation Act re-designated the Kenai National Moose Range to the Kenai National Wildlife Refuge (KNWR). Cooperative research was ongoing between the FWS and ADFG through 1981, when the FWS research staff position was eliminated by the Denver Wildlife Research Center, and since that time ADFG has had sole responsibility for research at the MRC. Currently, ADFG operates the MRC on KNWR lands under a Memorandum of Agreement with the FWS (Memorandum of Agreement, 29 April 2004). Kenai National Wildlife Refuge is responsible for habitat management activities within the MRC that are mutually agreed upon between ADFG and FWS.

The MRC was established at a time when browse production on the northern Kenai Peninsula was high following the large 1947 wildfire. In the late 1970's, as vegetative succession decreased available browse on portions of the Kenai National Moose Range, experiments with a LeTourneau mechanical drum crusher began on 4 sites near the MRC. Enhancements included crushing near Willow Lake (461 acres), 2 sites along Mystery Creek (945 acres and 910 acres), and one site south and west of the MRC enclosures (584 acres). In conjunction with these enhancements outside of the MRC, 158 acres were crushed within the

MRC in 1977. Further tree crushing within the MRC occurred from 1985-89 with an additional 764 acres treated (Figure 2). Recent habitat enhancements at the MRC include 17 acres of hand cut trees by KNWR fire crew, 25 acres of trees treated with a Feller-Buncher, and 30 acres of trees treated with a Hydro-axe (Figure 2). Currently, portions of the MRC that have remained undisturbed since the 1947 burn are mature mixed coniferous-deciduous forest. Those areas crushed within the MRC in the late 1980's have matured to the stem exclusion state with little woody or herbaceous vegetation near the ground for winter moose forage. The 3 small areas recently treated have been heavily utilized by moose during the growing season, resulting in little birch and aspen sapling regeneration and high establishment of bluejoint reedgrass (*Calamogrostis canadensis*). Existing winter browse consists of heavily broomed aspen (*Populus tremuloides*), paper and Kenai birch (*Betula papyrifera, Betula kenaica*), aspen bark, lowbush cranberry (*Vaccinium vitus-idaea*), and very few Scouler's willow (*Salix scouleriana*). Each of the 4 pens has a different mosaic of vegetation, a result of the rolling topography, previous moose densities, and previous enhancement projects.

Management Goals

Vegetative succession, coupled with various levels of moose densities, has reduced the quantity and quality of natural forage available to moose within each pen at the MRC. Available forage, including herbaceous vegetation in the understory during the summer, has declined as canopy cover increases from maturing paper birch, aspen, and spruce. Currently, woody browse accessible to moose for winter forage is the limiting factor. The capacity for MRC to overwinter even small numbers of moose in a healthy condition primarily on natural forage is compromised and further degrading. Management goals and objectives for the MRC to operate and maintain a healthy moose population are listed below.

Goals:

- Provide adequate natural forage with minimal supplemental feed to maintain up to 6 moose in each pen on natural forage (18-24 moose within the entire facility). Moose will be able to overwinter on natural forage and have measurable rump fat at the end of winter (April 15th).
- Through active vegetation management, maintain at least 35% of each large pen in deciduous woody vegetation that is less than 15 years old, while maintaining at least 20% of the pen in mature old growth forest.
- Determine vegetation age structure and composition on the MRC and evaluate the potential effects of forestry practices on moose habitat for land management applications on the Kenai Peninsula

Objectives:

- Use mechanical vegetation management to initially enhance 20% of each large pen to create early seral deciduous forest by 2014.
- Use mechanical vegetation management to enhance another 15% of each large pen by 2019.
- Create a rotation vegetation enhancement plan to keep at least 35% of each pen in early seral deciduous forest, treating each pen on a 5 year rotation after 2019.

Management Plan

Pen 1 (Figure 3)

Pen 1 is 592 acres, comprised of mixed aspen, birch and spruce forest, with intermixed areas of bogs and small lakes. Pen 1 contains the second largest lake on the MRC, 29 acres located at the northeast corner of the pen. There are 2 vegetation enclosures in Pen 1, a 6.5 acre enclosure at the northwest corner, and a 5 acre enclosure at the southeast corner. A USDA

Natural Resources Conservation Service Snotel site is also located in Pen 1 in a large stand of mature mixed forest. Pen 1 has had several habitat enhancements beginning in the late 1970's (Figure 3). Portions of Pen 1 were crushed in 1977 (158 acres) and 1986 (166 acres), with smaller areas enhanced by hand cutting in 2004 (17 acres), and cut and stacked with a feller-buncher then burned in 2008-2010 (25 acres). High moose densities in Pen 1 after tree crushing in the late 1980's and 1990's resulted in heavy utilization of birch and aspen regrowth. The small hand cut area was to provide ground fuel for a prescribed fire, but was never completed, resulting in no seed bed preparation for seedling establishment. The areas that were cut, stacked and burned with a feller-buncher have seen little establishment of birch and aspen in the burned areas, but are expected to provide adequate seedling establishment with time. Both areas have seen heavy moose use during late spring and early summer, with moose selecting fireweed (*Epilobium angustifolium*) and Jacob's ladder (*Polemonium pulcherrimum*), and probably are removing the few birch and aspen seedlings that are present in these areas. Given the small size of the hand cut and feller-buncher enhancements, and limited regeneration of aspen and birch, the areas have seen an establishment of bluejoint reedgrass, with intermixed fireweed and Jacob's ladder . Three additional areas in Pen 1 (< 40 acres each) have been prepared for prescribed burning; however, prescribed fires are compromised in any given year by weather conditions, availability of fire personnel and equipment, and risk of smoke affecting air traffic near Anchorage. Currently, given the low availability of winter browse in Pen 1, winter feeding is required to maintain the 4 MRC bulls in the pen, requiring felling of aspen and birch trees and supplemental pelleted ration from November 1st to April 15th.

Pen 1 will be enhanced by mechanical treatment in 2013, treating 115 acres (20% of the pen). Twenty-five acres, identified as having greater than 75% birch and aspen, will be treated

with a dozer or hydro-axe, breaking trees off at the root crown. All aspen stands treated shall have all trees removed, including adjacent mature aspen that may need to be cut by hand to promote sprouting. 50 acres, identified as having greater than 25% black spruce, will be treated with a shearblade, shearing the trees near the ground surface and push the debris into parallel wind-rows perpendicular to the slope that will later be burned. Furthermore, 40 acres of previously treated (hand-cut and feller-buncher) and now dominated by grass will be scarified, on the contour, to create an adequate seedbed for birch, aspen, and willow regeneration with a dozer blade. By synchronizing the 115 acres treatment with scarification of the smaller, previously treated areas, it will decrease moose pressure on a single area allowing seedling trees to establish. An additional 45 acres of mature forest shall be removed or crushed by 2018 (Table 1), and 40 acres of previously treated aspen/birch will be removed with dozer or hydro-axe at the same time. After 2018, a minimum of 65 acres need to be treated every 5 years to maintain 35% of the pen (195 acres) in early seral deciduous forest less than 15 years old (Table 1).

Table 1. Pen 1 Habitat Enhancement Rotation Plan (PT = Previously Treated)

Year	Acres	% of Pen	% of Pen <15yrs	Treatment	Community Treated
2013	40	7%	7%	Scarify	PT Aspen/Birch
2013	50	9%	16%	Shearblade/Burn	Black Spruce
2013	25	4%	20%	Hydro-axe or Dozer	PT Aspen/Birch
2018	45	8%	28%	Timber Removal	Mature Mixed Forest
2018	40	7%	35%	Hydro-axe or Dozer	PT Aspen/Birch
2023	65	12%	47%	Hydro-axe or Dozer	PT Aspen/Birch
2028	65	12%	38%	Hydro-axe or Dozer	PT Aspen/Birch
2033	65	12%	35%	Hydro-axe or Dozer	PT Aspen/Birch

Pen 2 (Figure 4)

Pen 2 currently is 559 acres, as the northern portion has been split to create a 7 acre rutting pen (Rut Pen), 2 holding pens adjacent to the lab (Pen 2A, 17 acres; Pen 2B, 14 acres), and a 56 acre calf rearing pen (Pen 2C). Currently, adult cow moose occupy the main portion of Pen 2, and calves are overwintered in Pen 2C. Pen 2 consists of mixed aspen, birch and spruce forest, with intermixed areas of bogs. One small lake is found in Pen 2A. Portions of Pen 2 were enhanced in the winters of 1986 and 1987 with the LeTourneau tree crushers, treating approximately 359 acres. Following tree crushing, moose were present in Pen 2 at a lower density then in Pen 1 and stands of birch and aspen have matured to the stem exclusion state. An addition 25 acres were treated in 2010 with a hydro-axe. Aspen and birch saplings are present in the 2010 treatment; however, moose have concentrated in this area, removing most seedlings over 2 feet tall. Areas within the 2010 treatment need to be scarified to promote seedling establishment, and additional areas in Pen 2 need to be enhanced to alleviate moose browse concentrating on the treated areas, otherwise bluejoint reedgrass may become dominant similar to the smaller treatments in Pen 1. Currently, 7 MRC cow moose and at least 1 wild cow moose occupy Pen 2, requiring felling of aspen and birch trees with minimal supplemental winter feeding.

Pen 2 will be enhanced by mechanical treatment in 2012, treating 115 acres (21% of the pen). Areas identified as having greater than 75% birch and aspen will be treated with a dozer or hydro-axe, breaking trees off at the root crown. All aspen stands treated shall have all trees removed, including adjacent mature aspen that may need to be cut by hand to promote sprouting. In addition, 25 acres of previously treated birch and aspen will be scarified, on the contour, to create an adequate seedbed for birch, aspen, and willow regeneration with a dozer blade. An

additional 55 acres of mature forest shall be removed or crushed by 2018 (Table 2). After 2018, a minimum of 65 acres need to be treated every 5 years to maintain 35% of the pen (195 acres) in early seral deciduous forest less than 15 years old (Table 2).

Table 2. Pen 2 Habitat Enhancement Rotation Plan (PT = Previously Treated)

Year	Acres	% of Pen	% of Pen <15yrs	Treatment	Community Treated
2012	115	21%	21%	Hydro-axe or Dozer	PT Aspen/Birch
2013	25	4%	25%	Scarify	PT Birch
2018	55	10%	35%	Timber Removal	Mature Mixed Forest
2024	65	12%	47%	Hydro-axe or Dozer	PT Aspen/Birch
2029	65	12%	33%	Hydro-axe or Dozer	PT Aspen/Birch
2034	65	12%	35%	Hydro-axe or Dozer	PT Aspen/Birch

Pen 3 (Figure 5)

Pen 3 is 616 acres in size, comprised of aspen, birch, and spruce mixed forest. Pen 3 contains the largest lake (42 acres) on the MRC, located in the middle of the eastern half of the pen. Pen 3 contained a 2.7 acre vegetation enclosure in the northwest corner; however, this enclosure is now open. In the winters of 1988 and 1989, approximately 239 acres of Pen 3 were enhanced with LeTourneau tree crushers. From 1989 to 1998 there were no moose present in Pen 3, allowing birch and aspen to establish without browsing. In 1999, 2 moose were placed in Pen 3, and increased to 6 moose in 2003. Moose have been utilizing natural forage year round since 1999 with no supplementation. Currently 6 MRC cow moose, and at least 1 wild cow moose, occupy Pen 3. Winter browse is becoming limited to overwinter animals without any supplemental feeding or felling of trees.

Pen 3 will be enhanced by mechanical treatment in 2013, treating 115 acres (20% of the pen). Areas identified as having greater than 75% birch and aspen will be treated with a dozer or

hydro-axe, breaking trees off at the root crown. All aspen stands treated shall have all trees removed, including adjacent mature aspen that may need to be cut by hand to promote sprouting. An additional 90 acres of mature forest shall be removed or crushed by 2018 (Table 3). To promote hardwood regeneration, 70 acres of mature forest will be removed. Any area where mature forest will be removed will not be wider than 4 times average birch height (birch height on adjacent untreated areas) for seed dispersal. Scarification in these sites will be accomplished during mature stand removal to promote seedling establishment. Furthermore, 20 acres of aspen and white spruce will be selectively removed at the same time, leaving mature birch for seed dispersal. After 2018, a minimum of 65 acres need to be treated every 5 years to maintain 35% of the pen (195 acres) in early seral deciduous forest less than 15 years old (Table 3).

Table 3. Pen 3 Habitat Enhancement Rotation Plan (PT = Previously Treated)

Year	Acres	% of Pen	% of Pen <15yrs	Treatment	Community Treated
2013	115	20%	20%	Dozer	PT Aspen/Birch
2018	90	16%	36%	Timber Removal	Mature Mixed Forest
2025	65	11%	47%	Hydro-axe or Dozer	PT Aspen/Birch
2030	65	11%	38%	Hydro-axe or Dozer	PT Aspen/Birch
2035	65	11%	34%	Hydro-axe or Dozer	PT Aspen/Birch

Pen 4 (Figure 6)

Pen 4 is 646 acres total, comprised of mixed mature forest (birch, aspen and white spruce), mature black spruce forest, and a large bog in the southeast corner. There are two vegetation enclosures, a 3.6 acre enclosure along the north fence, and a 1 acre enclosure on the south fence. Pen 4 has had no habitat enhancements, and any influences on vegetation have been from manipulating moose densities in the pen. Given inadequate forage to maintain moose year round in Pen 4, captive moose have not been kept in Pen 4 since 2002; however, up to 4 wild

moose were in the pen in early 2012. Using fence line traps and external gates, all wild moose have been removed from the pen.

Pen 4 requires the most enhancements to establish a rotation plan. Pen 4 will require enhancing 150 acres of black spruce in 2013 (23% of the pen). Areas of predominant black spruce will be treated with a shearblade, shearing the trees near the ground surface and push the debris into parallel windrows perpendicular to the slope that will later be burned. In 2018 and 2022, to promote hardwood regeneration, A total of 150 acres of mature forest will be removed (complete stand removal and selective removal). Any area where mature forest will be removed will not be wider than 4 times average birch height (birch height on adjacent untreated areas) for seed dispersal. Scarification in these sites will be accomplished during mature stand removal to promote seedling establishment. Selective removal of aspen and white spruce will leave leaving mature birch for seed dispersal. All aspen stands treated shall have all trees removed to promote root sprouting. After 2022, a minimum of 75 acres need to be treated every 5 years to maintain 35% of the pen (225 acres) in early seral deciduous forest less than 15 years old (Table 4).

Table 4. Pen 4 Habitat Enhancement Rotation Plan (PT = Previously Treated)

Year	Acres	% of Pen	% of Pen <15yrs	Treatment	Community Treated
2013	150	23%	23%	Shearblade/Burn	Black Spruce
2018	75	12%	35%	Timber Removal	Mature Mixed Forest
2022	75	12%	42%	Timber Removal	Mature Mixed Forest
2027	75	12%	35%	Hydro-axe or Dozer	PT Aspen/Birch
2032	75	12%	35%	Hydro-axe or Dozer	PT Aspen/Birch

Vegetation Monitoring

Representative areas of each vegetation class will be evaluated to describe the site. For each site, a sampling plot will be established to determine tree density and percent ground cover

(Figure 7). Tree density will be evaluated using two, 11.7 feet radius subplots placed 120 feet apart (adapted from Herrick et al. 2005, Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems). Percent ground cover will be evaluated on a 100 feet transect between the tree plots (Herrick et al. 2005). From the center of each tree density plot, a picture will be taking in the direction of the ground cover transect. After vegetation enhancement, seedling establishment will be evaluated in a 1 meter by 5 meter plot established randomly on the ground cover transect.

Figure 1. Kenai Moose Research Center

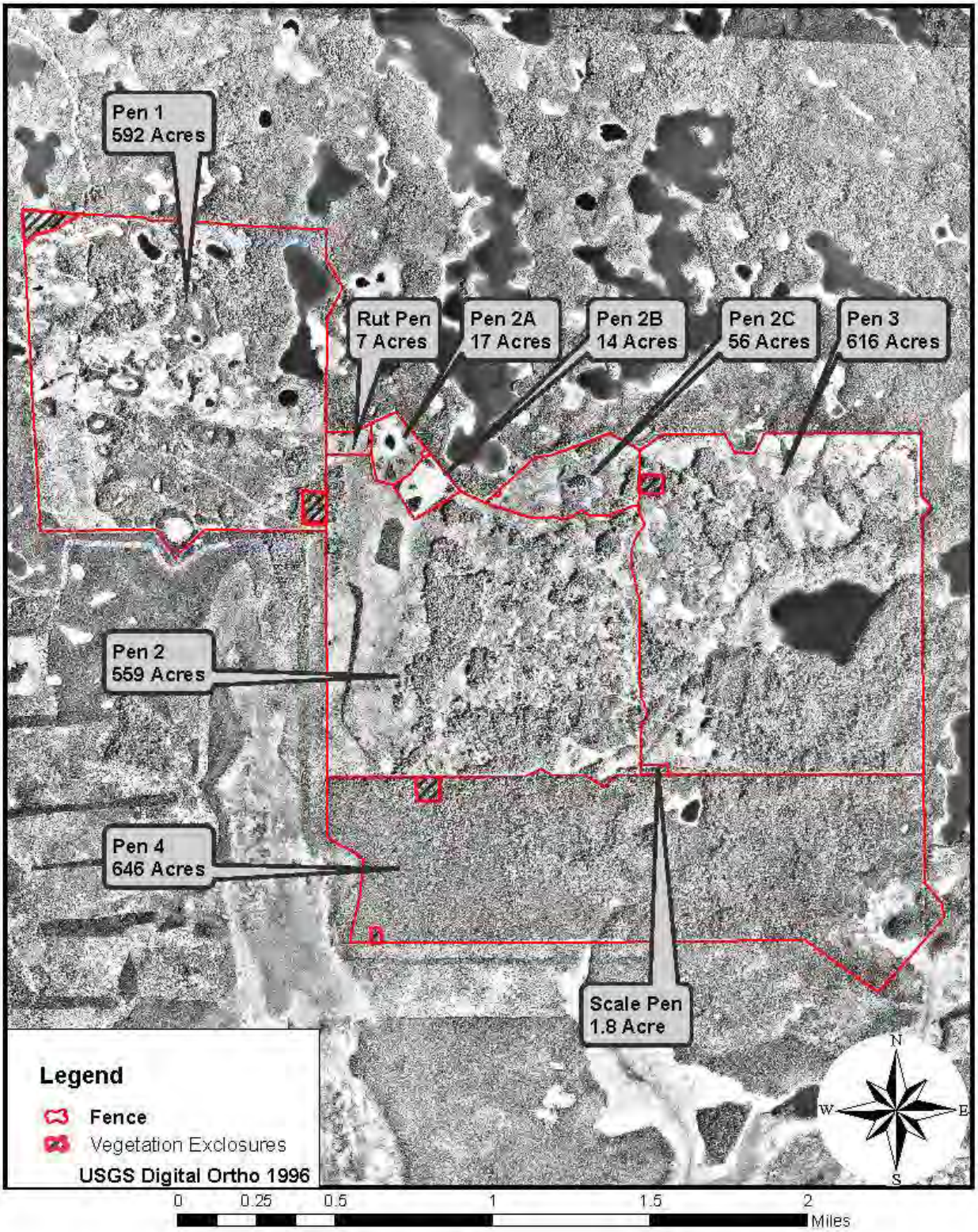


Figure 2. Kenai Moose Research Center habitat enhancements

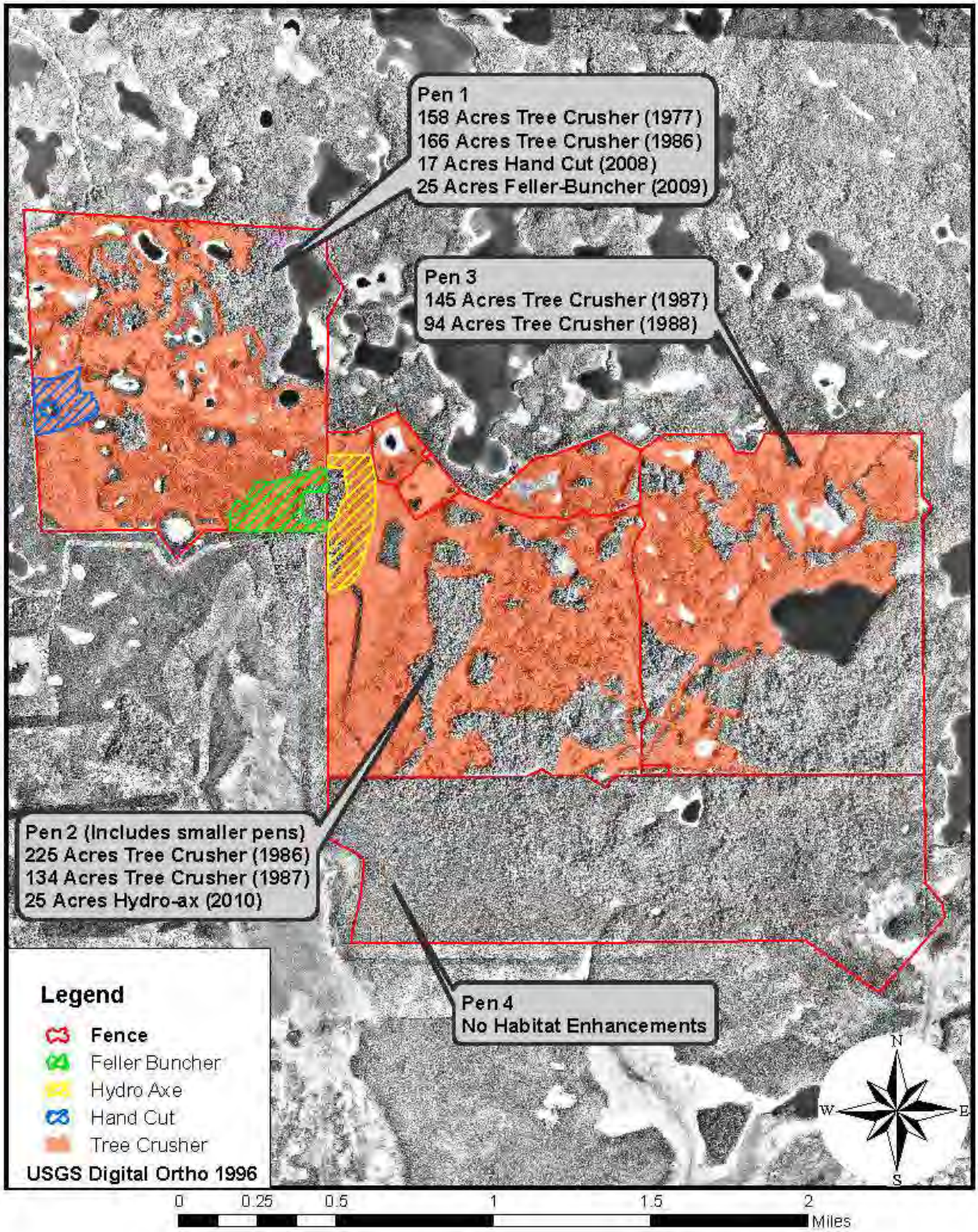


Figure 3. Pen 1 proposed habitat enhancements

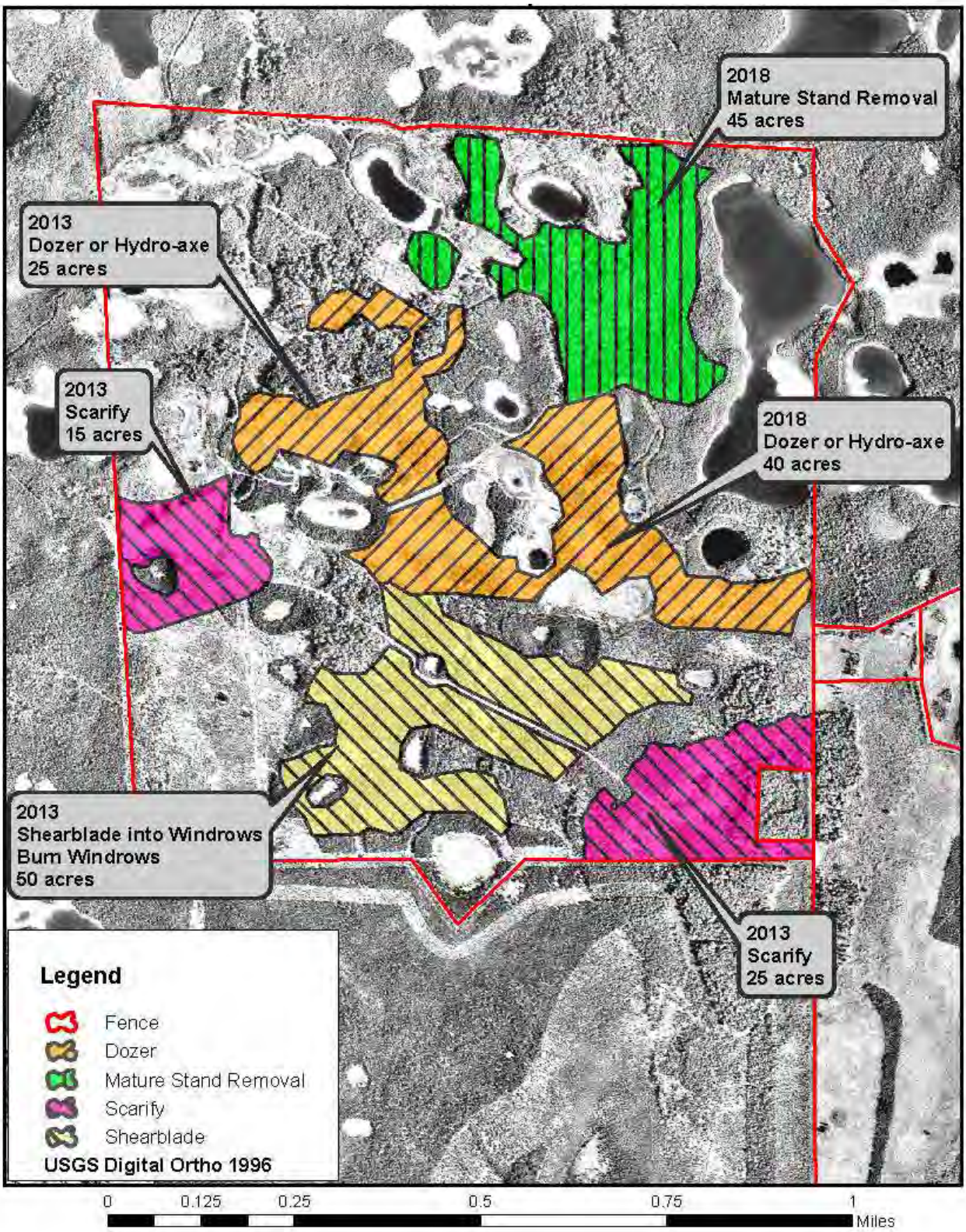


Figure 4. Pen 2 proposed habitat enhancements

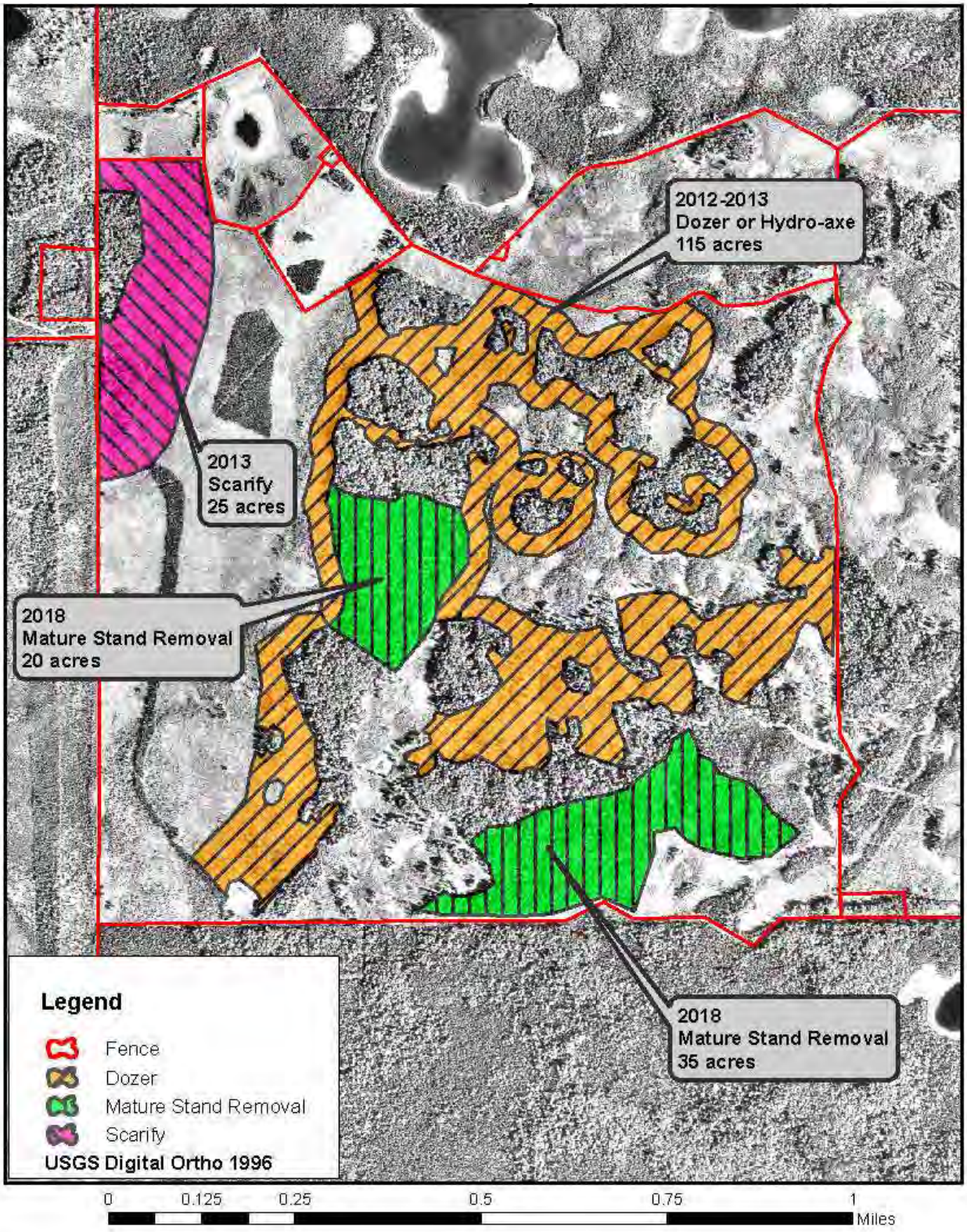


Figure 5. Pen 3 proposed habitat enhancements

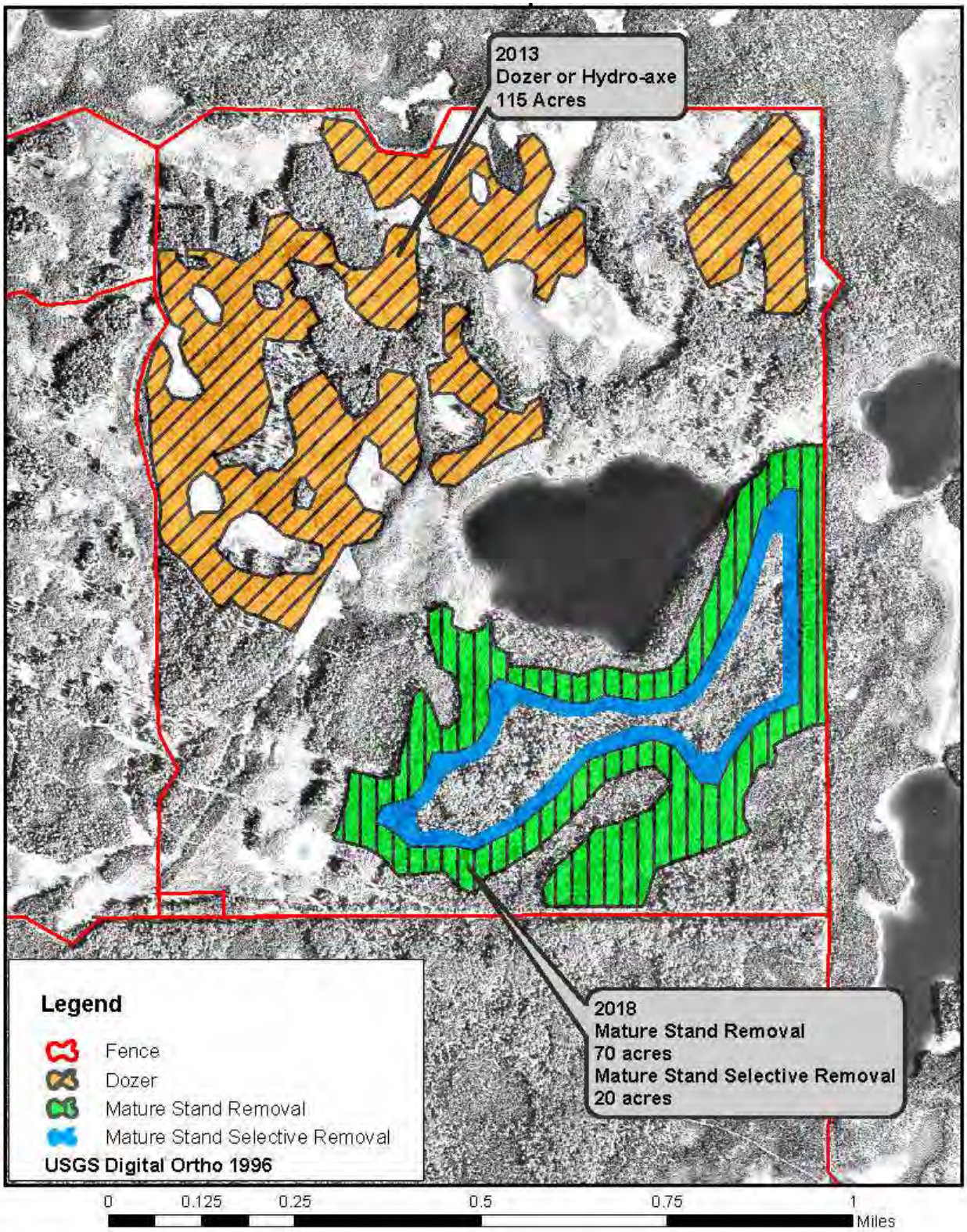


Figure 6. Pen 4 proposed habitat enhancements

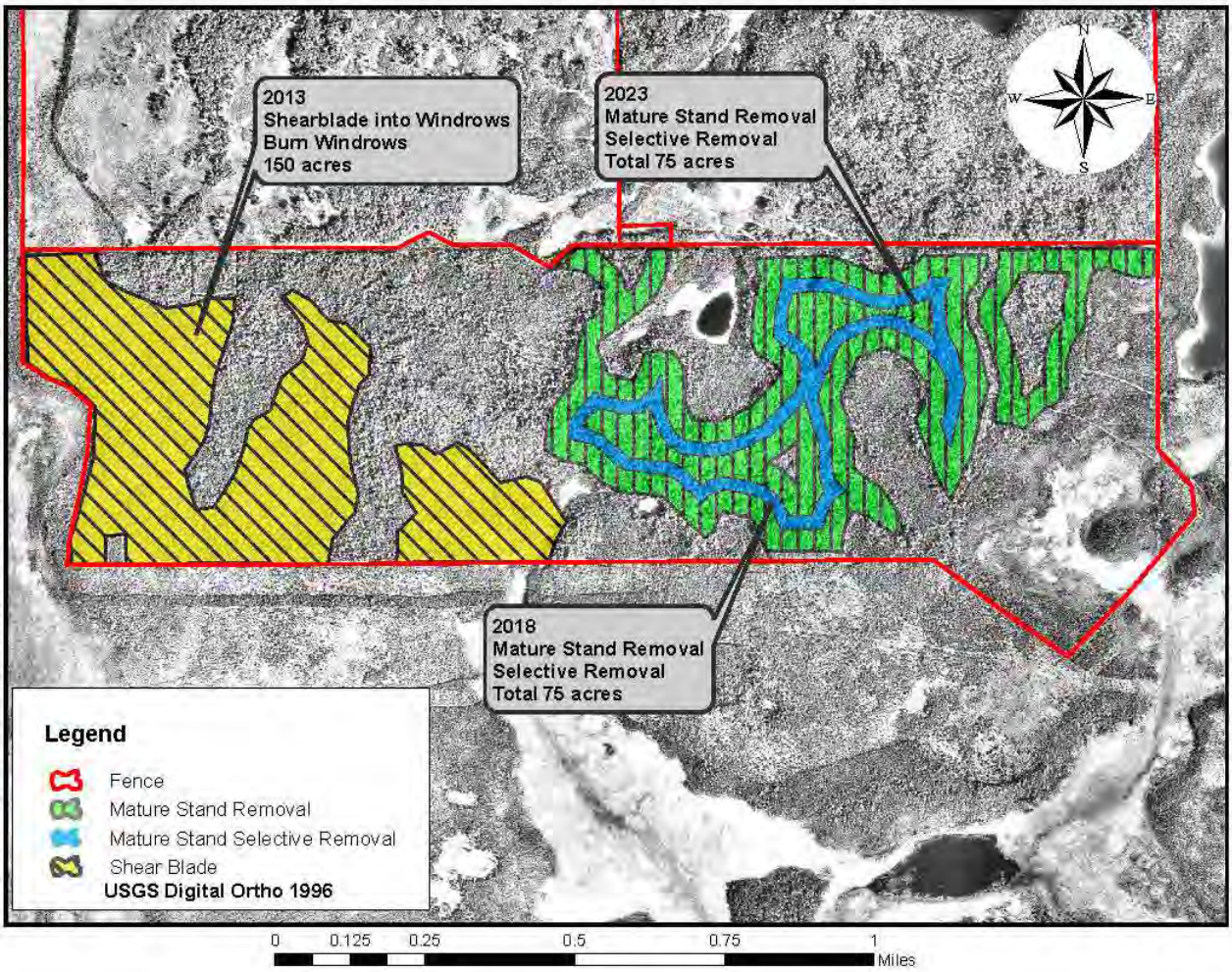
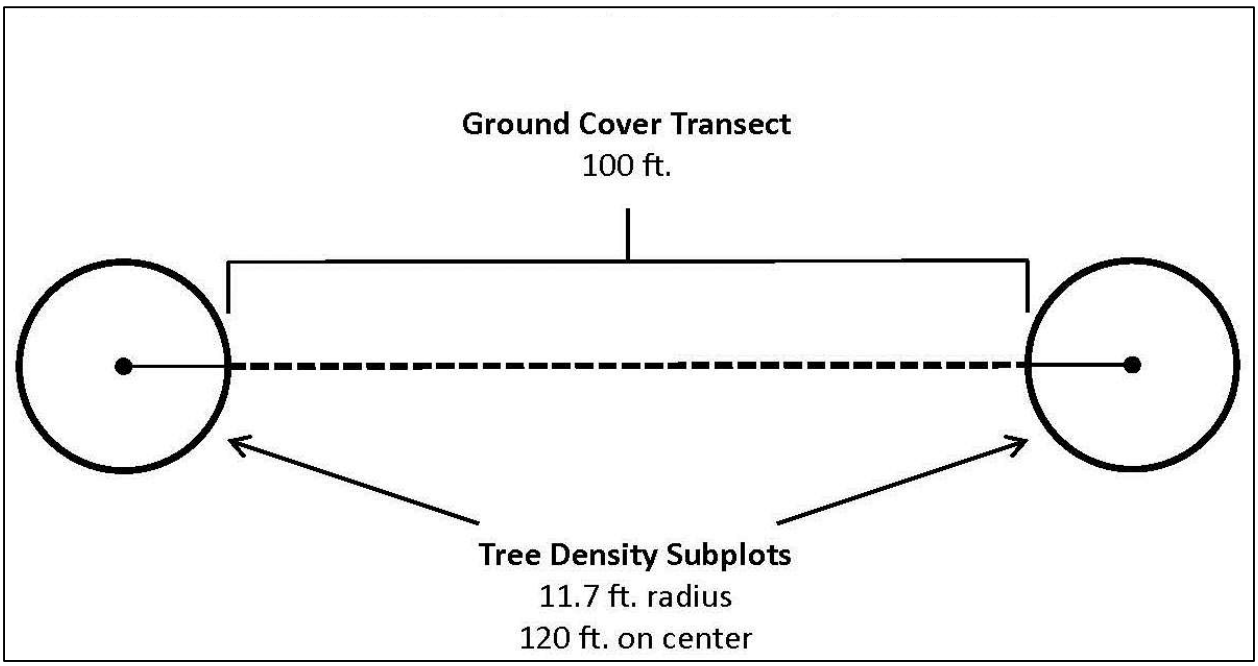


Figure 7. Tree density sampling plots and percent ground cover transect



Appendix P: Public Comment-Response Catalog

SUMMARY OF PUBLIC AND AGENCY COMMENTS AND USFWS RESPONSES

The Refuge published legal notices soliciting public comment on the Draft Environmental Assessment for the Kenai National Wildlife Refuge's Revised Fire Management Plan, in three area newspapers: the Peninsula Clarion, the Homer News and the Anchorage Daily News. The comment period was set for 30 days (May 1-May 31, 2013). The only written comments received were in a letter with "consolidated comments" from the State of Alaska's resource agencies, dated May 31, 2013, from the ANILCA Implementation Program, in the Office of Project Management and Permitting. The State letter is attached at the end of this appendix.

The following table outlines the State's comments and the Refuge's response to each comment.

Subject	Comment Number / Comment	Response Summary	Reference to Section
Fuels Management and Habitat	**1** "…the FMP does not address using prescribed fire for habitat management." (The implication is that the proposed plan is in conflict with one of the FMP's purposes: *"2. Maintain the ecological integrity of the Kenai NWR by using prescribed fire (planned ignitions), wildfire, and mechanical treatment methods."*)	While it is true that the Draft EA and revised FMP do not specifically address the use of prescribed fire for habitat management, the strategic use of planned (prescribed fire) and unplanned (wildfire) ignitions and mechanical treatments in the wildland-urban interface (WUI), is the best way for the Refuge to prepare for landscape-level wildfire. Without question, managing wildland fire on the landscape is the most productive and cost-effective way to maintain the ecological integrity and processes of the Refuge. By managing fire on the landscape, we can best achieve our mutual objective of maintaining healthy moose populations on the Kenai Peninsula.	1.7 Purpose of Action
Fuels Management and Habitat	**2** *"This EA does not propose using prescribed fire for habitat management…"* "This is in direct conflict with the Refuge's Moose/Habitat Management Plan…"	It should be noted that the Refuge FMP is not a habitat management, recreation management or wilderness stewardship plan. It is a step-down plan to the CCP that incorporates the Alaska Interagency Wildland Fire Management Plan. Consequently, and by design, its focus is on wildland fire management, preparedness, prevention and hazardous fuels management. Wildland fire management on a landscape such as the Kenai Peninsula, with all of its communities, its wildland-urban interface and intermix areas, and its intensive use by Alaskan residents and visitors during the fire season, is already very complex. To add habitat, wilderness and/or recreation management objectives to the FMP would	2.3. Proposed Alternatives

Subject	Comment Number / Comment	Response Summary	Reference to Section
		be infeasible and unrealistic. As a CCP step-down plan, ideally, the FMP would not conflict with the Moose Management Plan, the Skilak Lake Wildlife Recreation Area Management Plan or other step-down plans. However, the potential for conflicting goals, objectives and outcomes among step-down plans does exist. One example of conflicting resource management goals is protecting communities from wildfire versus protecting wilderness values from the adverse impacts of suppression activities. The Refuge managed these conflicting goals during the King County Creek Fire in 2005 and the Shanta Creek Fire in 2009. Another conflict may occur when a wildfire is allowed to burn in order to accomplish resource management objectives such as reducing hazardous fuels, maintaining ecological processes or improving moose winter browse. If that fire burns near or into the wildland-urban interface or approaches a community, those objectives will likely be replaced by protection objectives. The Glacier Creek Fire in 2004 was a wilderness fire that was managed under a monitoring strategy, until it approached private lands and structures at Bear Creek. Then the strategy was changed to protect those private lands and structures. Under federal wildland fire management policy, it	

Subject	Comment Number / Comment	Response Summary	Reference to Section
		is now possible to manage wildfires using multiple objectives. However, life safety and protection of private lands and assets always take precedence over natural resource management objectives.	
Fuels Management and Habitat	**3** "The FMP briefly mentions the Moose/Habitat Management Plan as a step-down plan/previous NEPA analysis for already-approved projects and treatments, but does not explain the relationship between the Moose/Habitat Management Plan and the FMP."	While both the FMP and the Moose Management Plan can be categorized as stand-alone, step-down plans to the Refuge Comprehensive Conservation Plan (CCP), their only relationship is that wildfire, prescribed fire and mechanical treatments that are managed to achieve fire management objectives may also provide some benefit to moose habitat.	2.3.3 Comparison of Alternatives
Fuels Management and Habitat	**4** "The FMP should provide a clear path to guide the public and resource managers to the decision-making process for the use of fire as a management tool in all situations. Currently it does not."	As a step-down plan to the Refuge CCP, and incorporating the fire management guidance provided by national interagency fire policy and the Alaska Interagency Wildland Fire Management Plan (AIWFMP), the proposed Refuge FMP is designed to guide land and fire managers in the management of wildland fire on the Kenai NWR. In the management of wildfire, the Refuge and all other Department of Interior land management agencies, by policy, use the Wildland Fire Decision Support System (WFDSS) as a decision-making tool for every wildfire. Refuge land and resource management goals, objectives and constraints are incorporated into WFDSS to help guide the decision-makers in managing wildfires.	General comment – no specific section referenced
Funding	**5** "While the Refuge lacks funds to do the	Collaborative interagency planning is the	General comment –

Subject	Comment Number / Comment	Response Summary	Reference to Section
Opportunities	needed habitat work regarding prescribed fire or other vegetation management, we do have the opportunity to collaborate (ADF&G, Kenai Peninsula Borough, the Refuge, Alaska Division of Forestry) on submitting a grant application to the Western States Wildland Urban Interface grants via the Division of Forestry. This could be used to align fire mitigation efforts consistent with local CWPPs with habitat improvement needs for moose and other species. Note that this grant provides for mitigation but not the habitat improvement; however, we would be able to address both through vegetation manipulation."	best way to develop federal, state, borough and non-governmental funding for fuels/vegetation management projects. The Refuge works collaboratively with many of its cooperators on the All Lands All Hands Committee. This interagency group helped Kenai Peninsula communities develop and implement their Community Wildfire Protection Plans (CWPP's), which are instrumental in the pursuit of federal fuels management funds and WUI grants.	no specific section referenced
Fuels Treatments in Designated Wilderness	**6** "We question the FMP's decision to not treat hazardous fuels within CWPPs that are also in designated wilderness *"because the area is designated wilderness"* (page 2-8 is one example). This decision seems counter to the CWPP's purpose to *"provide a seamless guide for fuel reduction across ownerships"* (page 2-6). This also seems counter to the FMP's allowance for prescribed fire and manual treatments in the Wilderness FMU. Finally, according to the Service Wilderness Stewardship Policy, these tools may be used if they are the minimum requirement for administering the area as wilderness (610 FW 2.23). The FMP acknowledges that the excess fuel loads on the Refuge are at least partially caused by past suppression of natural fire; this scenario is described as an unnatural condition that	The Refuge has, and will continue to treat hazardous fuels within designated Wilderness areas, through the use of fire for resource benefit and through mechanical treatments. Examples include the 26,500-acre Fox Creek (Wildland Fire Use) Fire in 2005 and the 1,960-acre Swan Lake (Wildland Fire Use) Fire in 2007. Two other Refuge wilderness fires that were monitored (instead of fully suppressed), include the 8,600-acre Glacier Creek Fire in 2004 and the Caribou Hills Fire in 2007, which burned about 6,400 acres of the Andrew Simons Wilderness. In 2009, during the Shanta Creek Fire (lightning-caused), the Refuge decided to build a 30-foot-wide contingency fuelbreak along the northern boundary of the Andrew Simons Wilderness to help protect the communities	2.3.2 Alternative B: Strategic and Collaborative Hazardous Fuels and Wildfire Mitigation

Subject	Comment Number / Comment	Response Summary	Reference to Section
	the Refuge is encouraged to restore (610 FW 2.16)."	of Funny River and Sterling. While the Refuge has not to date developed formal plans to use prescribed fire in designated Wilderness, the Refuge's Revised Comprehensive Conservation Plan (CCP) does allow for the use of that treatment method. The previous CCP did not. The Refuge, through collaborative planning with the Alaska Division of Forestry, the Kenai Peninsula Borough, the Chugach National Forest and the communities of the Kenai Peninsula, is in the process of reviewing CWPP's, assessing wildfire hazards and risk, and strategically planning future hazardous fuels treatments on the Refuge, including the potential for prescribed fire in wilderness.	
Resources Not Analyzed	**7** "We believe the items referenced in 3.2.2 deserve analysis related to the effects from both the alternatives. For instance, regarding Environmental Justice, subsistence users are affected by declining moose habitat due to lack of fire; fire can also have effects on social and economic values and conditions simply by causing recreation users to avoid areas, altering economic patterns. Transportation systems can be affected by smoke altering driving patterns and speeds. Most glaringly, however, is the absence of an analysis of recreation. According to ANILCA Section 303(4)(B), recreation is one of the specific purposes for which the Refuge was	Section 3.2.2 of the EA lists four resources/assets (environmental justice concerns, social and economic values/concerns, recreation, and transportation systems) that were not analyzed because they were not affected by, or not differentially affected by, either of the alternatives. In addition, the consequences of overall management of the Refuge, which includes its fire management program, upon each of these resources/assets were addressed in the Revised Comprehensive Conservation Plan and Environmental Impact Statement (August 2009). The Final EA is modified to	3.2.2 Resources Not Analyzed

Subject	Comment Number / Comment	Response Summary	Reference to Section
	established and shall be managed. Fire management can influence short and long term use of areas depending on the specific type of recreation considered. For instance, hunting effort may decline under an aggressive fire suppression effort that causes reduced habitat for moose as forest age. Conversely, fire can be used as a tool to improve beneficial habitat and increase opportunities for hunting. Given that the current succession of forest on the Kenai is influencing moose abundance, it is surprising that recreation was not considered."	expand this explanation.	
Page-specific Comments	**8** "Pg. 1-9, List of Applicable Statutes – Please add the Alaska National Interest Lands Conservation Act (16 USC 3101-3233)"	The reference to ANILCA is included in the Final EA.	1.10 Regulatory Compliance
Page-specific Comments	**9** "Page 3-26-to 3-28, Section 3.4.3.1 Special Status Wildlife Species. This section provides poorly referenced discussions related to the status of some species of wildlife on the Kenai Peninsula. As the Department of Fish and Game previously commented during the CCP revision process, we do not consider brown bears to be a species of special concern, as justified by recent population estimates derived by the Refuge. During the CCP revision we also questioned the reference to both marten and red fox as distinct subspecies, and further question the assertion that either is compromised due to overharvest. Their limitation on the Refuge is more likely the result of unfavorable habitat."	The discussion in the EA regarding marten is taken directly from Appendix 4 of the State's Wildlife Action Plan, including the reference to overtrapping as a potential concern. In 1998, the Kenai brown bear was designated a population of special concern by the State of Alaska because it "is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance." In August 2011, the State eliminated the "State species of concern" list but their previous status is noted in Appendix 7 of the Wildlife Action Plan. The EA has been modified to more specifically cite references. The marten and red fox have	3.4.3.1 Special Status Wildlife Species

Subject	Comment Number / Comment	Response Summary	Reference to Section
		been identified by Refuge biologists as *"species of special interest."*	
Page-specific Comments	**10** "Please justify the discussion regarding the *"known"* make-up of the *"brown haze"* seen over Cook Inlet during winter months, including the reference to *"smog from Anchorage"*. We are unaware of how this determination was made given that *"the refuge does not have air quality or visibility impairment data."*	The word "Known" was changed to "Potential", and the reference to "smog from Anchorage" was deleted in the Final EA.	3.6.1 Affected Environment
Page-specific Comments	**11** "We understand that the FMP only applies to the Refuge, but since it is only a part of the Kenai Peninsula and is adjacent to and encloses lands and waters under different administrative jurisdictions, please explain how the FMP will not conflict or will complement fuel and fire management actions elsewhere. A brief discussion of how the FMP relates to Alaska Interagency Wildland Fire Management Plan and other related plans would be useful, as would an explanation of how the FMP complements the CWPPs despite not proposing treatments in some CWPPs where the Refuge land is designated wilderness."	Section 3.16 of the Final EA has been modified to explain how the FMP relates to the AIWFMP, to the various CWPP's and to other applicable land use plans.	3.16 Possible Conflicts with Other Land Use Plans

Kenai National Wildlife Refuge
2013 FIRE MANAGEMENT PLAN

KENAI NATIONAL WILDLIFE REFUGE

FIRE MANAGEMENT PLAN

Revised September 2013
(09/20/2013)

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REVIEW AND APPROVALS

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1.0 INTRODUCTION

The revised 2013 Fire Management Plan (FMP) is a step-down plan to the Revised Comprehensive Conservation Plan (CCP) and Environmental Impact Statement for the Kenai National Wildlife Refuge, Alaska (11/17/2009). The FMP is an implementation plan that guides all fire management operations on and for the Refuge. This plan incorporates the Final Environmental Assessment (EA) and Finding of No Significant Impact (FONSI). This FMP replaces the 2012 Interim Fire Management Plan and the previous 2001 Kenai NWR FMP.

Our vision for wildland fire management on the Kenai National Wildlife Refuge is to implement a program of work that is aligned with the mission of the U.S. Fish & Wildlife Service and the National Wildlife Refuge System, and in concert with the establishing purposes of the Refuge and its Wilderness, to promote a Refuge land and wildland fire management environment where:

- natural fire is accepted and valued as an ecosystem process and fire adapted ecosystems are maintained;
- wildfires are managed both to protect human life, private property and other assets, and to accomplish identified resource management objectives;
- communities of the Kenai Peninsula, and biologically diverse landscapes of the Refuge are resistant to catastrophic wildfire and other natural disasters.

To realize this vision, the Refuge Fire Management Program must work cooperatively and collaboratively with Refuge Managers, other Refuge Staff, the Regional Fire Management Branch, Refuge Cooperators and Partners, and with the Public. We must help our neighbors, the residents of the Kenai Peninsula, adopt FireWise practices and promote FireWise Communities. We need to use the best available science to analyze landscapes, identify hazards and assess risks, and develop a strategic hazardous fuels treatment plan for the Refuge, especially where urban interface and intermix areas adjoin Refuge lands. And we need to explore new ways to reach area residents and Refuge visitors with fire safety and fire prevention information, thereby reducing the number of abandoned, unattended and escaped campfires.

This fire management plan allows the Refuge to manage fire on the landscape per the management guidelines and constraints of the CCP and per national, regional and local land and fire management policy.

1.1 Purpose of the Fire Management Plan

This plan is written to meet Department of Interior (DOI) and U.S. Fish and Wildlife Service (FWS) requirements that every area with burnable vegetation must have an approved Fire Management Plan (FMP).

This FMP defines a program of wildland fire management actions to achieve specific goals, objectives, and activities in the approved Comprehensive Conservation Plan (CCP). A Record of Decision for the *Revised Comprehensive Conservation Plan and Environmental Impact Statement for Kenai National Wildlife Refuge, Alaska,* was signed by the Regional Director on 11/17/09. To maintain currency, fire management plans must be reviewed each year using the

nationally established annual review process. Plans must be revised when significant changes occur or substantial changes in management are proposed. Minor plan revisions may be accomplished through an amendment added to the plan and signed by the line officer and servicing fire management officer. Major scheduled revisions to fire management plans will follow the 15 year Comprehensive Conservation Plan revision cycle to provide consistency in objectives and management strategy formulation.

The goal of a wildland fire management plan is to plan and implement actions to help accomplish the mission of the National Wildlife Refuge System, which 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. (095 FW 3.2)

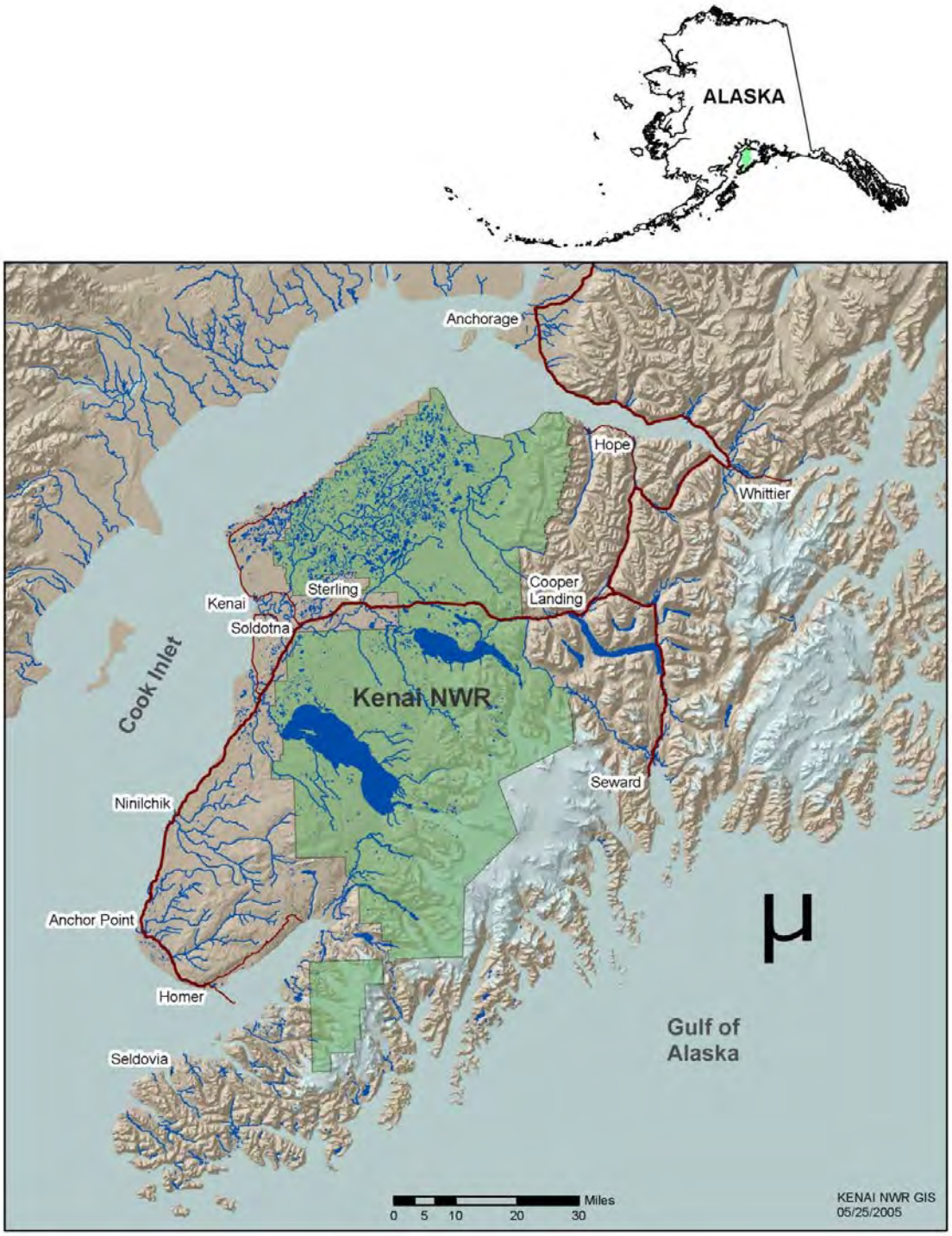
As described in Service Manual (621 FW 2.2), the Refuge FMP provides the planning framework for all Refuge fire management decision-making and identifies the approved course of action relating to fire as described in other plans. The FMP identifies action to be taken to preserve, protect and enhance natural and cultural resources with specific regard to wildland fire and provides the background and guidelines for management of wildfires and prescribed fires. It specifies the uses of fire that are consistent with and can enhance Refuge habitat and wildlife management objectives.

The FMP follows the outline of the April 2009 interagency format and incorporates current policy and terminology relating to interagency and Service fire management programs. This step-down plan from the CCP describes actions to prepare for and respond to unplanned ignitions, to plan and conduct prescribed fires, and to complete other fire management business. This plan is intended to integrate all wildland fire management activities within the context of the Kenai National Wildlife Refuge CCP and help achieve land and resource management goals and objectives identified in that document and in other step-down plans written and approved in the interim period.

1.2 General description of the Area in the FMP

The Kenai National Wildlife Refuge (Kenai NWR) is located on the Kenai Peninsula in south-central Alaska (**Figure 1 – Kenai NWR Location**). The Refuge is one of 16 refuges in Alaska which collectively, make up the Alaska Region (Region 7) of the National Wildlife Refuge System. The Kenai NWR encompasses approximately 1.98 million acres of diverse landscapes and habitats: from the Harding Icefield and the 6000' Kenai Mountains west to the glacial moraines, pothole lakes, forests and wetlands of the Kenai Lowlands, and south from the Turnagain Arm of Cook Inlet to Kachemak Bay. About two-thirds of the Refuge (1.3 million acres) is designated as wilderness in three distinct units: the Dave Spencer Wilderness (187,279 acres), the Mystery Creek Wilderness (46,086 acres), and the Andrew Simons Wilderness (1,087,434 acres).

Figure 1 - Kenai NWR Location



Lands adjacent to the Kenai NWR are managed or owned by the Chugach National Forest, Kenai Fjords National Park, the State of Alaska, the Kenai Peninsula Borough, Alaska Native corporations, and private individuals. Most of the eastern boundary of the Refuge borders Forest Service and National Park lands. The northern boundary is bordered by Turnagain Arm and Cook Inlet. The western boundaries are classified as wildland-urban interface, where State of Alaska lands, Alaska Native corporation lands, private lands and the communities of Nikiski, Kenai, Soldotna, Sterling, Funny River, Kasilof, Clam Gulch, Ninilchik, Nikolaevsk and Anchor Point (from north to south) border, or are near the Refuge. To the south, the Refuge is bordered by Kachemak Bay, State of Alaska lands and Kenai Fjords National Park. The land ownership within the Kenai NWR boundaries totals 1,987,202 acres and is summarized in **Table 1 – Land Ownership Acres**:

Table 1 – Land Ownership Acres

Owner	Acres
Fish & Wildlife Service	1,938,889
Wilderness	1,319,500
Non-Wilderness	667,702
Private	525
State of Alaska	1,362
Alaska Native Corporation	46,041
Native Allotments	385

Figure 2 - Kenai Peninsula Land Status shows the Refuge and other land ownership on the Kenai Peninsula.

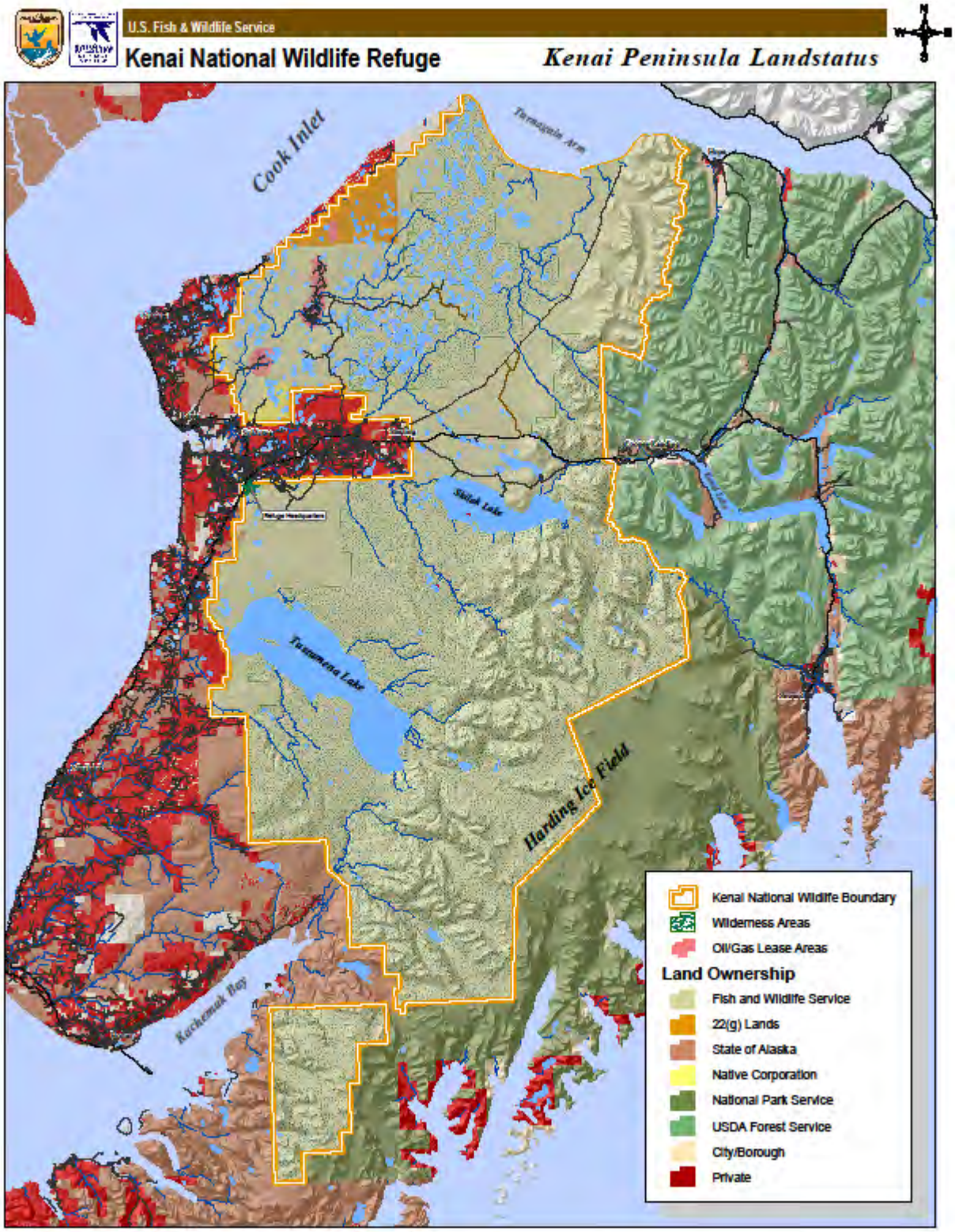


Figure 2 – Kenai Peninsula Land Status

1.3 Significant Values to Protect

The Kenai National Wildlife Refuge was first established as the Kenai National Moose Range on December 16, 1941 by President Franklin D. Roosevelt under ***Executive Order 8979***, for the purpose of "…protecting the natural breeding and feeding range of the giant Kenai moose on the Kenai Peninsula, Alaska…" With the passage of the ***Alaska National Interest Lands Conservation Act of 1980*** (ANILCA), the name of the Moose Range was changed to the Kenai National Wildlife Refuge and the Refuge was expanded by nearly a quarter of a million acres to its current size (1.98 million acres). ANILCA also designated 1.35 million acres of the Refuge as Wilderness and established five new Refuge purposes:

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 non-migratory 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 Wilderness units of the Kenai NWR:

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. *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.*

In consideration of the Service and National Wildlife Refuge System mission and the purposes of the Refuge as stated above, Kenai Refuge staff developed the following vision statement:

"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."

Human life is the single, overriding value to be protected by actions authorized under this plan. Priorities for the protection of communities and community infrastructure, property and improvements, and natural and cultural resources will be based on human health and safety, values at risk, and the costs of protection.

Other values to protect include property and infrastructure in the communities within and adjacent to Refuge Boundaries. There are also resources and infrastructure within the Refuge that warrant consideration regarding fire and/or protection from fire. They include: oil and natural gas facilities and pipelines, power lines, administrative properties, private property within the Refuge, ANCSA trust lands, backcountry recreation sites, and cultural resources. The Refuge also has many developed recreational and interpretive sites. Per the Regional Policy RW-1, dated August 2010, permitted cabins and their contents are not guaranteed fire protection.

1.3.1 Special Values of the Kenai NWR

The CCP identified seven significant or special values (valued ecosystems and places) of the Kenai National Wildlife Refuge: the Chickaloon Watershed and Estuary, the Harding Icefield, the Kenai River and its Tributaries, the Lowland Lakes System, the Skilak Wildlife Recreation Area, Tustumena Lake and its Watershed, and the Tustumena-Skilak Benchlands (See: **Figure 3 Kenai NWR Special Values**).

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.

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 Harding Icefield is receding.

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.

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.

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.

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.

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.

Outside of the Harding Icefield, each of these valued ecosystems or special places contains burnable vegetation and has a fire history. The potential impacts of wildfire and fire management activities upon these special areas of the Refuge and the values at risk contained therein, should be considered during incident and project planning. Values at risk are identified in Chapter 3 – Fire Management Unit Characteristics.

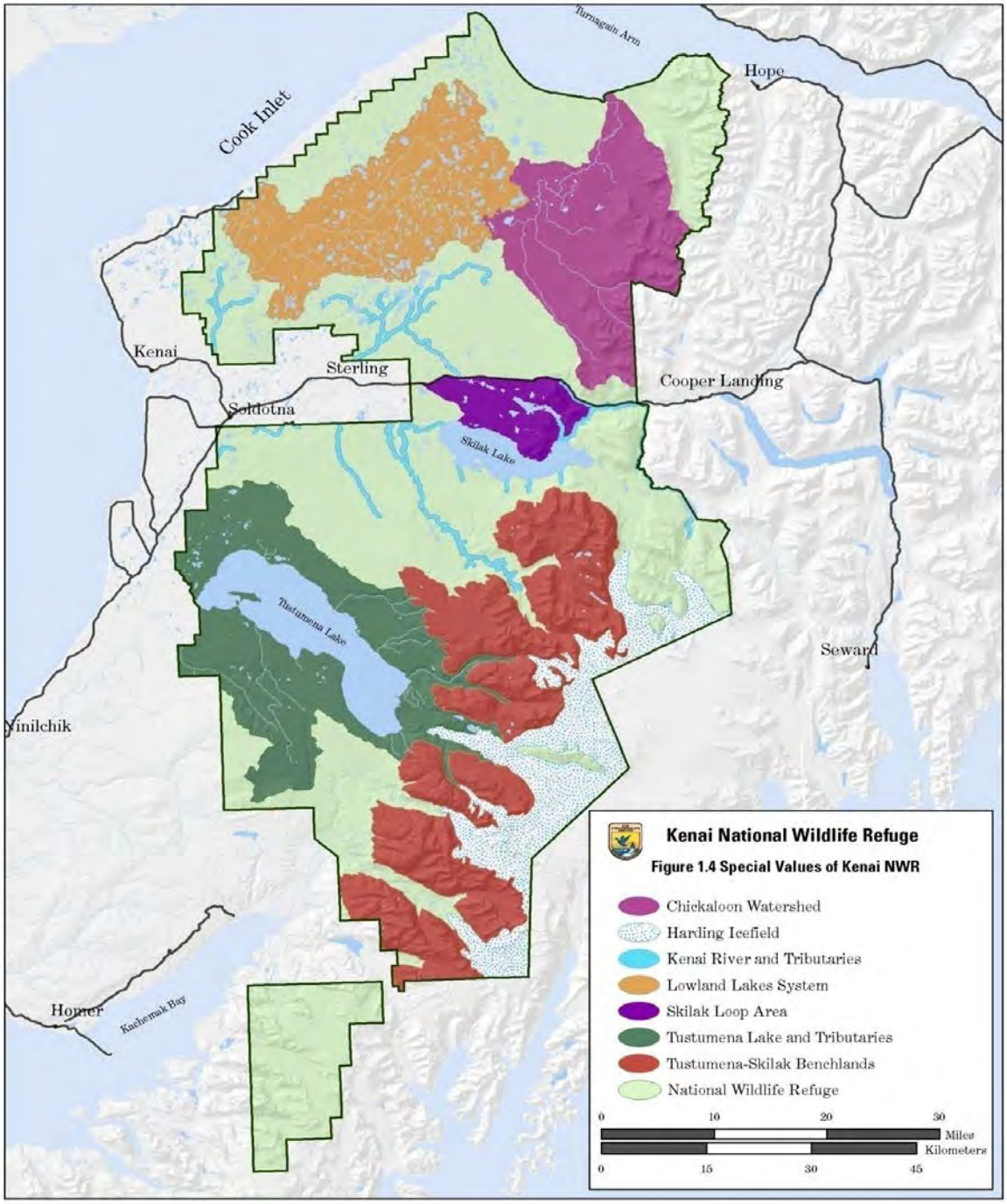


Figure 3 - Kenai NWR Special Values

1.4 Effects of Climate on Biotic Composition

Scientific efforts are underway in Alaska, to monitor climate change and its effects and to model/predict future impacts to biotic communities and physiographic features. Some of the more obvious and well-documented effects of climate change in south-central Alaska include receding glaciers, drying wetlands, the upward movement of tree line, the spruce bark beetle epidemic, and expanding grasslands. Less obvious and/or less-documented effects include changes to fire regimes, lightning occurrence, and

the spread of invasive species. One example of the climate research and monitoring, specific to the Refuge is included in **Appendix A** - Executive Summary for the Kenai National Wildlife Refuge: Projected Vegetation and Fire Regime Response to Future Climate Change in Alaska. June, 2009.

The following paragraphs in this section were developed by the FWS Alaska Regional Fire Ecologist:

The climate in boreal and arctic Alaska is changing (Arctic Climate Impact Assessment 2005, Intergovernmental Panel on Climate Change 2007, Hinzman et al. 2005). Mean annual air temperature in interior Alaska has increased by 1.3° C in the last 50 years and is expected to increase another 3° – 7° C by the end of the 21st century (Chapin et al. 2010). The snow-free period has increased, up to 10 days in some areas, largely due to earlier spring snowmelt (Hinzmen et al. 2005, Euskirchen et al. 2006). These changes will have numerous effects on vegetation, hydrology, insect occurrence, and wildlife that could fundamentally change boreal forest and tundra ecosystems. Effects include:

- Melting permafrost;
- Melting sea ice, which has implications for marine mammals and regional weather patterns (Hu et al. 2010);
- Drying wetlands (Riordan et al. 2006);
- Changing fire regimes(Kasischke et al. 2010), including changes in the initiation and end of fire season;
- Shifts in distribution of plants and animals (Murphy et al. 2010, Beck et al. 2011);
- Increased likelihood for invasive plant establishment (Villano 2008), and
- Increased possibility of wildlife disease and insect outbreaks.

Research and modeling efforts provide insight on potential future conditions, but specific agency guidance on addressing these changes is limited. The Service has developed a strategic plan for responding to climate change that includes three broad approaches: adaptation, mitigation, and engagement (USFWS 2010). The core of the Service's response will be adaptation, defined as "planned, science-based management actions, including regulatory and policy changes, that we take to help reduce the impacts of climate change on fish, wildlife, and their habitats."

Fire managers are faced with numerous challenges as they consider refuge and other legal mandates as well as safety obligations in the face of changing fire regimes. The primary goal for mitigation in the Service's strategic plan is to sequester carbon and it is uncertain how sequestration objectives will be applied in Alaska, where numerous species depend on fire and where many naturally occurring, landscape-scale fires are allowed to burn if they do not threaten life or property.

In the absence of specific guidelines regarding fire management and climate change, fire management planning will continue to be based on guidance provided in refuge CCPs and associated step-down plans, ANILCA, and evolving scientific data. Activities will be coordinated with Landscape Conservation Cooperatives and the regional Inventory and Monitoring Program when appropriate. Monitoring of fire effects and participation in research efforts will better inform management decisions in the face of climate change.

2.0 POLICY, LAND MANAGEMENT PLANNING AND PARTNERSHIPS

2.1 Federal Interagency Wildland Fire Policy

This FMP meets the Federal Wildland Fire Management Policy by implementing and following these guiding principles:

- Firefighter and public safety is the first priority in every fire management activity.
- The role of wildland fire as an essential ecological process and natural change agent has been incorporated into the planning process.
- Federal agency land and resource management plans set the objectives for the use and desired future condition of the various public lands.
- Fire management plans, programs, and activities support land and resource management plans and their implementation.
- Sound risk management is a foundation for all fire management activities. Risks and uncertainties relating to fire management activities must be understood, analyzed, communicated, and managed as they relate to the cost of either doing or not doing an activity.
- Fire management programs and activities are economically viable, based upon values to be protected, costs, and land and resource management objectives.
- Fire management plans and activities are based upon the best available science.
- Fire management plans and activities incorporate public health and environmental quality considerations.
- Federal, State, tribal, local, interagency, and international coordination and cooperation are essential.
- Standardization of policies and procedures among federal agencies is an ongoing objective.

In addition, the following guidelines from *Guidance for Implementation of Federal Wildland Fire Management Policy (February 2009)* are considered in order to provide consistent implementation of federal wildland fire policy:

- Wildland fire management agencies will use common standards for all aspects of their fire management programs to facilitate effective collaboration among cooperating agencies.
- Agencies and bureaus will review, update, and develop agreements that clarify the jurisdictional inter-relationships and define the roles and responsibilities among local, State, Tribal and Federal fire protection entities.
- Responses to wildland fire will be coordinated across levels of government regardless of the jurisdiction at the ignition source.
- Fire management planning will be intergovernmental in scope and developed on a landscape scale.
- Wildland fire is a general term describing any non-structure fire that occurs in the wildland. Wildland fires are categorized into two distinct types:
    - Wildfires – Unplanned ignitions or escaped prescribed fires
    - Prescribed Fires - Planned ignitions.

- A wildland fire may be concurrently managed for one or more objectives and objectives can change as the fire spreads across the landscape. Objectives are affected by changes in fuels, weather, topography; varying social understanding and tolerance; and involvement of other governmental jurisdictions having different missions and objectives.
- Management response to a wildland fire on federal land is based on objectives established in the applicable Land/ Resource Management Plan and/or the Fire Management Plan.
- Initial action on human-caused wildfire will be to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety.
- Managers will use a decision support process to guide and document wildfire management decisions. The process will provide situational assessment, analyze hazards and risk, define implementation actions, and document decisions and rationale for those decisions.

2.1.1 Federal Wildland Fire Cost Effectiveness Policy

Maximizing the cost effectiveness of a fire management program is the responsibility of all involved. Cost effectiveness is the most economical use of the resources necessary to accomplish mission objectives. Accomplishing fire operations objectives safely and efficiently will not be sacrificed for the sole purpose of "cost-savings." Care will be taken to ensure that suppression expenditures are commensurate with values to be protected, while understanding that other factors may influence spending decisions, including the social, political, economic, and biophysical environments (2012 Interagency Standards for Fire and Fire Aviation Operations, Chapter 1, Page 10).

2.1.2 National Fire Plan

This FMP meets the direction in the National Fire Plan because it emphasizes the following primary goals of the 10 Year Comprehensive Strategy and Cohesive Strategy for Protecting People and Sustaining Natural Resources:

- Improving fire prevention and suppression,
- Reducing hazardous fuels,
- Restoring fire-adapted ecosystems, and
- Promoting community assistance.

This FMP emphasizes the following overarching goals and performance measures described in *A National Cohesive Wildland Fire Management Strategy (2011):*

- **Restore and Maintain Landscapes:**

  GOAL: *Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.*

  Outcome-based Performance Measure:

  - Risk to landscapes is diminished.
- **Fire Adapted Communities:**

GOAL: *Human populations and infrastructure can withstand a wildfire without loss of life and property.*

Outcome-based Performance Measure:

- Risk of wildfire impacts to communities is diminished.
- Individuals and communities accept and act upon their responsibility to prepare their properties for wildfire.
- Jurisdictions assess level of risk and establish roles and responsibilities for mitigating both the threat and the consequences of wildfire.
- Effectiveness of mitigation activities is monitored, collected and shared.

➢ **Wildfire Response:**

GOAL: *All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.*

Outcome-based Performance Measure:

- Injuries and loss of life to the public and firefighters are diminished.
- Response to shared-jurisdiction wildfire is efficient and effective.
- Pre-fire multi-jurisdictional planning occurs...

2.1.3 Department of Interior (DOI) Fire Policy

This FMP incorporates and adheres to DOI policy stated in 620 DM 1 and 620 DM 2 by giving full consideration to the use of wildland fire as a natural process and as a tool in the land management planning process and by providing for the following:

- Wildfires, whether on or adjacent to lands administered by the Department, which threaten life, improvements, or are determined to be a threat to natural and cultural resources or improvements under the Department's jurisdiction, will be considered emergencies and their suppression given priority over other Department programs (620 DM 1.6 B).
- Bureaus shall cooperate in the development of interagency preparedness plans to ensure timely recognition of approaching critical wildfire situations, to establish processes for analyzing situations and establishing priorities, and for implementing management responses to these situations (620 DM 1.6 E).
- Bureaus will enforce rules and regulations concerning the unauthorized ignition of wildfires, and aggressively pursue violations (620 DM 1.7).
- Wildland fire will be used to protect, maintain, and enhance natural and cultural resources and, as nearly as possible, be allowed to function in its natural ecological role. (620 DM 1.4.D).

This FMP implements the policy outlined in the following text from 620 DM 2.4 that sets out the lead role of the Bureau of Land Management Alaska Fire Service (BLM AFS) as the Wildland Fire Protecting Agency for the DOI agencies in Alaska:

BLM will maintain and operate the Department of the Interior wildland fire suppression organization in Alaska with the primary intention of providing cost-effective suppression services and minimizing unnecessary duplication of suppression systems for Department of the

Interior agencies. BLM will also provide consistency in State and Native wildland fire relationships and provide State-wide mobility of wildland fire resources BLM is authorized to provide safe, cost-effective emergency wildland fire suppression services in support of land, natural and cultural resource management plans on Department of the Interior administered land and on those lands that require protection under the Alaska Native Claims Settlement Act, as amended (43 U.S.C. 1620(e)), herein after referred to as Native land. BLM will execute these services within the framework of approved fire management plans or within the mutually agreed upon standards established by the respective land managers/owners.

a. Nothing herein relieves agency administrators in the Interior bureaus of the management responsibility and accountability for activities occurring on their respective lands.

b. Wildland fire suppression and other fire management activities provided on Native lands under the authority of the Alaska Native Claims Settlement Act, as amended (43 U.S.C. 1620(e)), will consider Native land managers on an equal basis with Federal land managers.

c. Each bureau will continue to use its delegated authority for application of wildland fire management activities such as planning, education and prevention, use of prescribed fire, establishing emergency suppression strategies, and setting emergency suppression priorities for the wildland fire suppression organization on respective bureau lands."

2.1.4 U.S. Fish and Wildlife Service Fire Policy

This FMP addresses a full range of potential wildfires and considers a full spectrum of tactical options (from monitoring to intensive management actions) for wildfires in order to meet Fire Management Unit (FMU) objectives. It fully applies procedures and guidelines in the Service Fire Management Handbook and the Interagency Standards for Fire and Fire Aviation Operations and affirms these key elements of FWS fire policy (621 FW 1):

- Firefighter and public safety is the first priority of the wildland fire management program and all associated activities.
- Only trained and qualified leaders and agency administrators will be responsible for, and conduct, wildfire management duties and operations.
- Trained and certified employees will participate in the wildfire management program as the situation requires, and non-certified employees will provide needed support as necessary.
- Fire management planning, preparedness, wildfire and prescribed fire operations, other hazardous fuel operations, monitoring, and research will be conducted on an interagency basis with involvement by all partners to the extent practicable.
- The responsible agency administrator has coordinated, reviewed, and approved this FMP to ensure consistency with approved land management plans, values to be protected, and natural and cultural resource management plans, and that it addresses public health issues related to smoke and air quality.
- Fire, as an ecological process, has been integrated into resource management plans and activities on a landscape scale, across agency boundaries, based upon the best available science.

- Wildfire is used to meet identified resource management objectives and benefits when appropriate.
- Prescribed fire and other treatment types will be employed whenever they are the appropriate tool to reduce hazardous fuels and the associated risk of wildfire to human life, property, and cultural and natural resources and to manage our lands for habitats as mandated by statute, treaty, and other authorities.
- Management response to wildfire will consider firefighter and public safety, cost effectiveness, values to protect, and natural and cultural resource objectives.
- Staff members will work with local cooperators and the public to prevent unauthorized ignition of wildfires on FWS lands.

2.1.5 Regional or Refuge-specific Fire Management Policy

Background on Fire Management Policy in Alaska Region (1939 – 2010):

The history of fire control within Interior Alaska dates back to 1939 when the Alaska Fire Control Service was established under the General Land Office. Headquartered in Anchorage, it was given responsibility for fire suppression on an estimated 225 million fire-prone acres of public domain lands in Alaska. When the Bureau of Land Management (BLM) was formed in 1946, it received the management authority for most of Alaska's federal lands and also absorbed the Alaska Fire Control Service. The BLM fire organization was based in Fairbanks and Anchorage and the two offices worked cooperatively but separately. The BLM also kept a Division of Fire Management at the State Office.

In 1959, the first of three big divestures of land managed by BLM-Alaska began and, with the changes in land management authority, issues regarding wildland fire suppression responsibilities arose.

- Under the Statehood Act 1959, the State was granted 104 million acres of land.
- Alaska Native Claims Settlement Act of 1971 (ANCSA) established Native corporations and an entitlement of 44 million acres for those corporations.
- The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) transferred approximately 100 million acres from BLM administration to the National Park Service and Fish and Wildlife Service.

Under ANCSA, the federal government was directed to continue to provide wildland fire suppression on lands conveyed to Native regional and village corporations. ANCSA [43 USC 1620(e)] provides for forest fire protection services from the United States at no cost to Native individuals or to Native Groups, Village and Regional Corporations organized under ANCSA, as long as there are no substantial revenues from such lands.

In response to ANILCA, Secretarial Order #3077, dated March 17, 1982, creating "a fire line organization with headquarters in Fairbanks" was issued. BLM, Alaska Fire Service (AFS) was formed and, in Department of Interior Manual 620, AFS was assigned the fire suppression responsibility for all Department of Interior-administered lands in Alaska and Native Corporation land conveyed under ANCSA. Department of Interior-administered lands include land managed by the BLM, the National Park Service, Fish and Wildlife Service, and the Bureau of Indian Affairs. Each agency remained accountable for following its agency's mandates and

policies for resource and wildland fire management. The role of AFS is to implement each agency's direction.

BLM Anchorage and Fairbanks districts fire suppression authority was delegated to AFS. The Division of Fire Management in the State Office was phased out. Today, in conjunction with his interagency role, the AFS Manager works directly for the BLM State Director and serves as the BLM State Fire Management Officer. The BLM Field Offices[1] retain the fire management responsibilities; AFS implements the fire direction given by the Field Offices and provides technical fire management expertise. This same principal applies to FWS and NPS lands.

The State of Alaska established a wildland fire suppression organization in the Department of Natural Resources, Division of Forestry, and, in the mid-1970s, began to gradually assume suppression responsibilities in the Anchorage area and on the Kenai Peninsula.

A reciprocal fire protection agreement was signed by the BLM, AFS and the State to cooperatively provide fire suppression operations in fire-prone areas (AFS also has an agreement with the U.S. Army-Alaska for wildland fire suppression on BLM-managed lands withdrawn for military use). Under the State agreement, AFS has the suppression responsibility for wildland fires in the northern half of the Alaska, regardless of ownership. The State has suppression responsibility for wildland fires in Southcentral Alaska, most of Southwestern Alaska, and portions of the central Interior. Most State protection areas are lands previously protected by the BLM Anchorage District; most of AFS protection is in areas once protected by the BLM Fairbanks District. As of 1985 when the State took over protection responsibilities for 66 million acres in southwest Alaska, the State and AFS each protect roughly half of the fire-prone lands in Alaska. The Forest Service protects State, federal, and Native lands within the boundaries of the Chugach and Tongass National Forests.

Today AFS has an interagency multi-jurisdictional, landscape scale role in fire suppression that includes lands managed by all Department of Interior agencies, the State, Native corporations and the military.

In 2010 the reciprocal fire protection agreements between the protection agencies (DNR, BLM AFS and USFS) and the individual memorandum of agreement between land management agencies (FWS, NPS, BIA) were consolidated into the Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement, hereafter referred to as the Master Agreement. This Master agreement, with its exhibits, defined the roles and responsibilities of the jurisdictional and protection agencies, as well as operating procedures (See: section 2.3.2.1).

Alaska Interagency Wildland Fire Management Plan (AIWFMP)

The Alaska Interagency Wildland Fire Management Plan (2010) provides for a range of suppression responses to wildfire that protects human life and property and other identified resources and developments, balances suppression costs with values at risk and is in agreement with Refuge resource management objectives. The result is that developed areas and other high resource value areas are protected and the natural occurrence of fire in the ecosystem is maintained in remote areas with minimal cost-effective intervention. Currently many special

[1] BLM Districts are now called Field Offices.

areas of concern (such as archaeological/cultural/historic sites and administrative sites/cabins) have been identified and are protected through the selection/designation of the appropriate fire management option - one that provides for the suppression response necessary to protect the resource(s) at risk. As new values at risk are identified, the jurisdictional agency selects the appropriate fire management option, notifies the protection agency and provides the location and fire management option information to AFS.

Four wildland fire management options are established in the AIWFMP.

- ***Critical*** is the highest priority area/sites for suppression actions and assignment of available firefighting resources.
- ***Full*** is the second highest priority area/sites for suppression actions and assignment of available firefighting resources.
- ***Modified*** is a high priority for surveillance, suppression, and site protection during the peak of the fire season and less priority (often surveillance only) after a designated conversion date in the latter stages of the fire season, normally after July 10.
- ***Limited*** requires only a surveillance response as long as fires within this designation do not threaten to escape into higher priority areas; if a threat is ascertained, a suppression response may be initiated.

The **Critical** fire management option was specifically created to give the highest priority to suppression action on wildland fires that threaten human life, inhabited property, designated physical developments and to structural resources designated as National Historic Landmarks. Fires that threaten a critical site have priority over all other wildland fires. These areas are the priority for detection coverage. The initial response to wildland fire is to provide protection to the area/sites. Use of wildland fire would only be appropriate in extraordinary circumstances

The **Full** fire management option was established for the protection of cultural and paleontological sites, developed recreational facilities, physical developments, administrative sites and cabins, uninhabited structures, high-value natural resources, and other high-value areas that do not involve the protection of human life and inhabited property. Structures on or eligible for inclusion on the National Register of Historic Places and non-structural sites on the National Register are placed in this category. Fires occurring within or immediately threatening this designation will be high priority for initial action depending on the availability of firefighting resources but are less priority than wildland fires within or threatening a Critical Management Option area. The intent is to control wildland fires at the smallest acreage reasonably possible.

The **Modified** fire management option is intended to be the most adaptable option available to land managers. Unlike the Full management option, the intent is not to minimize burned acres but to balance acres burned with suppression costs and to accomplish land and resource management objectives. After the conversion date (usually around July 10), the default action for all fires occurring within this option will be surveillance and assessment to ensure that identified values are protected and that adjacent higher priority management areas are not compromised.

In the **Limited** fire management option fire may be allowed to function in its ecological role while providing for the protection of human life and site-specific values. Most natural ignitions will be managed for the purpose of maintaining fire's natural role in the ecosystem. Low impact

or indirect suppression methods will be used whenever possible, if suppression action is needed. The intent is to reduce overall suppression costs through minimum resource commitment without compromising firefighter safety.

Through the AIWFMP, the Jurisdictional land manager authorizes the Protecting Agency to provide an increased or decreased level of suppression action for a given wildfire, depending upon the situation (non-standard response). Additionally, the selected fire management option area should be re-evaluated during the next annual review period. The AWFCG may approve departures from the selected management options during periods of "unusual fire conditions" for a specific geographic area(s). These decisions will be based not only on fires and acres burning, but also on anticipated fire behavior and acreage likely to be burned, existing and anticipated smoke problems, probability of success, the experience and judgment of Service and Protecting Agency personnel, and decisions of the Multi-agency Coordinating Group (MAC Group).

The AIWFMP fire management objectives were developed to meet and support agencies' goals and to provide implementation guidance for fire operations. The objectives are:

- Protect human life.
- Prioritize areas for protection actions and allocation of available firefighting resources without compromising firefighter safety.
- Use a full range of fire management activities (fire suppression, monitoring, prescribed fire, thinning and other vegetation treatment projects, prevention and education programs, scientific studies, etc.) to achieve ecosystem sustainability including its interrelated ecological, economic, and social components.
- Use wildland fire to protect, maintain, and enhance natural and cultural resources and, as nearly as possible, enable fire to function in its ecological role and maintain the natural fire regime.
- Manage vegetation through various fuels treatment techniques to reduce and mitigate risks of damage from wildland fire.
- Balance the cost of suppression actions against the value of the resource warranting protection and consider firefighter and public safety, benefits, and resource objectives.
- Consider short and long-term cost effectiveness and efficiencies while maintaining responsiveness to Jurisdictional agency objectives and within the scope of existing legal mandates, policies and regulations.
- Minimize adverse environmental impact of fire suppression activities.
- Maintain each Jurisdictional agency's responsibility and authority for the selection and annual review of fire management options for the lands that they administer.
- Adhere to State and federal laws and Regulations.

The ***Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement (2010)*** authorizes The State of Alaska, Division of Forestry (DOF) to act as an agent of the BLM AFS within State protection zones as directed by the Refuge manager. The Kenai NWR is located within the Kenai-Kodiak Area State protection zone. The Kenai-Kodiak Area Office is located in Soldotna, Alaska.

FWS Alaska Regional Policy

All activities authorized under this FMP will comply with Region 7 FWS policies, including but not limited to:

- *Region 7 Policy for Management of Permitted Cabins on National Wildlife Refuges in Alaska (August 2010) (RW-1)*
- *Region 7 Policy on Minimum Requirement Analyses for Approving Administrative Activities in Refuge Wilderness Areas (RW-29)*
- *Revised Region 7 Bear Awareness and Firearms Safety Training Policy (June 2008)*
- *Revised Region 7 Watercraft Safety and Training Policy (June 2003)*

2.2 Land / Resource Management Planning

The Refuge fire management goals and objectives identified in this plan are closely tied to the goals, objectives, and management guidance outlined in the Refuge Comprehensive Conservation Plan (06/2010) and the Alaska Interagency Wildland Fire Management Plan (2010).

The range and scope of fire management actions and land and resource uses on the Refuge are defined by management category as described in the CCP. The AIWFMP defines initial wildland fire suppression responses and actions for the Refuge.

2.2.1 Land Management Plans

The Refuge establishing purposes mandated by ANILCA and identified in the CCP are as follows:

- To conserve 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 non-migratory birds.
- To fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats.
- 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.
- To provide in a manner consistent with sub paragraphs (i) and (ii), opportunities for scientific research, interpretation, and environmental education, and land management training.
- To provide, in a manner compatible with these purposes, opportunities for fish and wildlife-oriented recreation.

2.2.2 Environmental Compliance

The management direction and general actions specified in this fire management plan were previously evaluated in the revised ***Kenai National Wildlife Refuge Comprehensive Conservation Plan,*** *its accompanying* ***Environmental Impact Statement,*** and to some extent by the ***Alaska Interagency Fire Management Plan***. Public participation in those planning processes was encouraged and documented during scoping, in the development of alternatives and in the decision documents. The CCP and its associated documents specifically outline the acceptable range and magnitude of fire management actions for the KNWR, and this FMP is the landscape-level planning document for those permissible activities. The KNWR completed the

Revised Comprehensive Conservation Plan and, ***Environmental Impact Statement*** in August 2009 and the Final CCP Record of Decision in June 2010. As a mid-level, tiered, planning document or step-down plan, the KNWR-FMP is covered under the CCP, the AIWFMP, and the Environmental Assessment and Finding of No Significant Impact for the 2013 FMP, and is therefore compliant with the ***National Environmental Policy Act*** (NEPA).

Individual, ground-disturbing fire management projects designed to implement the management directions and accomplish the goals and objectives of this FMP will not be subject to NEPA requirements. However, if in the future, the Refuge proposes any ground-disturbing fire management projects that are not covered in the CCP, the 2013 FMP and EA, or another NEPA-compliant plan, those projects would be subject to NEPA requirements.

In that event, the fire management project planning process would normally follow these steps: 1) Project Proposal, 2) Scoping, 3) Development of Alternatives, 4) Environmental Analysis, 5) Decision Documentation, 6) Project Implementation, and 7) Monitoring and Evaluation. During scoping, to comply with the requirements of NEPA and ANILCA, the Refuge will provide adequate opportunities for the public to comment verbally and/or in writing, about proposed new fire management projects, including prescribed fire and hazard fuel reduction projects. Ongoing or multi-year projects will undergo the initial public comment period, and then will be listed on the annual list of projects until completed. The level of environmental analysis will depend upon the issues identified during public scoping, upon the alternatives subsequently developed, and upon the potential social and environmental impacts of the alternatives. There are three levels of environmental analysis possible: Categorical Exclusion (CE), Environmental Assessment (EA) and Environmental Impact Statement (EIS). Refuge fire managers will consult with regional FWS environmental compliance experts to select the appropriate level of analysis for each proposed project

Categorical Exclusions

The Code of Federal Regulations (CFR's) (43 CFR 46.210) and DOI Manual (Part 516 DM 8.5), identify Categorical Exclusions (CX's) pursuant to 43 CFR 46.205 for fire and fuels management actions. Categorical Exclusions are classes of actions which do not individually or cumulatively have a significant effect on the human environment. Categorical Exclusions are not the equivalent of statutory exemptions. If exceptions to CX's apply (46 CFR 43.215), CX's cannot be used. Two Departmental-wide CX's identified in the CFR's pertain specifically to fire management actions. The first CX (43 CFR 46.215(k)) deals with fuel reduction and the second (43 CFR 46.215(l)) relates to post-fire rehabilitation.

1) (43 CFR 46.215(k)): "Hazardous fuels reduction activities using prescribed fire not to exceed 4,500 acres, and mechanical methods for crushing, piling, thinning, pruning, cutting, chipping, mulching, and mowing, not to exceed 1,000 acres. Such activities:
    a. Shall be limited to areas:
        i. in wildland-urban interface; and
        ii. Condition Classes 2 or 3 in Fire Regime Groups I, II, or III, outside the wildland-urban interface;
    b. Shall be identified through a collaborative framework as described in "A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment 10-Year Comprehensive Strategy Implementation Plan;"

c. Shall be conducted consistent with agency and Departmental procedures and applicable land and resource management plans;
d. Shall not be conducted in wilderness areas or impair the suitability of wilderness study areas for preservation as wilderness;
e. Shall not include the use of herbicides or pesticides or the construction of new permanent roads or other new permanent infrastructure; and may include the sale of vegetative material if the primary purpose of the activity is hazardous fuels reduction." (Refer to the Environmental Statement Memoranda Series for additional, required guidance.)

2) (43 CFR 46.215(l)): "Post-fire rehabilitation activities not to exceed 4,200 acres (such as tree planting, fence replacement, habitat restoration, heritage site restoration, repair of roads and trails, and repair of damage to minor facilities such as campgrounds) to repair or improve lands unlikely to recover to a management approved condition from wildland fire damage, or to repair or replace minor facilities damaged by fire. Such activities must comply with the following (Refer to Environmental Statement Series for additional, required guidance.):
   a. Shall be conducted consistent with agency and Departmental procedures and applicable land and resource management plans;
   b. Shall not include the use of herbicides or pesticides or the construction of new permanent roads or other new permanent infrastructure; and
   c. Shall be completed within three years following a wildland fire.

In addition to the CX's identified above, the DOI Manual Part 516 DM 8.5 identifies CX's that are specific to the FWS. Identified below are categorical exclusions that may apply to fire management activities:

- 516 DM 8.5 A (2): "Personnel training, environmental interpretation, public safety efforts, and other educational activities, which do not involve new construction or major additions to existing facilities."

- 516 DM 8.5 B (4): "The use of prescribed burning for habitat improvement purposes, when conducted in accordance with local and State ordinances and laws".

- 516 DM 8.5 B (5): "Fire management activities, including prevention and restoration measures, when conducted in accordance with Departmental and Service procedures".

- 516 DM 8.5 B (9): "Minor changes in existing master plans, comprehensive conservation plans, or operations, when no or minor effects are anticipated. Examples could include minor changes in the type and location of compatible public use activities and land management practices."

- 516 DM 8.5 B(10): "The issuance of new or revised site, unit, or activity specific management plans for public use, land use, or other management activities when only minor changes are planned. Examples could include an amended public use plan or fire management plan."

When using CX(s) for planned fire management activities (including prescribed fires, non-fire hazardous fuels treatments, and BAER/BAR), the refuge staff will follow guidance identified in Code of Federal Regulations, DOI Manual, agency policy (Fire Management Handbook), and regional guidance for the application and documentation of the appropriate environmental analysis and NEPA documentation. Form(s) for documenting the use of CX(s) are located in **Appendix B – Categorical Exclusion Forms.** Cat-Ex forms will be kept in the project file (for fuels treatments) or incident history file (wildfires).

This plan meets the requirements established by the *National Environmental Policy Act*. The Service has determined that prescribed fire activities will be carried out only in accordance with a Fire Management Plan that is tiered to a land management plan, which addresses the use of fire as a management tool and has been through the NEPA process.

National Historical Preservation Act of 1966 (NHPA) and Archeological Resources Protection Act of 1979

Fire management activities on the Kenai NWR will be implemented in accordance with the regulations concerning cultural resources outlined in Section 106 of the *National Historic Preservation Act of 1966*, as amended. The refuges will also comply with procedures identified in the *Archeological Resources Protection Act of 1979* and the *Archeological and Historical Preservation Act of 1974*. All fire management activities will be in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended.

The USFWS Region 7 Historic Preservation Officer (RHPO) coordinates with the State Historic Preservation Officer (SHPO), on all matters concerning the potential impacts of fire management activities upon historical and cultural resources within the KNWR. Refuge fire management will notify the RHPO during the planning process for all proposed prescribed fire and mechanical (ground-disturbing) projects, and as necessary - during the management of a wildfire. The RHPO will provide direction as to whether a survey of the area has been done or whether consultation with the SHPO is necessary. Resources listed or considered for listing in the National Historic Register, may be subject to special requirements under the *National Historic Preservation Act of 1966*, as amended. In Region 7, the request for a Cultural Resources Review for fuels treatments is made using a form (See: **Appendix C – Cultural Resources Review Request**).

Alaska National Interest Lands Conservation Act (ANILCA) Section 810

In reference to Section 810 of ANILCA, the actions outlined in this fire management plan are not expected to have any significant negative impacts upon Subsistence activities on or adjacent to the Kenai NWR.

Endangered Species Act of 1973 (ESA)

Section 7 of the ESA of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), directs all Federal agencies to use their existing authorities to conserve threatened and endangered species and, in consultation with the U.S. Fish & Wildlife Service and the National Marine Fisheries Service, to ensure that their actions do not jeopardize listed species or destroy or adversely modify proposed critical habitat. Section 7(a)-(d) applies to situations involving acts of God, disasters, casualties, national defense or security emergencies, etc., and allows the regulations implementing this section to accommodate the need for Federal agencies to respond immediately to emergencies.

Clean Air Act
USFWS Fire Management activities which result in the discharge of air pollutants are subject to, and must comply with, all applicable Federal, State, interstate and local air pollution control requirements as specified by *Section 118 of the Clean Air Act (42 USO 7418)*. Emissions from prescribed fire treatments that are 40 acres or larger require air quality permits from the Alaska Department of Environmental Conservation (ADEC). ADEC reviews air quality permit applications submitted by the Refuge for individual prescribed fire plans, as specified in Alaska's Enhanced Smoke Management Plan for Prescribed Fire (March 2009).

Clean Water Act (CWA)
Fire management activities on the Kenai NWR must comply with regulations in the CWA. Erosion from wildland fires is considered a non-point source form of pollution by EPA. Recently burned areas may suffer erosion impacts when heavy precipitation events occur after an area burns. In addition, fire retardant chemicals and foams that may be used in wildland fire management operations may pose a threat to water resources. The Refuge will follow guidelines for the use of fire retardants and foams as specified in the *Guidelines for Aerial Delivery of Retardant or Foam near Waterways* [http://www.fs.fed.us/rm/fire/wfcs/Application_Policy-MultiAgency_042209-UPDATE.pdf]. In general, the use of retardants and foams on refuge lands is restricted and requires Refuge Manager-approval prior to use.

Wilderness
The Kenai NWR contains 1.32 million acres of designated wilderness. To date, a Wilderness Management or Wilderness Stewardship Plan has not yet been developed for the Refuge. A Wilderness Stewardship Plan should establish specific goals, objectives and management constraints relating to wilderness fire management on the Kenai NWR, and will be incorporated by reference in this FMP upon its completion. A minimum requirements analysis will be completed prior to any proposed fuels treatment activities within the Wilderness Area. Management should consider a minimum requirements analysis covering fire suppression tactics for all Refuge lands. Items to consider may include: the use of motorized equipment, aircraft, indirect fire suppression tactics, mitigation measures and rehabilitation standards.

2.3 Fire Management Partnerships

2.3.1 Internal Partnerships

The Refuge Fire Management Program partners with the following Service programs in the Alaska Region:

- **Kenai NWR Management Team**: This is an interdisciplinary team composed of the Refuge Manager, the Deputy Refuge Manager and Refuge Program Managers from: Administration, Visitor Services, Biology, Facilities and Maintenance, Law Enforcement and Fire Management.
- **FWS Alaska Region Fire Management Branch**: The Alaska Region Fire Management Branch is a staff of five: the Regional Fire Management Coordinator, a Regional Fire Planner, a Regional Wildland Urban Interface/Fuels Coordinator, a Regional Fire Ecologist, and a Fire Program Specialist.
- **FWS Alaska Region Fire Management Officer's (FMO's)**: There are four Zone FMO's in the Alaska Region: the Eastern Interior Alaska Refuges FMO (Arctic NWR/Yukon Flats NWR/Tetlin NWR/Kanuti NWR), the Southcentral Alaska Area

Refuges FMO (Kenai NWR/Kodiak NWR/Alaska Maritime NWR), the Southwest Alaska Area Refuges FMO (Innoko NWR/Yukon Delta NWR/Togiak NWR), and the Northwest Alaska Area Refuges FMO (Koyukuk/Nowitna NWR/Selawik NWR).

Development of this plan was in large part done by the Kenai NWR fire management staff in collaboration with others from the Refuge and the Alaska Region Fire Management Branch.

2.3.2 External Partnerships

The Kenai NWR Fire Management Program partners with a number of different land, fire and emergency management agencies at the local and regional levels. Those partnerships include:

- **Alaska Wildland Fire Coordinating Group (AWFCG)**
- **Alaska Multi Agency Coordinating Group (AMAC)**
- **Kenai Interagency Dispatch Center (KIDC)**
- **All Lands All Hands (ALAH)**
- **Kenai Peninsula Fire Chiefs Association (KPFCA)**
- **Kenai Peninsula Borough Local Emergency Planning Committee (LEPC)**

Alaska Wildland Fire Coordinating Group (AWFCG)
The Alaska Wildland Fire Coordinating Group (AWFCG) group provides coordination and recommendations for all interagency fire management activities in Alaska. Membership, procedures, and guidelines are documented in the AWFCG Memorandum of Understanding and Standard Operating Procedures available at: http://fire.ak.blm.gov/administration/awfcg.php. The Region 7 Fire Management Coordinator represents the Service on this group. Refuge fire management staff represents the Alaska Region on various AWFCG Committees.

Alaska Multi Agency Coordinating Group (AMAC)
The Alaska Multi-Agency Coordination Group (AMAC) provides a forum to discuss actions to be taken to ensure that an adequate number of resources are available to meet anticipated needs and to allocate those resources most efficiently. When activated and as warranted, the AMAC is tasked with the following: incident prioritization; resource allocation; coordination of state and federal disaster responses; political interfaces; media and agency information; anticipation of future resource needs; and the identification and resolution of issues. The *AMAC Operations Handbook* is available at: http://fire.ak.blm.gov/administration/mac.php. The Region 7 Fire Management Coordinator represents the Service on this group.

Kenai Interagency Dispatch Center (KIDC)
KIDC is the local area Dispatch Center for land and fire management agencies in Southcentral Alaska. KIDC is operated by the Alaska Division of Forestry Kenai-Kodiak Area Office, with assistance from the Chugach National Forest. KIDC provides dispatch services to the Kenai NWR through the ***Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement 2010 (Alaska Master Agreement),*** the ***Alaska Statewide Annual Operating Plan (Alaska AOP)***, and the ***KIDC Annual Operating Plan*** (See: **Appendix D – KIDC Operating Plan)**. The Refuge Manager is a member of the KIDC Board of Directors and the Refuge FMO is a member of the KIDC Operations Committee.

All Lands All Hands

On 02/12/2010, a Memorandum of Understanding (MOU) for the Development of a Collaborative Forest, Wildfire Protection and Fuels Treatment Program, among the USDA Forest Service – Alaska Region and the State of Alaska Division of Forestry and the USDI Kenai NWR, the BLM Anchorage Field Office, Kenai Fjords National Park, the BIA, and the Kenai Peninsula Borough, reestablished the Kenai Forest, Wildfire Protection and Fuels Management Coordinating Committee and the All Lands All Hands 5-Year Action Plan.

Wildland fire policy recognizes that effective fire management requires close coordination with local communities and other government agencies, particularly those communities that are in high wildland fire risk areas in the wildland/urban interface and other partner agencies that share in fire prevention concerns for those communities. As the management of private lands has become an increasingly important factor in the fire risk equation, the US Fish and Wildlife Service has recognized the importance of providing outreach, education and support to local communities, to reduce wildland fire hazards in and near those communities. The State of Alaska Department of Natural Resources, Division of Forestry, Kenai-Kodiak Area Office (KKAO) provides fire suppression services to the local communities and surrounding wildlands of the Kenai Peninsula. KKAO partners with the Kenai National Wildlife Refuge fire management program for numerous activities including:

- Preparedness and Suppression
- Fire Prevention, Outreach and Education programs.
- Wildfire Hazard Mitigation including Fuels Management.

The following communities adjacent to the Kenai National Wildlife Refuge (See: **Figure 4 – CWPP Area Boundaries**) have been identified as being at high risk from wildland fires originating on federal lands and have developed Community Wildfire Protection Plans (CWPP's):

- Nikiski/Salamatof/Grey Cliffs
- Kenai
- Soldotna/ Ridgeway
- Sterling
- Cooper Landing
- Funny River
- Kalifornsky/Kasilof/Cohoe/Clam Gulch
- Ninilchik/Ninilchik Forties
- Diamond Ridge/Fritz Creek/ Fox River

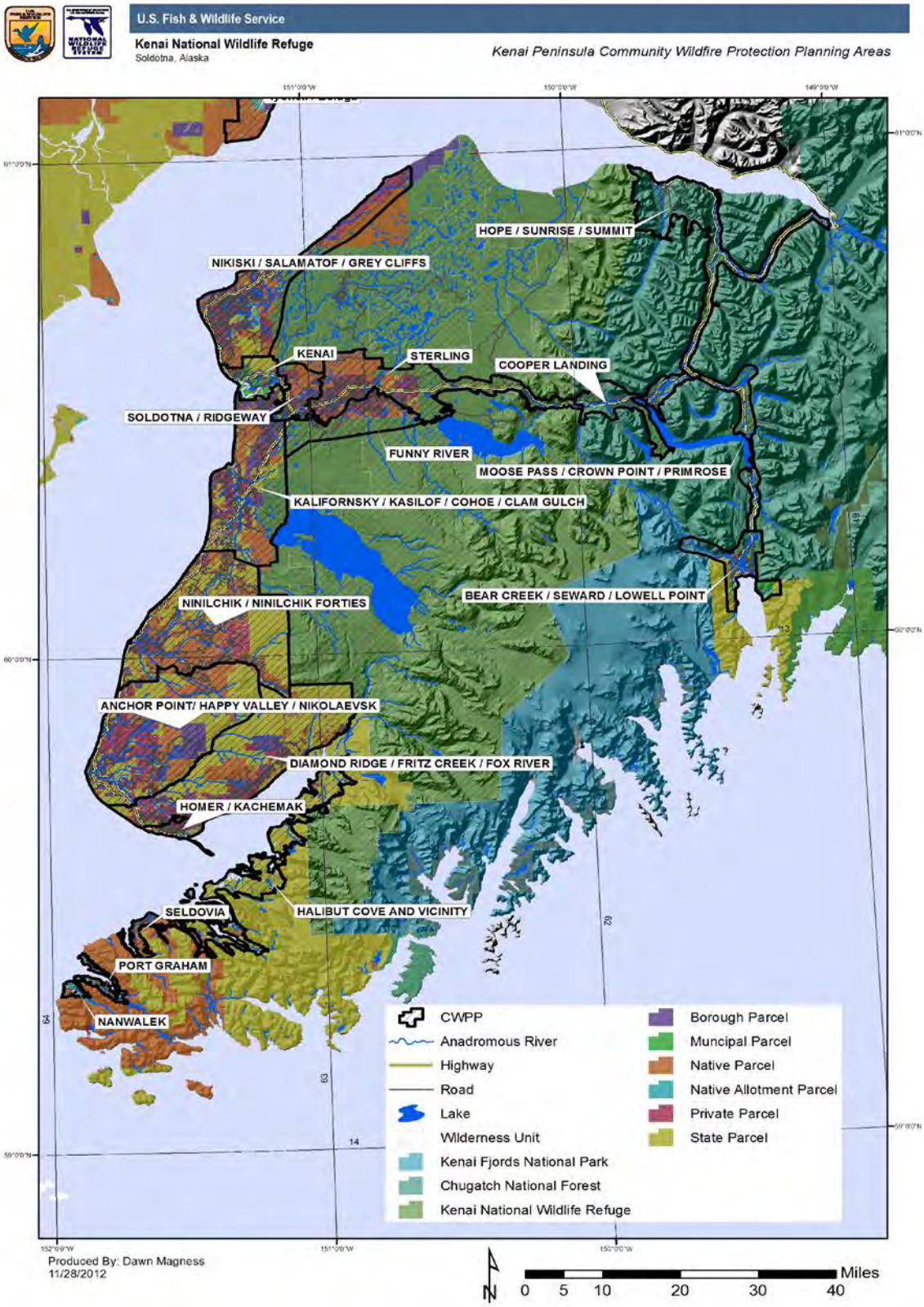


Figure 4 – CWPP Area Boundaries

Maps of the above listed CWPP areas are included in **Appendix E – CWPP Base Maps**.

Kenai Peninsula Fire Chiefs Association, Inc. (KPFCA)
The KPFCA is a 501(c)3, non-profit corporation, a professional association of fire chiefs from the municipal and volunteer fire departments and the land management agencies of the Kenai Peninsula. The Refuge FMO is voluntarily a dues-paying member of the KPFCA.

The objective of the KPFCA is to bring together persons and organizations interested in reducing the loss of life and property from fire or emergency incidents. The objective will be accomplished through the discussion of fire prevention, fire suppression, public relations, research, and the development of a bond of friendship and understanding among the participants.

Kenai Peninsula Borough Local Emergency Planning Committee (LEPC)
The Kenai Peninsula Borough LEPC membership is composed of emergency response agency, local industry and public-at-large representatives from within the Kenai Peninsula Borough. The Refuge FMO is a volunteer member of the committee. The Refuge Oil & Gas Liaison is the alternate member.

The mission of the Kenai Peninsula Borough LEPC is to prepare emergency response plans for all hazards, whether natural or manmade, occurring in the community; and to establish procedures for receiving and processing requests from the public for information generated by SARA Title III reporting requirements.

The Kenai Peninsula Borough Local Emergency Planning District (LEBD) is located in Southcentral Alaska. The LEBD has a population of more than 50,000 residents, increasing to more than 150,000 during the summer tourist season.

The borough conducted a hazard vulnerability analysis that identified the following hazards: earthquake, volcano, energy shortage, tsunami, fire, weather extremes, hazmat, flood, transportation accident and terrorism.

2.3.2.1 Interagency Agreements and Planning Documents

Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement 2010 (Alaska Master Agreement)
The *Alaska Master Agreement* documents the commitment of its signatories to improve the efficiency of fire management activities in Alaska, including prevention, preparedness, communication and education, fuels treatment and hazard mitigation, fire planning, response strategies, tactics and alternatives, and suppression and post-fire rehabilitation and restoration, by facilitating the coordination and exchange of personnel, equipment, supplies, services, and funds.

It also facilitates improved coordination regarding other incidents covered under the National Response Framework (NRF)

Signatories include:

- The State of Alaska, Department of Natural Resources (ADNR)
- The United States Department of Agriculture Forest Service, Region 10 (USFS)
- The United States Department of the Interior, National Park Service, Alaska Region (NPS)

- The United States Department of the Interior, Fish and Wildlife Service, Alaska Region (Region 7) (FWS)
- The United States Department of the Interior, Bureau of Indian Affairs, Alaska Regional Office (BIA)
- The United States Department of the Interior, Bureau of Land Management, Alaska (BLM)
- The United States Department of the Interior, Bureau of Land Management, Alaska Fire Service (AFS)

Alaska Statewide Annual Operating Plan (Alaska AOP)

The *Alaska AOP*, exhibit C of the Master Cooperative Agreement addresses cooperation, interagency working relationships and protocols, financial arrangements, and joint activities. The *Alaska Interagency Mobilization Guide* and the *Alaska Interagency Wildland Fire Management Plan* are incorporated by reference into the *Alaska AOP*. Signatories to the *Alaska AOP* include: State Forester, AFS Manager, USFS Regional Forester, FWS, NPS, BLM and BIA Regional Director.

Kenai National Wildlife Refuge falls within the scope of the *Alaska Master Agreement* and *Alaska AOP*. The State of Alaska Division of Forestry Kenai-Kodiak Area Office (KKAO) provides protection services, as an agent of Alaska Fire Service. Support services and some tactical resources such as air tankers and smokejumpers are available from AFS. The State is reimbursed annually by the Federal Government for services provided on Federal lands. Likewise, the State reimburses the Federal Government for services provided on State lands. The responsibility for compliance and performance of the State within the scope of this agreement remains with BLM Alaska Fire Service.

Consultation and coordination with the KKAO is essential for all of its fire management activities on the Refuge. Meetings are held each spring to discuss upcoming fire management activities. At that time, any active memorandums of understanding and cooperative agreements will be addressed; Refuge equipment and fireline qualified personnel will be identified; local procedures regarding management responses to unplanned ignitions will be discussed (contact lists updated); and both agencies will familiarize themselves with each other's concerns and issues.

Alaska Interagency Wildland Fire Management Plan 2010 (AIWFMP)

The purpose of the *Alaska Interagency Wildland Fire Management Plan 2010 (AIWFMP)* is to promote a cooperative, consistent, cost-effective, interagency approach to wildland fire management in Alaska and it is the interagency reference for wildland fire operational information.

It specifies direction for the response to a wildland fire that is based on the fire management option designation and provides guidelines to jurisdictional and protecting agencies for decision support requirements as the complexity of a wildland fire increases. The *AIWFMP* is designed to be used in conjunction with this FMP which contains definitive objectives and constraints for the Kenai Refuge. The *AIWFMP* is incorporated by reference into the *Alaska AOP*, and its specifics are outlined in **Section 2.1.5.**

Signatories include:

- The State of Alaska, Department of Natural Resources (AKDNR)
- The State of Alaska, Department of Environmental Conservation (AKDEC)
- The State of Alaska, Department of Fish and Game (AKDF&G)
- The United States Department of the Interior, National Park Service, Alaska Region (NPS)
- The United States Department of the Interior, Fish and Wildlife Service, Alaska Region (Region 7) (FWS)
- The United States Department of the Interior, Bureau of Indian Affairs, Alaska Regional Office (BIA)
- The United States Department of the Interior, Bureau of Land Management, Alaska (BLM)
- The United States Department of Agriculture Forest Service, Region 10 (USFS)
- The Association of Village Council Presidents
- Tanana Chiefs Conference, Inc. (TCC)
- Chugachmiut, Inc.
- Anchorage Fire Department

3.0 FIRE MANAGEMENT UNIT CHARACTERISTICS

The Refuge CCP lists five Management Categories as described below:

- Intensive Management – 54,500 acres (2.7 percent)
- Moderate Management – will be reduced and eventually eliminated. 129,550 acres (6.5 percent) will convert to Minimal management immediately. The remaining 49,450 acres (2.5 percent) will convert to Minimal management after current projects are completed.
- Traditional Management – will be eliminated. All of the 189,000 acres (9.6 percent) currently classified in this category will be reclassified as Minimal management.
- Minimal Management – 514,550 acres (25.9 percent) of the Refuge will be classified as Minimal management immediately. After current projects are completed, 49,450 additional acres will be reclassified from Moderate to Minimal management for a total of 564,000 acres or 28.4% of the Refuge.
- Wilderness Management – 1,320,500 acres (66.4 percent) will be managed under the Wilderness management category.

According to the ***Record of Decision*** for the Revised CCP (11/17/09), the five management categories previously applied to the Refuge will be reduced to four in the short term and eventually to three categories. In the CCP, land, resource, and fire management goals, objectives and constraints are described for the following four CCP Management Categories: Wilderness, Minimal, Moderate and Intensive.

In a future revision of the CCP under the preferred alternative and at the end of the life of the Alaska pipeline project (Enstar natural gas pipeline), Moderate management lands would convert to Minimal management and only three management categories---Wilderness, Minimal, and Intensive Management---would be used to describe management levels (and fire management units) on the Refuge.

A management category is used to define the level of human activity appropriate to a specific area of the Refuge. It is a set of Refuge management directions applied to an area in light of its resources and existing and potential uses to facilitate management and the accomplishment of Refuge purposes and goals. **Table 2 - Fire Management Activities by CCP Management Category**, shows fire management activities that are or may be allowed in each management category.

Table 2 – Fire Management Activities by CCP Management Category

ACTIVITY or USE	MANAGEMENT of WILDERNESS	MINIMAL MANAGEMENT	MODERATE MANAGEMENT	INTENSIVE MANAGEMENT
Fire Management—Prescribed Fires Fire ignited by management actions to meet specific management objectives.	May be allowed*	May be allowed	May be allowed	May be allowed
Fire Management—Wildland Fire Use The planned use of any wildland fire to meet management objectives.	May be allowed*	May be allowed	May be allowed	May be allowed
Fire Management—Fire Suppression Management actions intended to protect identified values from a fire, extinguish a fire, or confine a fire.	Allowed	Allowed	Allowed	Allowed

To align this plan with the CCP, the Fire Management Units (FMUs) for the Kenai NWR correspond directly with the CCP Management Categories as shown in **Figure 5 – Refuge Fire Management Units**, except for State/Private Lands. Note: neither the CCP, nor this plan describe management of state or private lands since those lands are outside of Refuge jurisdiction. However, the locations of State/Private Lands within Refuge boundaries are important to the management of adjacent Refuge lands.

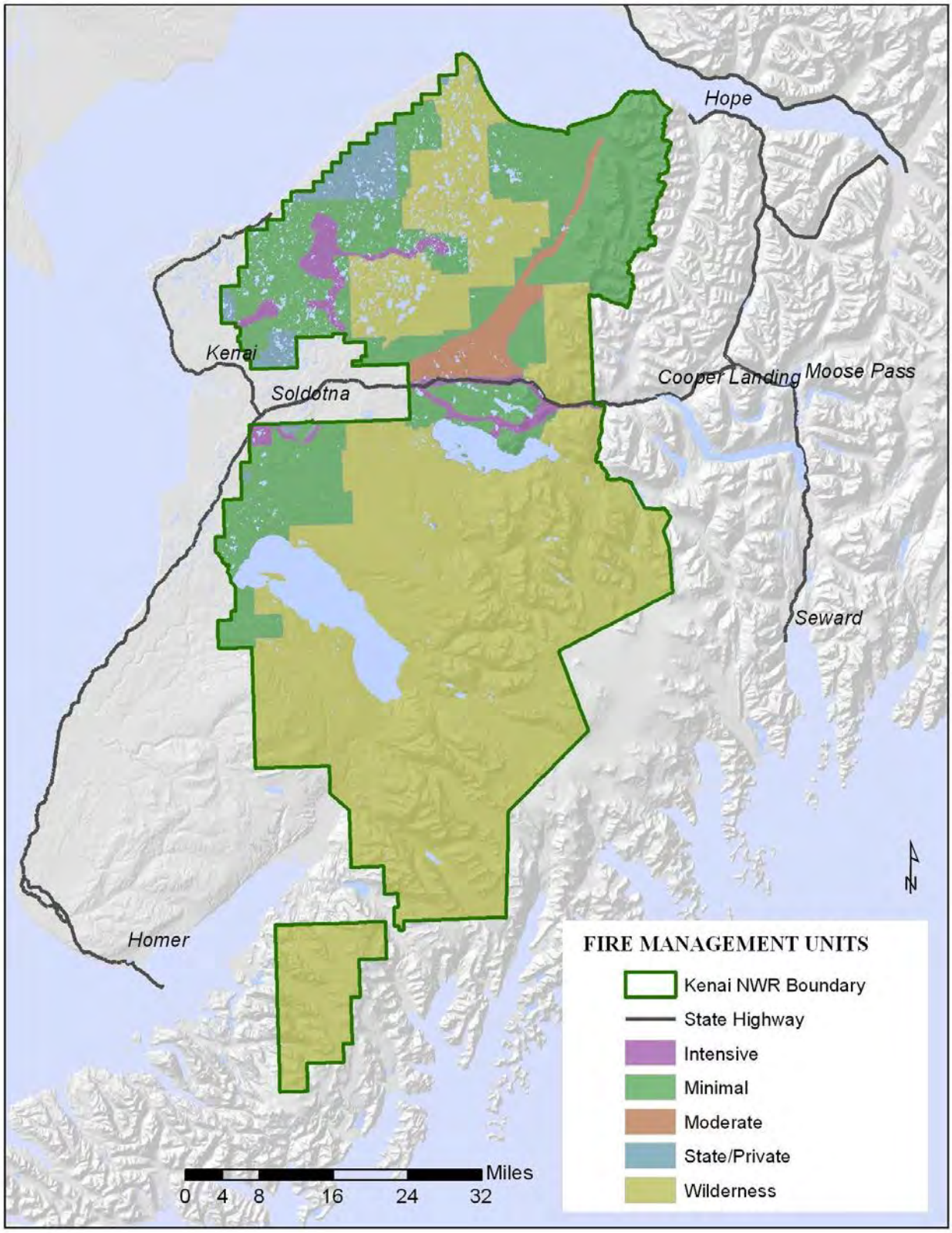


Figure 5 – Refuge Fire Management Units (FMU's)

Each FMU is discussed in greater detail in Section 3.2.

3.1 Area Wide Management Considerations

The management of wildland fire for the benefit of Refuge ecosystems should be the guiding principle while taking measures to protect human life, property and/or areas of special concern.

3.1.1 Fire Management Goals, Strategies, and Guidance from CCPs/Similar Plans

On page 2-3 of the CCP, Issue 1 asks the question: "*How will the Refuge address large-scale habitat changes and the use of fire?*" Under the headings, *Fire Management Program* and *Use of Fire as a Management Tool*, the CCP provides the following guidance:

- *Management direction will allow prescribed fire, wildfire, and mechanical treatments as the principle tools to improve wildlife habitats, reduce hazardous accumulations of wildland fuels, and maintain or restore natural fire regimes.*
- *Prescribed fire will 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 will be allowed in the Intensive, Moderate, Minimal, and Wilderness management categories (1,938,000 acres or 97.5 percent of the Refuge), but use will 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) will be suppressed through the use of a pre-identified management response.*

Under *Specific Management Direction,* on page 2-13 of the CCP and under the header: *Beetle Kill Trees/Fire Safety* is the following guidance:

- *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.*

Refuge managers consider spruce bark beetle outbreaks as naturally occurring events, and the intensive management of spruce bark beetle outbreaks would be inconsistent with Refuge goals. However, mitigation of the impacts of spruce bark beetle outbreaks, such as focusing management efforts to reduce hazardous fuels accumulations in wildland-urban interface areas, is consistent with Refuge goals.

Fire-Related Goals and Objectives in the CCP

The CCP establishes nine broad goals, each with subsets of objectives. Objectives under five of these goals are related to fire and fire effects; these are excerpted in **Table 3 – Fire Management Goals and Objectives from the 2009 Kenai NWR CCP**. A number of these objectives are best addressed in other step-down plans, such as the Inventory and Monitoring Plan, or through targeted research projects rather than in the FMP. However, they are included here to highlight the fundamental role that fire plays in the Kenai ecosystem and to illustrate that an interdisciplinary approach is necessary to manage fire, resources, and personnel on the Refuge.

Fire management staff have reviewed the fire-related CCP objectives and re-evaluated them for adequacy in priority and timeline given the current situation with respect to funding and staffing. CCP objectives are static for the life of the CCP, but annual updates of the FMP allow the Refuge to take an adaptive approach to setting objectives, developing tasks to successfully accomplish the objectives and monitoring progress. Current FMP objectives are discussed in section 3.1.2. New objectives not included in the CCP will be developed as necessary but will relate back to goals documented in the CCP.

Table 3 – Fire Management Goals and Objectives from the 2009 Kenai NWR CCP
[*Note: Objectives are numbered and organized by priority (from highest to lowest) under each goal*].

CCP Goal	CCP Objective	Objective Category	Description	Program Responsibility/ Status
Research	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)	Biology (Refuge Ecologist) with contributions from Refuge Cooperators (USFS for FIA plots)
	1.3	Natural Processes/ Disturbance Regimes	Continue annual monitoring of snowshoe hare populations on five established sites	Biology
	1.4	Capacity Building	Actively seek to fund at least one cooperative fire research project every 3-5 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.	Fire and Biology
	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	Fire: FWS R7 Fire Branch purchased a new RAWS to replace the manual weather station at ADOF/KKAO in 2012. The purchase and installation of additional stations should be preceded by a gap analysis.
	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, FRCC, and FPA projects	Fire and Cooperators (LANDFIRE fuels updated state-wide in 2011-2012)
	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.	Fire/Biology
	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.	Biology
	1.16	Capacity Building	Within five years of Plan's approval, re-establish a remote-sensing, lightning detection capability for the Kenai Peninsula.	Fire (This objective is no longer applicable; the National Weather Service

				is deploying a new lightning detection system in Alaska in 2012)

CCP Goal	CCP Objective	Objective Category	Description	Program Responsibility/ Status
	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 50-200 years.	Biology and Fire
Conservation and Management	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.	Biology/GIS
	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.	Fire
	2.13	Habitat and Population Management	Within two years of Plan's approval, revise the 1996 Moose Management Plan.	Biology
	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.	Fire and Biology (A Wildfire and Hazard Fuels Mitigation Monitoring Plan will be developed for the Refuge and be incorporated into the FMP as an appendix by the 2013 fire season.)
	2.18	Habitat and Population Management	Within five years of Plan's approval, use prescribed fire or mechanical treatment 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	Fire (Federal fire funding constraints and local fire management factors make this objective unreachable. However, the management of naturally ignited wildfires to achieve these resource management objectives is both ecologically and economically desirable and achievable.)
Resource Assessment	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	Fire (Through spatial analysis of fire history and fuels, Refuge Management needs to understand where natural

			Kenai Peninsula with emphasis on the suppression of natural ignitions in Wilderness and Limited Fire Management Option areas	fire ignitions may be managed for resource benefits and where fuels mitigation treatments should be strategically located to enhance that management practice.)

CCP Goal	**CCP Objective**	**Objective Category**	**Description**	**Program Responsibility/ Status**
	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.	Biology/Fire (the Alaska Regional Fire Branch owns two EBAMS, one of which has been used on the Refuge to monitor particulate emissions for prescribed fire and during volcanic eruptions.)
Environmental Education and Training	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)	Fire
	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.	Fire
Facilities	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	Fire
	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	Fire

3.1.2 Fire Management Plan Objectives

The following fire management plan objectives have been identified through the CCP revision process or through national/regional policy compliance:

- Refuge Fire Prevention Technician, in collaboration with other agency Prevention Officers, to develop a Refuge Wildfire Prevention and Outreach Plan prior to 2013 fire season and attach it to the Revised FMP as an appendix. The Prevention Plan will be reviewed/updated annually.
- Refuge FMO/AFMO, in collaboration with Refuge Ecologist and Regional Fire Ecologist, to develop Refuge Wildfire and Hazard Fuels Mitigation Monitoring Plan prior to 2013 fire season and attach it to the Revised FMP as an appendix.
- Refuge FMO/AFMO, in collaboration with Refuge GIS and All Lands All Hands cooperating agencies, to develop Refuge Strategic Hazard Fuels Mitigation Plan for CWPP areas, private inholdings, Native Allotments, and Refuge historic cabins, cultural sites and public use cabins, prior to 2014 fire season, and attach it to the Revised FMP as an appendix. The Fuels Mitigation Plan will be updated annually.
- Refuge Fire Prevention Technician to revise and maintain Refuge Fire Management Web Page, per national/regional standards, prior to the 2014 fire season. The Fire Web Page will be updated at least quarterly and as necessary during the fire season.

3.1.3 Common Characteristics of the Fire Management Units (FMUs)

General management direction from the Refuge CCP, regardless of FMU, is that natural wildland fires should be allowed to burn unless life, property or significant resource values are at risk and that such fires should be managed to meet refuge goals and objectives.

Special Management

Special management lands are managed within one of the CCP management categories described previously, but have additional requirements because of their status. An example of Special Management areas would be Research Natural Areas.

- ***Management of Selected Lands***
  The Service retains management responsibility for lands selected but not yet conveyed to Native village and regional corporations or to the State of Alaska. The appropriate Native corporation or agency of the State of Alaska will be contacted and its views considered prior to issuing a permit involving these lands. Fees collected for special use or right-of-way permits will be held in escrow until the selected lands are conveyed or relinquished. Management of these lands will be the same as for adjacent Refuge lands.
- ***Alaska Native Claims Settlement Act Section 22(g)***
  Section 22(g) of the Alaska Native Claims Settlement Act (ANCSA) provides that those refuge lands established prior to December 18, 1971, and are conveyed under that act remain subject to the laws and regulations governing the use and development of the Refuge. The compatibility standard, as it applies to activities occurring on these lands, is described in 50 CFR 25.21(b) (1). In addition, the Service retains the right of first refusal on village corporation lands if these lands are ever offered for sale. The Refuge will work with landowners to balance the commercial development and use of 22(g) lands with the protection of resources important to Refuge purposes.

3.1.4 Other Characteristics Common to the Fire Management Units (FMU's)

Topography/Water

The Refuge is divided into two main physiographic regions: a mountainous region and forested lowlands. Elevations on the Refuge range from sea level to more than 6600 feet in the Kenai Mountains, with tree line at about 1800 feet. Among the peaks of the Kenai Mountains lies the Harding Ice Field. This ice field thrusts numerous glacial fingers out into the Refuge.

The Kenai River, the largest and most productive anadromous river system on the Kenai Peninsula, drains about 2148 square miles (5563 km2). About 54 percent of the Kenai River watershed is in the Refuge, 37 percent is in the Chugach National Forest, and the remainder is in State and private lands. Ten major tributaries feed the Kenai River System: Beaver Creek, Slikok Creek, Soldotna Creek, Funny River, Moose River, Killey River, Skilak River, Russian River, Cooper Creek, and Juneau Creek. Other Refuge river and stream systems flowing into the waters of Cook Inlet include the 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, and most of them are on the Refuge. The largest are two glacial lakes, Tustumena Lake (74,000 acres or 31,000 ha) and Skilak Lake (25,000 acres or 10,000 ha). More than 4500 smaller lakes dot the Refuge, mostly in the Moose, Swanson, and Chickaloon River drainages.

Wildlife

There are at least 201 known vertebrate species on the Refuge, including: 150 birds, 30 mammals, 20 fishes and 1 amphibian (wood frog). While none of these species are listed as threatened or endangered, there are several species of interest and one proposed for listing (Kittlitz's murrelet). There are 5 species of salmon, bald eagles, trumpeter swans, loons, a wide variety of furbearers such as lynx, wolverine and marten, Dall sheep, mountain goats, wolves, caribou, moose, and significant populations of brown and black bear on the Refuge.

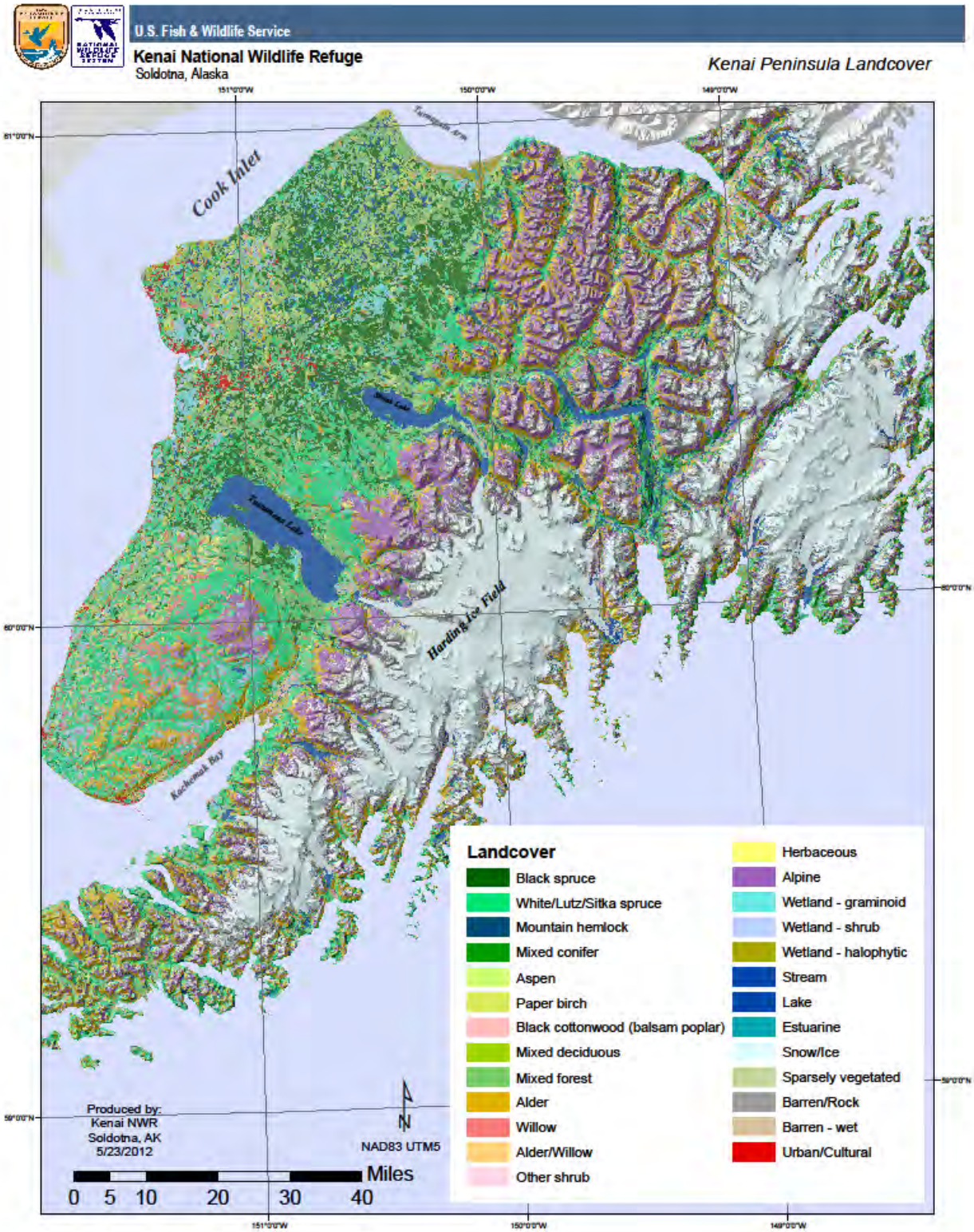
Vegetation

Thirty-nine percent of the Refuge is forested. Scattered stands of black spruce are interspersed with muskeg, peat bogs and grassy wet meadows in the lowlands, while white spruce and mixed conifer-hardwood forests dominate drier upland sites on ridges and in the foothills of the mountains. White spruce stands are often intermixed with deciduous trees, including white birch, aspen, cottonwood, balsam poplar, alder and willow species, especially on disturbed sites such as old fire scars. Alpine tundra covers about 11 percent of the Refuge. Lowland shrubs (alder and willow) cover about 9 percent of the Refuge. Of this lowland shrub class, about 87 percent is dwarf shrub and lichen tundra, and 13 percent is represented by tall shrub (alder and willow) thickets usually associated with tundra. Water and associated wetlands cover 13 percent of the Refuge, while snow fields, ice, and glaciers cover the remainder. **Table 4 – Kenai NWR Landcover**, summarizes the landcover (vegetation) classes of the Refuge by acreage and percentage, and **Figure -6 – Kenai Peninsula Land Cover**, is a map of the landcover/vegetation classes of the Kenai Peninsula.

Table 4 – Kenai NWR Landcover

Land Cover Class	Acreage	Percent of Refuge
Black spruce	298,499	15.01%
White/Lutz/Sitka spruce	203,484	10.23%
Mountain hemlock	31,792	1.60%
Mixed conifer	18,386	0.92%
Aspen	4,497	0.23%
Paper birch	54,514	2.74%
Black cottonwood (balsam poplar)	5,252	0.26%
Mixed deciduous	8,843	0.44%
Mixed forest	321,606	16.17%
Alder	114,309	5.75%
Willow	19,983	1.00%
Alder/Willow	3,664	0.18%
Other shrub	3,284	0.17%
Herbaceous	16,335	0.82%
Alpine	208,224	10.47%
Wetland - graminoid	80,999	4.07%
Wetland - shrub	16,084	0.81%
Wetland - halophytic	8,113	0.41%
Stream	10,795	0.54%
Lake	147,951	7.44%
Estuarine	835	0.04%
Snow/Ice	263,744	13.26%
Sparsely vegetated	24,968	1.26%
Barren/Rock	101,255	5.09%
Barren - wet	19,553	0.98%
Urban/Cultural	1,547	0.08%
Totals	1,988,515	100.00%

Figure 6 - Kenai Peninsula Land Cover



Spruce Bark Beetle

Historically, the Kenai NWR and other areas of the Kenai Peninsula suffer periodic infestations of the spruce bark beetle (*Dendroctonus rufipennis*) in white spruce. Tree-ring studies on the Refuge indicate significant beetle outbreaks occurred in the 1820's, 1880's, 1910-20's and 1950's. The most recent outbreak began in the late 1960's, when substantial beetle-kill was observed in the Swanson River Road area in the northern portion of the Refuge. The infestation eventually involved hundreds of thousands of acres from Point Possession to Kachemak Bay and throughout the valleys of the Kenai Mountains. Recently, spruce mortality has declined sharply, primarily because there are few mature, uninfested spruce stands remaining. The risk of catastrophic fire remains high in dense stands of beetle-killed trees, especially in wildland-urban interface areas. After needle drop, the risk of crown fire may decline, although some stands still contain enough fine, dry aerial fuels to support crown fire. As dead stands break down, large dead woody fuels accumulate on the ground, increasing the intensity and residence time of wildfires and making suppression activities more difficult.

Fire Behavior/Fire Weather

Topographic and climatic features of the western Kenai Peninsula are major influences on fire behavior on the Refuge. Cold air drainage (advection) from the Harding ice field and associated large glaciers produce localized turbulence and downslope/down-valley winds that can be extreme and can occur suddenly, producing dramatic changes in fire behavior. The Skilak glacier and the downslope winds it produces on Skilak Lake, is one example. Severe turbulence and downslope foehn or east winds can occur anywhere along the west slope of the Kenai Mountains when conditions are right.

During the late spring/early summer fire season, moist ocean breezes from the southwest (Gulf of Alaska) and from Cook Inlet west of the Refuge, dominate the general wind pattern. These daily sea breezes occur along the western boundaries of the Refuge and tend to have a dampening effect on fire behavior as relative humidity increases with their occurrence. However, when high temperatures and atmospheric instability combine with these moist sea breezes, thunderstorms often form along the western foothills of the Kenai Mountains.

Occasionally, when high pressure over the interior of Alaska is coupled with low pressure in the Gulf of Alaska, strong north (gradient) winds occur over the Refuge. These cool, dry winds can produce relative humidity less than 20 percent and wind speeds in excess of 50 miles per hour. These fire weather conditions are known to cause severe fire behavior.

Due to the rain shadow effect of the Kenai Mountains to the east and the Alaska Range to the west, annual precipitation on the Kenai lowlands, ranges from 25 inches at Homer and 19 inches at Kenai to 17 inches at Sterling. Half of the annual precipitation falls as light rain or drizzle, between early August and November. Soil and duff moistures during this period are generally high, and fire severity or depth of burn is correspondingly low and spotty. From mid-April to July, the Refuge experiences its longest days (up to 20 hours of daylight) and lowest relative humidity. These factors, in addition to the typical lack of precipitation in early summer, can contribute to extreme fire weather and fire behavior on the Kenai. Running crown fires and long-range spotting are possible during these times.

The lowland areas of the western Kenai Peninsula are populated by large stands of black spruce. Fires characteristically burn with fairly high intensity and slow, predictable rates of spread.

Surface fuels including shrubs, feather mosses and lichens are the primary carriers of fire in these black spruce stands. Ignition of the tree crowns will occur just behind the flaming front if flame lengths are sufficient to ignite the lower lichen-covered branches. Very low relative humidity and high winds can produce sudden, extreme fire behavior in black spruce forests.

Fire Effects

The white spruce forests of the Kenai National Wildlife Refuge are intolerant to fire and experience a high level of mortality and stand replacement on drier upland sites. Underburning for stand maintenance is not generally practical in white or black spruce stands, because of the resulting high tree mortality. However, black spruce is a fire-adapted species that is often regenerated by fire, even stand-replacement fires. Black spruce produces tightly compacted, semi-serotinous cones that release seeds over a period of several years, but will release a particularly large pulse of seeds following a fire. The cones are high in the canopy and usually remain viable even after intense crown fires.

The hardwood tree and shrub species on the Refuge, including willow, birch, aspen, and cottonwood, typically regenerate through root suckering following fire, provided the fire does not damage the root systems. This vegetative regeneration provides abundant browse for moose and hare. Another pathway to stand replacement, by seedling establishment, is dependent upon mineral soil exposure. The more soil exposed, the greater the likelihood of hardwood regeneration.

The effects of fires on understory vegetation are variable. Lichens recover relatively slowly following a fire: 80 years is generally considered the minimum time necessary to regenerate mature spruce/lichen forest. In the absence of fire however, mosses may replace lichens as forest canopies close over a period of centuries. This can have a negative impact on caribou, which rely on lichens for sustenance in winter. Some grasses, such as *Calamagrostis canadensis* (bluejoint reedgrass), are stimulated by fire, while others are suppressed, depending upon the season and the intensity of the fire. Moss layers may be consumed by fire, though usually not entirely, creating a mosaic pattern of exposed mineral soil that provides a seed bed for both hardwoods and conifers.

Fire behavior varies by forest type or vegetation community. Large areas of the Refuge include stands of mixed spruce/hardwoods, white spruce, shrublands, and grasslands. Mixed spruce/hardwood stands generally burn with less intensity than black spruce, having less ladder fuel and more canopy shading. Pockets of hardwoods can provide a natural barrier to fire spread; crowning spruce fires will normally drop to the ground when encountering a hardwood stand, in all but the most extreme conditions. Fires also do not carry as well in the brush and shrublands found on the Refuge, especially where shrubs are sparse. Labrador tea however, can be a primary carrier of fire. Dead or cured stands of *Calamagrostis canadensis* can produce rapid rates of spread and high fireline intensity, especially during the early and late fire seasons when dead grass fuel loads are at their peak.

Fire History

An aerial view of the Kenai National Wildlife Refuge reveals a mosaic pattern of spruce and mixed hardwood stands in every stage of post-fire forest succession. Historic records of past fire activity are somewhat lacking compared with other regions of the United States, but a number of studies of Kenai Peninsula fire frequency and fire history have been completed (Lutz, 1960;

DeVolder and others, 1999), or are in progress. Using lake sediment and soil charcoal samples, dendro-chronological dating of fire-scarred and fire-killed trees, and geo-spatial analysis, these studies document large landscape fires back to 1708. Annual Narratives prepared by refuge managers, record fire data beginning in 1941. From 1974 to the present, official fire records and State Fire Reports complete the extent of Refuge fire records. The known large fire history of the Kenai Peninsula is shown in **Figure 7 – KNWR Large Fire History**.

According to data from 1974 – 2005, the average number of fires (both human-caused and lightning-caused) on the Refuge was 7.75 fires/year. These fires burned an average of 2,080 acres/year. These averages were influenced by several large fires in 2004 and 2005. The fires from those two years increased the average number of fires by 0.41 fires/year and the average annual acres burned by 1286 acres/year. Wet fire seasons generally experience fewer fire starts and lower acreage burned, while dry years see a higher frequency of ignitions, greater fire severity and larger fires. Over the past ten years (2002-2011), 70 Refuge fires burned 68,832.3 acres. So, the 10-year averages are 7 fires/year and 6883 acres/fire.

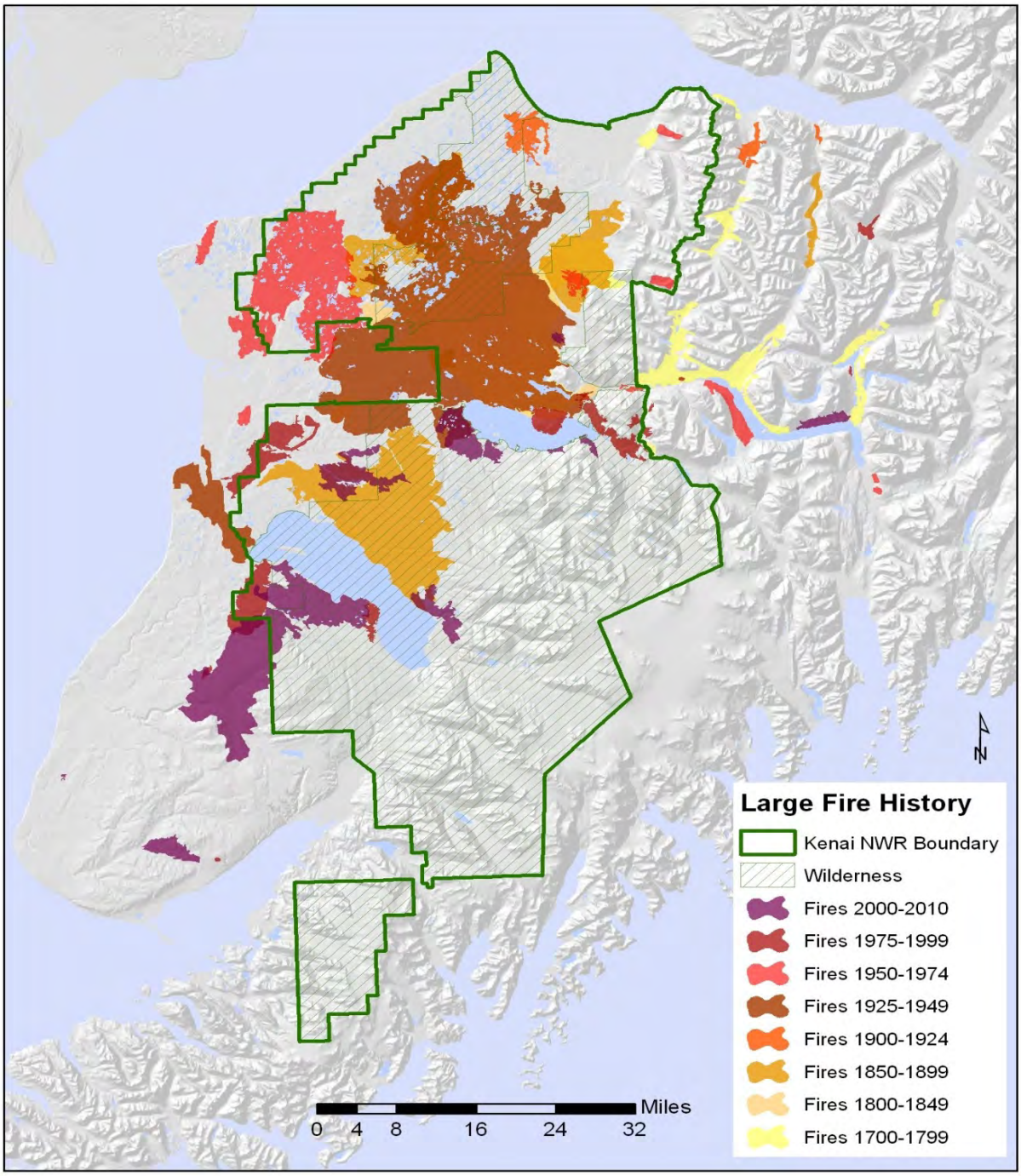
Climate change may be affecting the frequency and sources of ignition on the Kenai Peninsula and the Refuge. In the absence of reliable weather and fire information prior to 1947, anecdotal information is that lightning and lightning-caused fires are an atypical or occasional occurrence on the Peninsula. This conclusion is supported by the number of Peninsula fires started by humans (1149), and the number started by lightning (50), in the years 1990 – 2005. While less than 5 percent of the Peninsula's fires were started by lightning, almost 1/4 of these 50 lightning fires occurred in 2005 alone.

Appendix F – Refuge Fire History lists large fires on the Refuge over the last ten years and also looks at potential trends.

Fire Ecology and Fire Regime Shift Due to Climate Change

The Refuge Biology Staff produced a comprehensive report for this FMP describing the historic fire regime and climate change and the effects of climate change on the fire regimes of the Kenai NWR. The report also lists fire monitoring efforts that have been conducted on the Refuge throughout its history. This report is attached as **Appendix S – Fire Ecology and Fire Regime Shift due to Climate Change.**

Figure 7 - KNWR Large Fire History



Fuels and Expected Fire Behavior

Refuge lands other than those covered by glaciers or water, are covered by a diverse mix of forest types and vegetation communities, which are represented by a variety of fuel types and complexes, and their corresponding fire behavior characteristics. The ***Fuel model guide to Alaska vegetation (Cella, Allen, et al,. April 2008)*** and its associated ***Fuel Model Crosswalk***

(Scott 2008), describe the Fuel Models of Alaska and the Kenai Peninsula and a comparison of the three fuel model guides used for various applications in Alaska (13 NFFL, Scott and Bergen 40, and CFFDRS). See: **Appendix G – Fuel Model Crosswalk AWFCG (condensed).**

Employee and Firefighter Safety

The safety of Service employees and cooperators involved in fire management activities is of primary concern. Only employees that are trained and qualified per national/regional/local standards will be assigned to fire management duties. All fire management personnel will be issued appropriate personal protective equipment and will be trained in its proper use. No Service employee, contractor or cooperator will be knowingly exposed to life threatening conditions or situations except when necessary to save the life of another person.

Fast moving, wind-driven wildfires pose a significant threat to firefighter safety, whether firefighters are in engines, on equipment, or on a hand crew. Road access/egress on many Refuge fires is limited or nonexistent, and remote fires often require aviation or boat transportation. It is important that firefighters practice good risk management and ensure that Lookouts/Communications/Escape Routes/Safety Zones (LCES) principles are followed at all times.

Public Safety

Smoke from Refuge wildfires or prescribed fires could impair visibility on roads/highways, and may cause traffic hazards and health risks. Warning signs will be posted along impacted roads, including reduced speed limits, if necessary. Prior to prescribed fire ignitions, the following Refuge cooperators will be notified: Alaska State Troopers, Central Emergency Services and other local fire departments, adjacent landowners, the Flight Service Office in Kenai, the Federal Aviation Administration tower in Anchorage, and the Alaska Division of Forestry. Prescribed fires will be closely monitored for: smoke trajectory, ventilation factor, adverse impacts to known sensitive areas or resources, and overall air quality. Aviation and traffic control will be coordinated with the appropriate agencies.

The Kenai NWR contains no Class-I airsheds, as defined by the Clean Air Act. The nearest Class-I airshed is at Tuxedni Bay, which is located about 50 miles west of the Kenai Refuge boundary, on the west side of Cook Inlet and along the eastern boundary of Lake Clark National Park. Aside from Tuxedni Bay, the next nearest Class-I airshed is Denali National Park, more than 200 miles north of the Refuge. Other sensitive smoke targets are the communities, hospitals, schools and airports of the Kenai Peninsula, the city of Anchorage and other communities around northern Cook Inlet.

Response Capability

The current Kenai NWR Fire Management Staff consists of a Permanent Full-time (PFT) Fire Management Officer (FMO), a PFT Assistant Fire Management Officer (AFMO), a Permanent Seasonal (PS) Fire Prevention Technician, and a PS Prescribed Fire/Fuels Technician (See: **Appendix H – Refuge Fire Management Organization Chart**). In addition to the permanent fire staff, the Refuge typically hires 1-4 Temporary Forestry (Fire) Technicians (depending upon annual preparedness and hazardous fuels project funding). These temporary fire technicians are also available to respond to wildfires on or off the Refuge. The fire management staff is supplemented by Refuge collateral-duty firefighters (up to 15 permanent and seasonal staff) that are certified for arduous duty each season.

Refuge fire-funded equipment includes:

- 2 type-6 wildland engines
- 1 type-4 wildland engine
- 1 Bombardier Muskeg specialty tracked vehicle (type-6 wildland engine)
- 1 type-1 Dozer
- 1 type-3 Dozer
- 1 4WD UTV
- 1 4WD ATV
- 1 6WD ATV
- 1 T-300 Bobcat skid steer loader with FECON tree shear attachment
- Small (20 Person) fire cache

The **Refuge Dispatch Plan** (**Appendix I**), shows qualified Refuge firefighters and lists Refuge fire equipment.

3.2 Fire Management Units

A map of the Refuge Fire Management Units (FMU's) is shown in **Figure 5 – Refuge FMU's.** Each of the FMU's is described in detail below.

3.2.1 Wilderness FMU

This category applies only to areas designated by Congress as units of the National Wilderness Preservation System; areas proposed for Wilderness designation will be managed under Minimal management, consistent with section 1317(c) of Alaska National Interest Lands Conservation Act (ANILCA) and U.S. Fish and Wildlife Service (Service) policy. Designated Wilderness will be managed under the Wilderness Act of 1964 and the exceptions provided by ANILCA. Because Wilderness units are part of a nationwide, multi-agency system, the Service recognizes that responsibilities for managing Refuge Wilderness go beyond the mission of the Service and that the purposes of the Wilderness Act are within and supplemental to the other purposes for which individual refuges were established.

The history and intent behind the Wilderness Act make Wilderness more than just another category of management. Wilderness encourages a broadened perspective of the Refuge landscape, one that extends beyond managing it solely as wildlife habitat. Wilderness is managed as an area "retaining its primeval character and influence." In addition, Wilderness provides human visitors with opportunities for solitude or a primitive and unconfined type of recreation, which may be characterized in terms of experiential dimensions such as discovery, self-reliance, and challenge.

Wilderness areas are managed to preserve their experiential, aesthetic, scientific, and other related values. Research has shown that some values of Wilderness extend beyond their boundaries to people who may never visit but who benefit from the protection of natural ecological processes---benefits such as clean air and water and the simple knowledge that such places exist. In managing Wilderness, managers are encouraged to consider these off-site and symbolic values as well as tangible resource values.

Permanent structures are generally prohibited; examples of exceptions are historic and cultural resources and in certain circumstances, administrative structures or cabins that predate ANILCA, cabins that are necessary for trapping and public use cabins necessary for the protection of human health and safety. Facilities and structures are rustic and unobtrusive in appearance.

Compatible commercial uses of Wilderness areas are generally limited to those activities that facilitate wilderness recreation (e.g., guided fishing, hunting, and wilderness trips). All commercial activities and facilities require authorizations such as special use permits.

The Wilderness Act provides a special provision allowing measures to be taken "as may be necessary in the control of fire, insects, and diseases, subject to such conditions as the Secretary deems desirable" [Section 4 (d)(1)] Actions such as prescribed fires or invasive species control may be conducted in wilderness in accordance with Service policy at 610 FW 2.23 and 610 FW 2.19, respectively. Prescribed fire and Non-fire applications such as manual thinning may be desirable options for protecting specific resource values by reducing fuel buildups and modifying forest structure to reduce fire intensities if ignitions do occur. Management activities in Wilderness must be found to be the minimum requirements for the administration of the area as Wilderness.

3.2.1.1 Wilderness FMU – Description

With the passage of ANILCA in 1980, Congress designated 1.32 million acres or about two-thirds of the Refuge as Kenai Wilderness. There are three separate and distinct units of designated wilderness on the Refuge: the Dave Spencer Wilderness Area (187,228 acres), which includes the Swanson River and Swan Lake National Recreation Canoe Trails; the Mystery Creek Wilderness Area (46,086 acres), in the Mystery Hills area of the Kenai Mountains north of the Sterling Highway; and, the Andrew Simons Wilderness Area (1,087,094 acres), which covers most of the Refuge lands south of the Kenai River.

Dave Spencer Wilderness – Description

Also known as the Kenai Lowlands and the Canoe Trails, the Dave Spencer Wilderness covers a large area of the northern portion of the Refuge, from Point Possession south to the Moose River. It is generally flat to gently rolling terrain with hundreds of pothole lakes, wetlands and moraines characteristic of post-glacial deposits. Most of the area is forested with stands of black spruce occupying the wetter, poorer sites and mixed stands of white (Lutz) spruce and hardwoods (birch, aspen and poplar) on the drier upland sites. Non-forested wetlands and muskegs frequently occupy the lowland areas between lakes and at lake margins. The area also contains three river systems: the Chickaloon, the Swanson and the Moose.

Access into the Dave Spencer Wilderness is limited. The only road access is north from the Sterling Highway on the Swanson River Road, then east on the Swan Lake Road to one of three trailheads on the Canoe Trail System: Canoe Lake (West Entrance), Portage Lake (East Entrance), and Paddle Lake (North Entrance). There are a number of lakes in the wilderness area where float plane access is permitted, and it is possible to reach the northern boundary of the wilderness by boat (Cook Inlet - Turnagain Arm), or All-Terrain Vehicle (ATV) at low tide.

The most fire-prone habitats or fuel types in the Dave Spencer Wilderness include stands of black spruce, mixed stands of white spruce and hardwoods, bluejoint meadows or grasslands, and areas of beetle-killed spruce where grasses, forbs and brush provide a flashy fuelbed mixed with the heavy down-dead beetle-killed fuels.

Historically, large landscape fires like the human-caused, 310,000 acre Skilak Lake Fire (1947) have affected the Dave Spencer Wilderness, though no large fires have occurred there since. There is no history of Emergency Stabilization (ES) or Burned Area Rehabilitation (BAR) projects in the Dave Spencer Unit, and prior to the new CCP, prescribed fire was not allowed in Kenai Wilderness areas. The wildfire season in the area is typically from the snow-free date in early April or May to the onset of fall rains in August or September, though exceptions exist. Fire intensity, fire size and complexity vary with fire weather and fuel conditions, but the interconnected lakes, rivers and wetlands in the Dave Spencer Wilderness tend to keep large fast-moving forest fires from occurring, except during periods of drought or hot/dry weather.

Mystery Creek Wilderness – Description

Also known as the Mystery Hills, the Mystery Creek Wilderness is the smallest of the three Kenai Wilderness areas at just over 46,000 acres. The eastern boundary of this unit is shared with the Chugach National Forest. The southern boundary follows the Sterling Highway right-of-way. The unit is predominantly mountainous and alpine with white (Lutz) spruce and mountain hemlock forests at the lower elevations along the western and southern boundaries.

The only access is from the Skyline and Fuller Lakes Trailheads on the Sterling Highway, or from horse trails along Mystery Creek Road to the west.

The most fire-prone habitats or fuel types in the Mystery Creek Wilderness include stands of black spruce, mixed stands of white spruce and hardwoods, bluejoint meadows or grasslands, and areas of beetle-killed spruce where grasses, forbs and brush provide a flashy fuelbed mixed with the heavy down-dead beetle-killed fuels.

Historically, there have been three large fires that have burned western, forested portions of the wilderness: the Skilak Lake Fire (1947), the Chickaloon Fire (1974) and the lightning-caused Mystery Hills Fire (2001). There is no history of Emergency Stabilization or Burned Area Rehabilitation projects in the Mystery Creek Unit, and prior to the new CCP, prescribed fire was not allowed in Kenai Wilderness areas. The wildfire season in the area is typically from the snow-free date in early April or May to the onset of fall rains in August or September, though exceptions exist. Fire intensity, fire size and complexity vary with fire weather and fuel conditions, but the threat of wildfires is likely limited to the forested portions of the wilderness at the lower elevations (below 1000’ above sea level).

Andrew Simons Wilderness – Description

This is the largest and most diverse of the three Refuge Wilderness areas at more than 1 million acres. Its upper elevations are found high in the Kenai Mountains (over 6000’ above sea level), where the Harding Icefield terminates in several glaciers (including: Skilak, Tustumena, Dinglestadt and Wosnesenski) that intrude into the eastern edge of the Refuge. Although these glaciers have receded dramatically over the last century, the Skilak and Tustumena Glaciers are responsible for the formation of the two largest freshwater lakes on the Kenai Peninsula: Skilak and Tustumena. Skilak Lake is part of the Kenai River system and Tustumena is drained by the Kasilof River. These are the two largest and most productive salmon streams on the Kenai Peninsula.

These lakes and their associated rivers provide boat and float plane access into the Andrew Simons Wilderness. There is no road access. The only other access into the wilderness is by float plane into several small, designated lakes, or by trail – including: the Cottonwood Creek, Hanson Horse Trail and Funny River Horse Trail on the northern boundary; the Doc Pollard Trail from Kasilof to Tustumena Lake; and, the Bear Creek, Moose Creek, Emma Lake, Tustumena Glacier and Clear Creek Trails from Tustumena Lake.

The most fire-prone habitats or fuel types in the Andrew Simons Wilderness include large, continuous stands of black spruce, mixed stands of white spruce and hardwoods, bluejoint meadows or grasslands, and areas of beetle-killed spruce where grasses, forbs and brush provide a flashy fuelbed mixed with the heavy down-dead beetle-killed fuels.

The fire history of the Andrew Simons Wilderness includes many large landscape wildfires, primarily on the Benchlands between Skilak and Tustumena Lakes. Some have been documented as far back as the late 19th century. Since 1990, there have been twelve large wildfires that have consumed more than 80,000 acres in the Andrew Simons Wilderness. Six of the twelve large fires were ignited by lightning. And four of the large fires have occurred south of Tustumena Lake (3 since 2005), in an area that has no documented fire history prior to 1990.

There is no history of prescribed fire in this wilderness area. And the only ES and/or BAR project ever completed on the Refuge, was after the Glacier Creek Fire in 2004. The Refuge completed two Burned Area Emergency Response (BAER) projects in 2005-2006: 1) a two-year trail reconstruction project to restore the 3.2-mile Emma Lake Trail, a traditional/subsistence hunting trail that was obliterated by the fire; and 2) a two-year exotic plant survey that discovered 19 species of exotic vascular plants – two of which had never before been documented on the Refuge.

3.2.1.2 Wilderness FMU - Values to Protect

Dave Spencer Wilderness – Values to Protect

- WUI areas designated in Federal Register as Community at Risk (CAR) or designation as Community of Interest (COI) and key descriptors (location, access, etc.): the community of Sterling, Alaska abuts the southern boundary of the Dave Spencer Wilderness.
- Service structures, infrastructure and private lands (in-holdings): the Moose Research Center (MRC). Established in 1966, the MRC is a world-renowned, one-of-a-kind facility that continues to play a role in the understanding of the nutritional, physiological, and ecological aspects of moose. The Dave Spencer Wilderness encloses the 19,250-acre MRC on three sides. The only access to the MRC is via the Swan Lake Road from the west. There are four one-mile-square fenced moose pens and several buildings at the MRC. Two cabins in the compound house two or more State employees and family members, year-round. There is also a Private Inholding just northeast of Dipper Lake, along the northwest shore of Chickaloon Bay. There are no other structures, infrastructure or private in-holdings in the Dave Spencer Wilderness.
- Adjacent landownership, structure types, and land use: the wilderness area boundary abuts an area of State-selected and private lands at its far northwestern corner – between Point Possession and Miller Creek. There are a number of privately-owned recreation cabins within a few miles of the Refuge boundary in this area.
- Threatened and Endangered (T&E) or special status species and habitats, critical habitat for other species of concern: while there are no known T&E or special status species and habitats, there are dozens of lakes in the wilderness that are designated as permanent nesting habitats for trumpeter swans.
- Historic and Archeological resources – structures, sites, etc.: historic and cultural resources are common throughout the Refuge, especially along major waterways where salmon populations occur. To protect known cultural and historical resources the Refuge keeps the locations of known sites secure. The Refuge provides Resource Advisors to protecting agencies or incident management teams as necessary to protect known sites from damage due to fire management activities.
- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): the CCP identifies three special value areas that partially intersect the Dave Spencer Wilderness: the Chickaloon Watershed and Estuary, the Kenai River and its Tributaries, and the Lowland Lakes System (See:

Figure 3). The Lowland Lakes System includes the world-class Swanson River and Swan Lake Canoe Trails. Wilderness values include: wilderness character where the earth and its community of life are untrammeled by man, primeval character and influence, natural and unimpaired conditions, and opportunities for solitude or a primitive and unconfined type of recreation.

- Hunting and recreation, subsistence use (notably in Alaska): large and small game and waterfowl hunting, fishing, camping, canoeing and subsistence uses occur in the wilderness area.
- Mining, oil and gas wells and utility right-of-ways: while there are no mining, oil and gas wells or utility rights-of-way within the designated wilderness, the Swanson River Oil & Gas facilities are just west of the southern half of the wilderness area.
- Structures lacking defensible space, water supply issues: while there are no developed fire-fighting water sources at the MRC, there are accessible lakes near the structures.

Mystery Creek Wilderness – Values to Protect

- Adjacent landownership, structure types, and land use: the eastern boundary of the Mystery Creek Wilderness is shared by the Seward Ranger District of the Chugach National Forest. The southern boundary abuts the Sterling Highway right-of-way.
- Historic and Archeological resources – structures, sites, etc.: historic and cultural resources are common throughout the Refuge, especially along major waterways where salmon populations occur. To protect known cultural and historical resources the Refuge keeps the locations of known sites secure. The Refuge provides Resource Advisors to fire protecting agencies or incident management teams as necessary to protect known sites from damage due to fire management activities.
- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): Wilderness values include: wilderness character where the earth and its community of life are untrammeled by man, primeval character and influence, natural and unimpaired conditions, and opportunities for solitude or a primitive and unconfined type of recreation. The Chickaloon Watershed and Estuary is a special value area identified by the CCP that encompasses a large portion of the Mystery Creek Wilderness.
- Hunting and recreation, subsistence use (notably in Alaska): large and small game and waterfowl hunting, fishing, camping, canoeing and subsistence uses occur in the wilderness area.

Andrew Simons Wilderness – Values to Protect

- WUI areas designated in Federal Register as Community at Risk (CAR) or designation as Community of Interest (COI) and key descriptors (location, access, etc.): Communities at Risk include Sterling, Alaska and Funny River, Alaska. Both communities are directly north of the northwest corner of the Andrew Simons Wilderness. Along the southern edges of these communities there are dozens of primary residences and businesses within one mile of the wilderness boundary. Sterling is accessed via the Sterling Highway and secondary roads. The only access into Funny River is via the Funny River Road. There is one Community of Interest: the Ninilchik Forties Subdivision, along the western boundary of the wilderness in the Caribou Hills area south of Tustumena Lake and north of Deep Creek. This community is accessed via Oilwell Road out of Ninilchik, Alaska on the Sterling Highway. There are more than 200 structures in this unincorporated community of residences and recreation cabins.
- Service structures, infrastructure and private lands (in-holdings): There are several Refuge Public Use and Administrative Cabins in the Andrew Simons Wilderness, some of which are also historic resources (see below: Historic and Archeological resources): Doroshin Bay, Emma Lake, Nurses, Pipe Creek, Andrew Berg's, Big Bay and Caribou Island. There is also a Refuge Radio System Repeater (the Tustumena Repeater) just south of the southern end of Tustumena Lake on a point above the tree line. Private lands (in-holdings) in the Wilderness include:
    - Romig Family Trust Parcels (1 modern cabin + historical structures) at the northern end of Upper Russian Lake (46.4 acres)

  - Alaska Wildland Adventures Lodge and cabins at Cottonwood Creek on Skilak Lake (5 acres)
  - Guff Sherman Cabin and other parcels with cabins at Douglas Point on Skilak Lake (5 acres)
  - Dolchok Allotment and Cabins at Harvey Lake on the Tustumena Benchlands (100 acres)
  - Bear Creek Subdivision Parcels on Tustumena Lake (38 acres)
  - Jim Taylor Cabin on Tustumena Lake (4+ acres)
  - Blake Cabin (historic) near Indian Creek on Tustumena Lake [T1S, R8W, Sec 2] (5 acres)
  - Ptarmigan Head Parcel (no structures) north of Caribou Lake [T2S, R11W, Sec 24 & 25] (11.9 acres)
- Adjacent landownership, structure types, and land use: on its eastern side, the Andrew Simons Wilderness shares common boundaries with the Chugach National Forest – Rifle Ranger District and Kenai Fjords National Park. The western boundary abuts State and Private Lands from Crooked Creek south. The southern satellite unit also known as the Glacier Unit of the Andrew Simons Wilderness is surrounded by National Park lands to the east and State and Private Lands to the north and west.
- Threatened and Endangered (T&E) or special status species and habitats, critical habitat for other species of concern: the Kittlitz's murrelet (a candidate species for listing), likely nests on the southern unit of the Refuge, which is part of the Andrew Simons Wilderness.
- Historic and Archeological resources – structures, sites, etc.: historical cabins around Skilak, Emma, and Tustumena Lakes: Doroshin Bay, Emma Lake, Nurses, Pipe Creek, Andrew Berg, Big Bay and Caribou Island. Archeological resources are known to exist around Skilak and Tustumena Lakes and the Kenai and Kasilof Rivers and major tributaries, especially where salmon runs are present.
- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): Wilderness values include: wilderness character where the earth and its community of life are untrammeled by man, primeval character and influence, natural and unimpaired conditions, and opportunities for solitude or a primitive and unconfined type of recreation. Special value areas identified in the CCP that intersect with the Andrew Simons Wilderness include: the Skilak Wildlife Recreation Area, the Kenai River and its Tributaries, the Tustumena-Skilak Benchlands, Tustumena Lake and its Watershed, and the Harding Icefield (See: Figure 3).
- Hunting and recreation, subsistence use (notably in Alaska): hunting, trapping, fishing and wildlife photography, camping, boating, hiking, horseback riding and subsistence uses all occur within the Andrew Simons Wilderness.
- Structures lacking defensible space, water supply issues: All known structures including private in-holdings have had at least basic defensible space work completed around the structures.

3.2.1.3 Wilderness FMU - Fire Management Guidance

Firefighter and public safety is always the first priority of fire management. This fire management plan and its activities reflect this commitment. Having provided for safety first, preserving the wilderness character of the three designated Wilderness Areas in the Refuge is the focus of fire management in the Wilderness FMU.

The following fire management guidance applies to all three Wilderness Areas in the Refuge:

- Response to wildfires – preferred strategies and tactics: The default management response to human-caused wildfires is initial attack fire suppression. A human-caused fire that escapes or exceeds the initial attack response will be managed according to an incident management plan prepared by the designated Incident Commander or Incident Management Team, and as documented in the Wildland Fire Decision Support System (WFDSS). The default fire management response to lightning-caused wildfires is to protect such fires as natural ecological processes, allowing them to burn freely upon the landscape until they go out. When that response is not safe or practicable due to life safety or other values at risk, the wildfire should be managed according to an incident management plan and as documented in the WFDSS.

- Allowance to manage wildfires to enhance/benefit resources: Naturally-ignited wildfires may be managed to maintain/enhance/benefit wilderness resources or wilderness values.
- Allowance for hazardous fuels treatments and treatment types: A minimum requirements analysis will be conducted for administrative activities proposed in Wilderness areas. This two-step decision process involves determining if an activity should be conducted in the Wilderness Area and if so, determining the minimum tool, which is the least intrusive tool, equipment, device, force, regulation, or practice determined necessary to achieve a management objective in Wilderness. Actions such as prescribed fires or invasive species control may be conducted in wilderness in accordance with Service policy at 610 FW 2.23 and 610 FW 2.19, respectively. Fire management activities other than emergency response, must be found to be the minimum requirements for the administration of the area as Wilderness.
- Where the Wilderness FMU abuts Refuge boundaries, hazardous fuels projects and treatments will focus on the highest risk areas. Typically, these are adjacent to or included in current CWPP areas. Collaborative projects, including a mix of Refuge, State, and private lands, are the optimal desired project design. Treatment types may range from thinning with power tools, to landscape-scale prescribed fire treatments. Habitat treatments should occur where altered fire return intervals are occurring or vegetation manipulation using hazardous fuels treatment techniques are desired. All treatment types will minimize effects on wilderness values while reducing risk from Refuge wildfires spreading into adjacent communities. Minimizing the effects on wilderness values can be achieved by:
    - Avoiding hard edging (straight line) treatment areas. A wandering edge with occasional screening strips are desired.
    - Retention of whole crown to base height pockets to minimize shooting lanes in treatment areas.
    - Limiting periods of treatment activity to times of least visitor use.
    - Development of standard treatment prescriptions and adaptive management of project implementation.
- Acreage targets and/or limits by habitats/cover types: There are no specific acreage targets and/or limits by habitats/cover types in the Wilderness FMU.
- Retardant or foam use restrictions/constraints: The Refuge Manager or designated Agency Administrator must approve retardant or foam use prior to use.
- Equipment or aircraft use limitations/application of Minimum Impact Suppression Techniques (MIST):
    - *Do not use aerial retardants and foams within 300 feet of waterways or water bodies.*
    - *Do not allow more than 40 people in a single fire camp in the wilderness.*
    - *Repair ground disturbed by suppression activities to pre-incident condition.*
    - *The Refuge Manager must approve heavy equipment use (dozers), prior to use.*
    - *Inform the Regional Archeologist of cultural sites discovered during fire operations.*
    - *Use MIST to the greatest extent possible on all Refuge lands.*
- Staff or monitor wildfires during active burning periods until controlled.
- In this FMU, the default management strategy is to monitor wildfires by aircraft (and by ground when needed), until a season-ending event. Management Action Points (MAPs) will be established for incidents with potential to spread to, and impact values to protect and management actions defined and initiated to mitigate fire impacts.
- The FMP and a delegation of authority provide a general strategy to an IC, who has discretion to select and implement appropriate tactics within the limits for the FMU(s), including when and where to use MIST unless otherwise specified.

- Natural recovery is the preferred choice for recovery following wildfires. However, when natural recovery is not likely, Emergency Stabilization (ES) treatments may be needed to prevent further degradation of cultural and natural resources in the burned area. Any seeding will use seeds from natural sources whenever feasible.

3.2.1.4 Wilderness FMU - Safety Considerations

- Difficulty of movement in marshes/wetlands: marshes, peat bogs, lake and river margins and other riparian/wetland habitats are common in all three Wilderness areas on the Refuge.
- Entrapment in flashy fuels: *Calamagrostis canadensis* (aka, Canada bluejoint or bluejoint reedgrass) meadows and grasslands are the most common and hazardous flashy fuel type on the Refuge and present in all three Wilderness areas.
- Public evacuation/closures during fire operations: during wildfire or prescribed fire operations, it might be necessary to close affected areas within the Wilderness FMU and/or evacuate Refuge visitors. During past wildfire incidents, trails, roads or other access points in the Refuge have been temporarily closed in the interest of public safety. During wildfire incidents, locating and evacuating Refuge visitors could prove especially difficult, due to the remoteness and inaccessibility of the three Wilderness areas in this FMU.
- Smoke impacts on highway safety: smoke from large wildfires or prescribed fires in any of the three Wilderness areas could impact local highways, communities and air traffic, depending upon fire location, intensity, wind direction and atmospheric conditions. Smoke management objectives need to be identified in incident management plans and prescribed fire plans and air quality/smoke conditions should be monitored. The Alaska Department of Environmental Conservation is the point of contact for all air quality and smoke-related issues.
- Gas lines, power lines, mine shafts: there are no natural gas pipelines, power lines or mine shafts in any of the three Wilderness areas.
- Unexploded ordnance (UXO): it is possible that unexploded ordnance exists in this FMU, especially discarded small arms ammunition from hunters or UXO left over from previous military exercises and/or seismic exploration activities. While it is also unlikely that UXO would be encountered on any given wildfire or prescribed fire, firefighters and fire managers should always be alert to possible UXO hazards, take steps necessary to control identified hazards and mitigate risks to fire personnel and the public.
- Repeater locations/radio dead spots: The Refuge maintains four radio repeaters, from north to south along the western slope of the Kenai Mountains: the Trapper Joe Repeater on a ridge just east of Trapper Joe Lake; two repeaters on Hideout Hill (the Hideout and Swanson Repeaters), just north of Hidden Lake; and, the Tustumena Repeater on a ridge just south of the southeastern end of Tustumena Lake. All of the repeaters are above the tree-line and powered by batteries with solar panel charging systems. All four provide both narrowband digital and analog radio communications capabilities to the Refuge. The Hideout Repeater is the primary repeater for most Refuge radio communications. The Swanson Repeater is located on the same site to provide redundancy for the Refuge Radio System and an alternate repeater for emergencies. The Tustumena Repeater is the only one located within designated Wilderness (Andrew Simons). Despite this very reliable radio communications infrastructure, there are radio dead spots across the Refuge, especially in deep canyons and depressions or low-lying areas distant from any repeater. There is no Service radio coverage in areas of the Refuge south of Kachemak Bay.
- Hazards from poisonous plants, venomous animals, predatory animals, illegal dump sites, and illegal drug operations: while there are no poisonous plants like poison oak or poison ivy on the Refuge, there are poisonous mushrooms and berries that should not be consumed by humans. There are no snakes or other venomous animals but healthy populations of black and brown bear are present throughout the Refuge. Refuge employees are required to carry 12-guage shotguns with rifled slugs,

and other bear deterrents like pepper spray and air horns, while working in bear country. Refuge employees receive bear safety training and firearms training and are annually certified to carry the shotgun. Refuge employees often provide bear guard services to visiting firefighters on large wildfire incidents. Occasionally, illegal dump sites are found along the road system, though the Refuge makes every effort to clean up those sites as soon as possible. Illegal drug operations such as marijuana plantations or Meth labs, though not common, are known to occur on the Refuge.

3.2.2 Minimal FMU

Minimal management is designed to maintain the natural environment with very little evidence of human-caused change. Habitats should be allowed to change and function through natural processes. Administration will ensure that the resource values and environmental characteristics identified in the CCP are conserved. Public uses, economic activities, and facilities should minimize disturbance to habitats and resources. Ground-disturbing activities are to be avoided whenever possible.

Management actions in this category focus on understanding natural systems and monitoring the health of Refuge resources. Generally, no roads or permanent structures are allowed (except cabins). Temporary structures may be allowed in situations in which removal is planned after the period of authorized use, and the site can be rehabilitated using plants native to the immediate area. Existing cabins may be allowed for administrative, public use, subsistence, or commercial or economic (e.g., guiding) purposes. New subsistence or commercial cabins may be authorized if no reasonable alternatives exist. Public use or administrative cabins may be constructed if necessary for health and safety.

Public use of the Refuge for wildlife-dependent recreation and subsistence activities is encouraged. Public use facilities are not generally provided. Mechanized and motorized equipment may be allowed when the overall impacts are temporary or where its use furthers management goals.

If a transportation or utility system, as defined in section 1102 of ANILCA, is proposed to cross an area in Minimal management, the authorization process would incorporate a corresponding CCP amendment to change the management category in the affected area from Minimal to Moderate or Intensive management, as appropriate.

Compatible economic activities may be allowed where the evidence of those activities does not last past the season of use, except as noted in the preceding discussion of cabins. The primary economic activities are likely to be guiding and outfitting of recreation activities such as hunting, fishing, hiking, river floating, and sightseeing. All economic activities and facilities require authorizations such as special use permits.

Prescribed fire and Non-fire applications such as manual thinning may be desirable options for protecting specific resource values by reducing fuel buildups and modifying forest structure to reduce fire intensities if ignitions do occur.

3.2.2.1 Minimal FMU – Description

As the second largest of the Refuge FMU's (514,550 acres or 25.9%), most of the lands in the Minimal FMU occur north of the Kenai River and are fragmented by lands in the Moderate, Intensive and Wilderness FMU's (See: Figure 6). The remainder of the Minimal FMU occurs between the Kenai and Ninilchik Rivers and west of the Andrew Simons Wilderness.

Land ownerships adjacent to the Minimal FMU include the Chugach National Forest to the east of the Chickaloon River watershed, and State, Borough, Municipal and Private lands along the western boundaries of the Refuge. Adjacent wildland fire management (Protecting Agency) jurisdictions include the USDA Forest Service and the Alaska Division of Forestry.

Access into the Minimal FMU is better than in Wilderness, but still limited. Road access to Minimal areas or to trails that access Minimal areas includes the Spur Highway, Marathon Road (and associated Beaver Creek Oil and Gas Field roads), the Swanson River Road (and associated Swanson River Oil and Gas Field roads), the Swan Lake Road (and associated Moose Research Center roads), the Mystery Creek Road (and associated pipeline access roads), the Sterling Highway, the Funny River Road and the Tustumena Lake Road. Trail access includes: the Seven Lakes Trail, the Skilak Overlook Trail and several other foot trails within the Skilak Wildlife Recreation Area, the Funny River Horse Trail and the Doc Pollard Trail. Navigable river access is via the Swanson, Kenai and Kasilof Rivers. Aviation access is via floatplane or helicopter.

The wildfire and prescribed fire season in the Minimal FMU is typically from the snow-free date in early April or May to the onset of fall rains in August or September, though exceptions exist. Prescribed fires (especially pile burning) can occur outside of the wildfire season. Fire behavior, fire intensity, fire size and complexity vary with fire weather and fuel conditions, but the threat of wildfires is likely limited to burnable fuels at lower elevations (below 1000' above sea level). Hazardous fuel types or complexes include black spruce types, *Calamagrostis canadensis* grasslands, and areas of beetle-killed spruce where grasses, forbs and shrubs mix with heavy downed dead fuels to elevate the potential for catastrophic fire behavior, fireline intensity and resistance to control.

Since the Refuge was established in 1943, a number of large fires have impacted portions of what is now the Minimal FMU: the 1947 Skilak Lake Fire (310,000 acres), the 1969 Swanson River Fire (79,000 acres), the 1974 Chickaloon River Fire (3780 acres), two large fires in 1996 – Hidden Creek (5200 acres) and Crooked Creek (11,940 acres), and the 2009 Shanta Creek Fire (13,221 acres). Prior to Refuge establishment, other known large fires in Minimal included one near Point Possession (1915) and another near Slikok Lake (1926).

3.2.2.2 Minimal FMU - Values to Protect

- WUI areas designated in Federal Register as Community at Risk (CAR) or designation as Community of Interest (COI) and key descriptors (location, access, etc.): From north to south…Gray Cliffs Subdivision (COI) – access via Spur Highway and coastal trail north from Captain Cook State Park; Nikiski (CAR) – access via Spur Highway; Kenai (CAR) – access via Spur Highway and Bridge Access Road/Kalifornsky Beach Road; Sterling (CAR) – access via Sterling Highway; Soldotna (CAR) – access via Sterling Highway, Spur Highway and K-Beach Road; Funny River (CAR) – access via Funny River Road from Sterling Highway; Kasilof (CAR) – access via Sterling Highway; and, Ninilchik Forties Subdivision (COI).

- Service structures, infrastructure and private in-holdings: There are a number of Refuge Public Use Cabins in the Minimal FMU, including cabins at Pincher Creek, Vogel Lake and McLain Lake. Private in-holdings include the Caribou Island Subdivision on Skilak Lake and a small private parcel on the Lower Chickaloon River about 2.5 miles northeast of Lonesome Lake. Refuge infrastructure in the Minimal FMU includes three radio repeaters: one east of Trapper Joe Lake and two on Hideout Hill, north of Hidden Lake.
- Adjacent landownership, structure types, and land use: Minimal FMU areas are adjacent to the Seward Ranger District of the Chugach National Forest, to State, Borough, Municipal and private lands and to ANCSA (22g) parcels owned by the Tyonek and Salamatof Native Village Corporations, along the western boundaries of the Refuge.
- Historic and Archeological resources – structures, sites, etc.: historic and cultural resources are common throughout the Refuge, especially along major waterways where salmon populations occur. To protect known cultural and historical resources the Refuge keeps the locations of known sites secure. The Refuge provides Resource Advisors to fire protection agencies or incident management teams as necessary to protect known sites from damage due to fire management activities.
- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): areas of the Minimal FMU abut all three Refuge Wilderness areas so the potential impacts of fire management activities upon adjacent Wilderness values should be considered and mitigated as necessary. Special value areas identified in the CCP that intersect areas of the Minimal FMU include: the Lowland Lakes System, the Chickaloon Watershed and Estuary, the Skilak Wildlife Recreation Area, the Kenai River and its Tributaries, and Tustumena Lake and its Watershed (See: Figure 3).
- Hunting and recreation, subsistence use (notably in Alaska): hunting, trapping, fishing and wildlife photography, camping, boating, hiking, horseback riding and subsistence uses all occur within areas of the Minimal FMU.
- Mining, oil and gas wells and utility right-of-ways: there are no mines, oil wells, gas wells, pipelines or utility right-of-ways in the Minimal FMU.

3.2.2.3 Minimal FMU - Fire Management Guidance

Firefighter and public safety is always the first priority of fire management. All fire management plans and activities must reflect this commitment. Other fire management guidance specific to the Minimal FMU includes:

- Response to wildfires – preferred strategies and tactics: The default management response to human-caused wildfires is initial attack fire suppression. A human-caused fire that escapes or exceeds the initial attack response will be managed according to an incident management plan prepared by the designated Incident Commander or Incident Management Team, and as documented in the Wildland Fire Decision Support System (WFDSS). The default fire management response to lightning-caused wildfires is to protect such fires as natural ecological processes, allowing them to burn freely upon the landscape until they go out. When that response is not safe or practicable due to life safety or other values at risk, the wildfire should be managed according to an incident management plan and as documented in the WFDSS.
- Allowance to manage wildfires to enhance/benefit resources: Naturally-ignited wildfires may be managed to maintain/enhance/benefit natural resources or accomplish Refuge management objectives.
- Allowance for hazardous fuels treatments and treatment types: the full range of hazardous fuels treatments and treatment types are allowed, especially in wildland-urban interface or intermix areas.

Where the Minimal FMU abuts Refuge boundaries, hazardous fuels projects and treatments will focus on the highest risk areas. Typically these are adjacent to or included in current CWPP areas. Collaborative projects including a mix of Refuge, State, and private lands is the optimal desired project design. Treatment types may range from thinning with power tools, mastication, biomass removal, to landscape

scale prescribed fire treatments. Habitat treatments should occur where altered fire return intervals are occurring or vegetation manipulation using hazardous fuels treatment techniques are desired. All treatment types will minimize effects on refuge values while reducing risk from Refuge wildfires spreading into adjacent communities. Minimizing the effects on Refuge values can be achieved by:

- Avoiding hard edging (straight line) treatment areas (a wandering edge with occasional screening strips is desired).
- Retention of whole crown to base height pockets to minimize shooting lanes in treatment areas.
- Limiting periods of treatment activity to times of least visitor use.
- Development of standard treatment prescriptions and adaptive management of project implementation.

- Acreage targets and/or limits by habitats/cover types: There are no specific acreage targets and/or limits by habitats/cover types in the Minimal FMU.
- Retardant or foam use restrictions /constraints: The Refuge Manager or designated Agency Administrator must approve retardant or foam use on the Refuge, prior to use except in case of imminent threat to life, safety or loss of homes, facilities or infrastructure.
- Equipment or aircraft use limitations/application of Minimum Impact Suppression Techniques (MIST): See below.
    - *Do not use aerial retardants and foams within 300 feet of waterways or water bodies.*
    - *Do not allow more than 40 people in a single fire camp in the wilderness.*
    - *Repair ground disturbed by suppression activities to pre-incident condition.*
    - *The Refuge Manager must approve heavy equipment use (dozers) prior to use.*
    - *Inform the Regional Archeologist of cultural sites discovered during fire operations.*
    - *Use MIST to the greatest extent possible on refuge lands.*
- Staff or monitor wildfires during active burning periods until controlled.
- In this FMU, the management strategy is to monitor wildfires by aircraft (and by ground when needed), until a season-ending event. Management Action Points (MAPs) will be established for incidents with potential to spread to and impact values to protect and management actions defined and initiated to mitigate fire impacts.
- The FMP and a delegation of authority provide a general strategy to an IC, who has discretion to select and implement appropriate tactics within the limits for the FMU(s), including when and where to use MIST unless otherwise specified.
- In this FMU, prescribed fires will be used in conjunction with herbicide treatments as specified in other refuge plans to help control invasive species and reduce the build-up of hazardous fuels.
- Natural recovery is the preferred choice for recovery following wildfires. However, when natural recovery is not likely, Emergency Stabilization (ES) treatments may be needed to prevent further degradation of cultural and natural resources in the burned area. Any seeding will use seeds from natural sources whenever feasible.

3.2.2.4 Minimal FMU - Safety Considerations

- Difficulty of movement in marshes/wetlands: marshes, peat bogs, lake and river margins and other riparian/wetland habitats are common in all areas of the Minimal FMU.
- Entrapment in flashy fuels: *Calamagrostis canadensis* (aka, Canada bluejoint or bluejoint reedgrass) meadows and grasslands are the most common and hazardous flashy fuel type on the Refuge and present in all areas of the Minimal FMU.

- Public evacuation/closures during fire operations: during wildfire or prescribed fire operations, it might be necessary to close affected areas within the Minimal FMU and/or evacuate Refuge visitors. During past wildfire incidents, specified trails, roads or other access points in the Refuge have been temporarily closed for public safety reasons. During wildfire incidents, locating and evacuating Refuge visitors could prove especially difficult, due to the remoteness and inaccessibility of much of this FMU.
- Smoke impacts on highway safety: smoke from large wildfires or prescribed fires in any of the three Wilderness areas could impact local highways, communities, and air traffic, depending upon fire location, intensity, wind direction and atmospheric conditions. Smoke management objectives need to be identified in incident management plans and prescribed fire plans and air quality/smoke conditions should be monitored. The Alaska Department of Environmental Conservation is the point of contact for all air quality and smoke-related issues.
- Gas lines, power lines, mine shafts: there are no power lines or mine shafts in the Minimal FMU, but there are two natural gas pipe lines: the Enstar line from Chickaloon Bay to Sterling crosses a portion of the FMU along the east side of Chickaloon Bay, and the Wolf Lake to Beaver Creek natural gas pipe line.
- Unexploded ordnance (UXO): it is possible that unexploded ordnance exists in this FMU, especially discarded small arms ammunition from hunters or UXO left over from previous military exercises and/or seismic exploration activities. While it is also unlikely that UXO would be encountered on any given wildfire or prescribed fire, firefighters and fire managers should always be alert to possible UXO hazards, take steps necessary to control identified hazards and mitigate risks to fire personnel and the public.
- Repeater locations/radio dead spots: The Refuge maintains four radio repeaters, from north to south along the western slope of the Kenai Mountains: the Trapper Joe Repeater on a ridge just east of Trapper Joe Lake; two repeaters on Hideout Hill (the Hideout and Swanson Repeaters), just north of Hidden Lake; and, the Tustumena Repeater on a ridge just south of the southeastern end of Tustumena Lake. All of the repeaters are above the tree-line and powered by batteries with solar panel charging systems. All four provide both narrowband digital and analog radio communications capabilities to the Refuge. The Hideout Repeater is the primary repeater for most Refuge radio communications. The Swanson Repeater is located on the same site to provide redundancy for the Refuge Radio System and an alternate repeater for emergencies. The Tustumena Repeater is the only one located within designated Wilderness (Andrew Simons). Despite this very reliable radio communications infrastructure, there are radio dead spots across the Refuge, especially in deep canyons and depressions or low-lying areas distant from any repeater. There is no Service radio coverage in areas of the Refuge south of Kachemak Bay.
- Hazards from poisonous plants, venomous animals, predatory animals, illegal dump sites, illegal drug operations: while there are no poisonous plants like poison oak or poison ivy on the Refuge, there are poisonous mushrooms and berries that should not be consumed by humans. There are no snakes or other venomous animals but healthy populations of black and brown bear are present throughout the Refuge. Refuge employees are required to carry 12-guage shotguns with rifled slugs, and other bear deterrents like pepper spray and air horns, while working in bear country. Refuge employees receive bear safety training and firearms training and are annually certified to carry the shotgun. Refuge employees often provide bear guard services to visiting firefighters on large wildfire incidents. Occasionally, illegal dump sites are found along the road system, though the Refuge makes every effort to clean up those sites as soon as possible. Illegal drug operations such as marijuana plantations or Meth labs, though not common, are known to occur on the Refuge.

3.2.3 Moderate FMU

Moderate management is meant to allow compatible management actions, public uses, commercial uses, and facilities that may result in changes to the natural environment that are

temporary or permanent but small in scale and that do not disrupt natural processes. The natural landscape is the dominant feature of Moderate management areas, although signs of human actions may be visible.

Management actions in the Moderate management category will focus on maintaining, restoring, or enhancing habitats to maintain healthy populations of plants and animals where natural processes predominate. For example, large biomass removal and prescribed burning may be used to convert mature forests to earlier native seral stages to enhance browse for moose. In general, management facilities, both temporary and permanent, will be allowed for the purposes of gathering data needed to understand and manage resources and natural systems of the Refuge. Structures will be designed to minimize overall visual impact.

Public facilities provided in Moderate management will, while protecting habitats and resources, allow the public to enjoy and use Refuge resources in low numbers over a large area, or they will encourage the short-term enjoyment of the Refuge in focused areas. The emphasis is on small facilities that encourage outdoor experiences. Facilities such as public use cabins, rustic campgrounds, kiosks, viewing platforms, trails, and toilets may be provided. Facilities will be designed to blend with the surrounding environment.

Compatible economic activities may be allowed where impacts to natural processes and habitats are temporary (e.g., small-scale logging where an earlier seral stage meets management goals; facilities in support of guiding and outfitting services such as tent platforms or cabins that encourage enhanced public use). All economic activities and facilities require authorizations such as special use permits.

Prescribed fire and Non-fire applications such as manual thinning and biomass removal may be desirable options for protecting specific resource values by reducing fuel buildups and modifying forest structure to reduce fire intensities if ignitions do occur.

3.2.3.1 Moderate FMU – Description

The 49,450-acre Moderate FMU is a long, relatively narrow area of the Refuge north of the Sterling Highway and along the western foothills of the Kenai Mountains. This FMU was established to encompass the Enstar Natural Gas Pipeline and its associated access roads. The Enstar pipeline connects natural gas facilities in Anchorage and Nikiski Alaska and crosses the Refuge between Chickaloon Bay and Sterling AK. Access into the FMU is from the Sterling Highway, Mystery Creek Road, and along the pipeline right-of-way.

Most of the lands in the FMU slope gently to the northwest, with numerous creeks and rivers crossing the unit. Soils in the unit tend to be well-drained except in the lowland bogs at the southern end of the unit, which drain into the Moose River watershed.

The wildfire and prescribed fire season in the Moderate FMU is typically from the snow-free date in early April or May to the onset of fall rains in August or September, though exceptions exist. Prescribed fires (especially prescribed pile burning) can occur outside of the wildfire season (if piles have been covered). Fire behavior, fire intensity, fire size and complexity vary with fire weather and fuel conditions, but the threat of wildfires is increased by wildlife-oriented recreation activities in the fall when the Mystery Creek Road is opened to the public. Lightning also plays a role in the fire regime of this FMU as thunderstorms typically build up along the western foothills of the Kenai Mountains.

Hazardous fuel types or complexes include black spruce, *Calamagrostis canadensis* grasslands, and areas of beetle-killed spruce where grasses, forbs and shrubs mix with heavy downed dead fuels to elevate the potential for catastrophic fire behavior, fireline intensity and resistance to control. Two large fires have crossed this FMU since the Refuge was established: the 310,000-acre Skilak Lake Fire (1947) and the 3780-acre Chickaloon River Fire (1974).

Over its history, the Refuge has conducted a number of mechanical treatments and prescribed fires along Mystery Creek Road, to reduce hazardous fuels (black spruce) and improve moose browse.

3.2.3.2 Moderate FMU - Values to Protect

- WUI areas designated in Federal Register as Community at Risk (CAR) or designation as Community of Interest (COI) and key descriptors (location, access, etc.): the only Community at Risk near the Moderate FMU is Sterling AK at the western end of the unit.
- Service structures, infrastructure and private in-holdings: there is one public use cabin at Trapper Joe Lake and a couple of remote landing strips along the pipeline corridor. There is a single-lane bridge across the Chickaloon River and a couple of primitive wooden bridges across creeks along the Mystery Creek Road and the pipeline access road. The Refuge owns the Kenai NWR Remote Automated Weather Station (RAWS), on the west side of Mystery Creek Road at Mile 6. There are no private in-holdings in the Moderate FMU.
- Adjacent landownership, structure types, and land use: the Moderate FMU is completely surrounded by Refuge lands and other FMU's, except for its extreme western end, where it interfaces with private lands and the community of Sterling AK. There is a subdivision with numerous private residences and a few businesses along Atkins Road near the Refuge boundary.
- Historic and Archeological resources – structures, sites, etc.: historic and cultural resources are common throughout the Refuge, especially along major waterways where salmon populations occur. To protect known cultural and historical resources the Refuge keeps the locations of known sites secure. The Refuge provides Resource Advisors to fire protection agencies or incident management teams as necessary to protect known sites from damage due to fire management activities.
- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): areas of the Moderate FMU abut the Dave Spencer and Mystery Creek Wilderness areas so the potential impacts of fire management activities upon adjacent Wilderness values should be considered and mitigated as necessary. Two special value areas identified in the CCP that intersect with the Moderate FMU include the Chickaloon Watershed and Estuary and the Skilak Wildlife Recreation Area (See: Figure 3).
- Hunting and recreation, subsistence use (notably in Alaska): hunting, trapping, fishing and wildlife photography, camping, boating, hiking, horseback riding and subsistence uses all occur within the Moderate FMU.
- Mining, oil and gas wells and utility right-of-ways: there are no mines or oil/gas wells in the Moderate FMU. However, the reason for this FMU's establishment is the Enstar natural gas pipeline and associated access road system (Mystery Creek Road). A high-voltage electric transmission line traverses the southern end of this FMU.
- Structures lacking defensible space, water supply issues: there are no structures lacking defensible space in the FMU. Natural water supplies exist at several locations in the FMU, including Mystery Creek and the Chickaloon River and their tributaries. Accessible lakes are limited along the length of this FMU.

3.2.3.3 Moderate FMU - Fire Management Guidance

Firefighter and public safety is always the first priority of fire management. All fire management plans and activities must reflect this commitment. Other fire management guidance specific to the Moderate FMU includes:

- Response to wildfires – preferred strategies and tactics: The default management response to human-caused wildfires is initial attack fire suppression. A human-caused fire that escapes or exceeds the initial attack response will be managed according to an incident management plan prepared by the designated Incident Commander or Incident Management Team, and as documented in the Wildland Fire Decision Support System (WFDSS). The default fire management response to lightning-caused wildfires is to protect such fires as natural ecological processes, allowing them to burn freely upon the landscape until they go out. When that response is not safe or practicable due to life safety or other values at risk, the wildfire should be managed according to an incident management plan and as documented in the WFDSS.
- Allowance to manage wildfires to enhance/benefit resources: Naturally-ignited wildfires may be managed to maintain/enhance/benefit natural resources or accomplish Refuge management objectives.
- Allowance for hazardous fuels treatments and treatment types: the full range of hazardous fuels treatments and treatment types are allowed, especially in wildland-urban interface or intermix areas.

  Moderate FMU hazardous fuels projects and treatments will focus on the highest risk areas. Typically these are adjacent to or included in current CWPP areas. Collaborative projects including a mix of Refuge, State, and private lands is the optimal desired project design. Treatment types may range from thinning with power tools, mastication, biomass removal, to landscape scale prescribed fire treatments. Habitat treatments should occur where altered fire return intervals are occurring or vegetation manipulation using hazardous fuels treatment techniques are desired. All treatment types will minimize effects on Refuge values while reducing risk from Refuge wildfires spreading into adjacent communities. Minimizing the effects on Refuge values can be achieved by:
    - Avoiding hard edging (straight line) treatment areas (a wandering edge with occasional screening strips is desired).
    - Retention of whole crown to base height pockets to minimize shooting lanes in treatment areas.
    - Limiting periods of treatment activity to times of least visitor use.
    - Development of standard treatment prescriptions and adaptive management of project implementation
- Acreage targets and/or limits by habitats/cover types: There are no specific acreage targets and/or limits by habitats/cover types in the Moderate FMU.
- Retardant or foam use restrictions /constraints: The Refuge Manager or designated Agency Administrator must approve retardant or foam use on the Refuge, prior to use except in case of imminent threat to life, safety or loss of homes, facilities or infrastructure.
- Equipment or aircraft use limitations/application of Minimum Impact Suppression Techniques (MIST): See below.
    - *Do not use aerial retardants and foams within 300 feet of waterways or water bodies.*
    - *Do not allow more than 40 people in a single fire camp in the wilderness.*
    - *Repair ground disturbed by suppression activities to pre-incident condition.*
    - *The Refuge Manager must approve heavy equipment use (dozers) prior to use except in case of imminent threat to life, safety or loss of homes, facilities or infrastructure.*
    - *Inform the Regional Archeologist of cultural sites discovered during fire operations.*
    - *Use MIST to the greatest extent possible in wilderness and sensitive cultural areas.*
- Staff wildfires during active burning periods until controlled.
- In this FMU, the management strategy is to monitor wildfires by aircraft (and by ground when needed), until a season-ending event. Management Action Points (MAPs) will be established for

incidents with potential to spread to and impact values to protect and management actions defined and initiated to mitigate fire impacts.

- The FMP and a delegation of authority provide a general strategy to an IC, who has discretion to select and implement appropriate tactics within the limits for the FMU(s), including when and where to use MIST unless otherwise specified.
- In this FMU, prescribed fires will be used in conjunction with herbicide treatments as specified in other refuge plans to help control invasive species and reduce the build-up of hazardous fuels.
- Natural recovery is the preferred choice for recovery following wildfires. However, when natural recovery is not likely, Emergency Stabilization (ES) treatments may be needed to prevent further degradation of cultural and natural resources in the burned area. Any seeding will use seeds from natural sources whenever feasible.

3.2.3.4 Moderate FMU - Safety Considerations

- Difficulty of movement in marshes/wetlands: marshes, peat bogs, lake and river margins and other riparian/wetland habitats are common in the Moderate FMU.
- Entrapment in flashy fuels: *Calamagrostis canadensis* (aka, Canada bluejoint or bluejoint reedgrass) meadows and grasslands are the most common and hazardous flashy fuel type on the Refuge and present throughout the Moderate FMU.
- Public evacuation/closures during fire operations: during wildfire or prescribed fire operations, it might be necessary to close affected areas within the FMU and/or evacuate Refuge visitors. During past wildfire incidents, specified trails, roads or other access points in the Refuge have been temporarily closed for public safety reasons. During wildfire incidents, locating and evacuating Refuge visitors could prove especially difficult, due to the remoteness and inaccessibility of areas within the Moderate FMU. Normally, the Mystery Creek Road and pipeline access roads are closed to motor vehicles – except during moose hunting season. The Refuge usually closes the road when winter weather makes the road impassable. But, when the road is open, this FMU is a very popular destination for recreationists. A late season fire in or adjacent to this FMU could result in evacuations and closure of the area.
- Smoke impacts on highway safety: smoke from large wildfires or prescribed fires in any of the three Wilderness areas could impact the Sterling Highway, local communities and air traffic, depending upon fire intensity, wind direction and atmospheric conditions. Smoke management objectives need to be identified in incident management plans and prescribed fire plans and air quality/smoke conditions should be monitored. The Alaska Department of Environmental Conservation is the point of contact for all air quality and smoke-related issues.
- Gas lines, power lines, mine shafts: there are no power lines or mine shafts in the Moderate FMU, but there is one natural gas pipe line - the Enstar line between Chickaloon Bay and Sterling. The Enstar pipe line and its access roads are the reason this FMU exists. If/when the pipe line and its access roads are removed and the right-of-way is reclaimed, the Moderate FMU is slated to be reclassified as Minimal.). A high-voltage electric transmission line traverses the southern end of this FMU.
- Unexploded ordnance (UXO): it is possible that unexploded ordnance exists in this FMU, especially discarded small arms ammunition from hunters or UXO left over from previous military exercises and/or seismic exploration activities. While it is also unlikely that UXO would be encountered on any given wildfire or prescribed fire, firefighters and fire managers should always be alert to possible UXO hazards, take steps necessary to control identified hazards and mitigate risks to fire personnel and the public.
- Repeater locations/radio dead spots: The Refuge maintains four radio repeaters, from north to south along the western slope of the Kenai Mountains: the Trapper Joe Repeater on a ridge just east of Trapper Joe Lake; two repeaters on Hideout Hill (the Hideout and Swanson Repeaters), just north of Hidden Lake; and, the Tustumena Repeater on a ridge just south of the southeastern end of

Tustumena Lake. All of the repeaters are above the tree-line and powered by batteries with solar panel charging systems. All four provide both narrowband digital and analog radio communications capabilities to the Refuge. The Hideout Repeater is the primary repeater for most Refuge radio communications. The Swanson Repeater is located on the same site to provide redundancy for the Refuge Radio System and an alternate repeater for emergencies. The Tustumena Repeater is the only one located within designated Wilderness (Andrew Simons). Despite this very reliable radio communications infrastructure, there are radio dead spots across the Refuge, especially in deep canyons and depressions or low-lying areas distant from any repeater. There is no Service radio coverage in areas of the Refuge south of Kachemak Bay.

- Hazards from poisonous plants, venomous animals, predatory animals, illegal dump sites, illegal drug operations: while there are no poisonous plants like poison oak or poison ivy on the Refuge, there are poisonous mushrooms and berries that should not be consumed by humans. There are no snakes or other venomous animals but healthy populations of black and brown bear are present throughout the Refuge. Refuge employees are required to carry 12-guage shotguns with rifled slugs, and other bear deterrents like pepper spray and air horns, while working in bear country. Refuge employees receive bear safety training and firearms training and are annually certified to carry the shotgun. Refuge employees often provide bear guard services to visiting firefighters on large wildfire incidents. Occasionally, illegal dump sites are found along the road system, though the Refuge makes every effort to clean up those sites as soon as possible. Illegal drug operations such as marijuana plantations or Meth labs, though not common, are known to occur on the Refuge.

3.2.4 Intensive FMU

This category is designed to allow compatible management actions, public facilities, and economic activities that may result in alterations to the natural environment. In Intensive management areas, the presence of human intervention may be very apparent. Roads, buildings, and other structures are likely to be seen. Intensive management is applied to the smallest area reasonable to accommodate the intended uses. When Intensive management is proposed for an area, the specific purposes for its establishment will be described.

Natural processes or habitats may be modified through human intervention. Habitats may be highly modified to enhance conditions for one or more animal species. For example, water regimes may be artificially controlled to improve habitat for waterfowl.

High levels of public use may be accommodated and encouraged through modifications to the natural environment such as paving, buildings, developed campgrounds, and other facilities that could alter the natural environment in specific areas. Public facilities are designed to provide a safe and enjoyable experience of the natural environment and an increased understanding of Refuge resources for a wide range of visitors. Facilities may accommodate a large number of visitors while protecting refuge resources from damage through overuse.

Compatible economic uses of Refuge resources that result in alterations to the natural environment may be authorized in Intensive management areas. All economic uses are subject to the compatibility standard, must contribute to the purposes of the Refuge, and require official authorizations such as special use permits.

3.2.4.1 Intensive FMU – Description

There are five distinct, road-accessible administrative units or areas within the 54,500-acre Intensive FMU:

- Swanson River Road/Swan Lake Road (includes the Swanson River Oil and Gas Unit and the Moose Research Center)
- Marathon Road (Beaver Creek Oil and Gas Unit)
- Sterling Highway/Skilak Loop Road (Skilak Wildlife Recreation Area)
- Funny River Road
- Kenai National Wildlife Refuge Headquarters

Each of the areas encompasses one or more primary and secondary roads and all of the intensive management activities associated with access into areas of the Refuge. Wildfires within these areas are almost always aggressively suppressed to protect lives and other values at risk. Intensive hazardous fuels management activities are planned and implemented in this FMU, especially near wildland-urban interface and intermix areas.

The wildfire and prescribed fire season in the Intensive FMU is typically from the snow-free date in early April or May to the onset of fall rains in August or September, though exceptions exist. Prescribed fires (especially slash pile burns) can occur outside of the wildfire season (if piles have been covered). Fire behavior, fire intensity, fire size and complexity vary with fire weather and fuel conditions, but the threat of wildfires is increased by intense uses and human activities. Hazardous fuel types or complexes include black spruce types, *Calamagrostis canadensis* grasslands, and areas of beetle-killed spruce where grasses, forbs and shrubs mix with heavy downed dead fuels to elevate the potential for catastrophic fire behavior, fireline intensity and resistance to control. Large fires including the Skilak Lake Fire in 1947, the Swanson River Fire in 1969, and the Hidden Creek Fire in 1996 have historically impacted portions of this FMU.

3.2.4.2 Intensive FMU - Values to Protect

- WUI areas designated in Federal Register as Community at Risk (CAR) or designation as Community of Interest (COI) and key descriptors (location, access, etc.): Communities at Risk adjacent to areas of the Intensive FMU include: Kenai AK, Soldotna AK, Sterling AK and Funny River AK. Each of the five Intensive FMU areas involves a primary or secondary road that provides access/egress for Alaska residents, visitors and Refuge employees.
- Service structures, infrastructure and private in-holdings: there are many Service structures and infrastructure within the five areas of the Intensive FMU, including: the Moose Research Center, the Rainbow Lake and Dolly Varden Campgrounds, and the Dolly Varden Public Use Cabin (Swanson River Road/Swan Lake Road area); the Watson Lake, Kelly-Peterson Lakes, Hidden Lake, Upper Skilak, Lower Ohmer Lake, Engineer Lake and Lower Skilak Campgrounds, the Visitor Contact Station (VCS), the Skilak Guard Station, the Skilak GS RAWS (a State-owned weather station on Refuge lands near the Guard Station), the Swanson RAWS in the Swanson River Oil and Gas Unit, and Public Use Cabins at Upper Ohmer Lake and Engineer Lake (Sterling Highway/Skilak Loop Road area); and the Refuge Headquarters Compound with all of its buildings, vehicles and equipment. There are no private in-holdings within the areas of the Intensive FMU.
- Adjacent landownership, structure types, and land use: each of the five Intensive FMU areas abuts State, municipal and/or private lands with homes, businesses and public buildings.
- Historic and Archeological resources – structures, sites, etc.: historic and cultural resources are common throughout the Refuge, especially along major waterways where salmon populations occur. To protect known cultural and historical resources the Refuge keeps the locations of known sites

secure. The Refuge provides Resource Advisors to fire protection agencies or incident management teams as necessary to protect known sites from damage due to fire management activities.

- Special designated areas/special values (Wilderness, Wild & Scenic River, etc.): areas of the Intensive FMU abut all three Refuge Wilderness areas so potential impacts of fire management activities upon adjacent Wilderness values should be considered and mitigated as necessary. Special value areas identified in the CCP that intersect with areas in the Intensive FMU include: the Lowland Lakes System, the Skilak Wildlife Recreation Area, and the Kenai River and its Tributaries (See: Figure 3).
- Hunting and recreation, subsistence use (notably in Alaska): hunting, trapping, fishing and wildlife photography, camping, boating, hiking, horseback riding and subsistence uses all occur within areas of the Intensive FMU.
- Mining, oil and gas wells and utility right-of-ways: there are no active or historic mining areas within the Intensive FMU, though gravel pits exist at several locations. The Swanson River and Beaver Creek Oil and Gas Units have changed ownership over their history on the Refuge, but both remain active with significant infrastructure and new oil and gas exploration and construction activities. Power lines, oil and natural gas pipelines and communications towers exist throughout the FMU.

3.2.4.3 Intensive FMU - Fire Management Guidance

Firefighter and public safety is always the first priority of fire management. All fire management plans and activities must reflect this commitment. Other fire management guidance specific to the Intensive FMU includes:

- Response to wildfires – preferred strategies and tactics: the default management response to human-caused and naturally-ignited wildfires is aggressive initial attack fire suppression. Any wildfire that escapes or exceeds the initial attack response will be managed according to an incident management plan prepared by the designated Incident Commander or Incident Management Team, and as documented in the Wildland Fire Decision Support System (WFDSS).
- Allowance to manage wildfires to enhance/benefit resources: while it is possible to manage naturally-ignited wildfires to maintain/enhance/benefit natural resources or accomplish Refuge management objectives, the default fire management response within the Intensive FMU is full suppression. Use of wildfire to benefit resource values should only be allowed when life safety, infrastructure and other values can be protected.
- Allowance for hazardous fuels treatments and treatment types: the full range of hazardous fuels treatments and treatment types are allowed, especially in wildland-urban interface or intermix areas.

  Intensive FMU hazardous fuels projects and treatments will focus on the highest risk areas. Typically these are adjacent to or included in current CWPP areas. Collaborative projects including a mix of Refuge, State, and private lands is the optimal desired project design. Treatment types may range from thinning with power tools, mastication, biomass removal, chemical treatments, and landscape-scale prescribed fire treatments. Habitat treatments should occur where altered fire return intervals are occurring or vegetation manipulation using hazardous fuels treatment techniques are desired. All treatment types will minimize effects on Refuge values while reducing risk from Refuge wildfires spreading into adjacent communities. Minimizing the effects on Refuge values can be achieved by:
    - Avoiding hard edging (straight line) treatment areas (a wandering edge with occasional screening strips is desired).
    - Retention of whole crown to base height pockets to minimize shooting lanes in treatment areas.
    - Limiting periods of treatment activity to times of least visitor use.
    - Development of standard treatment prescriptions and adaptive management of project implementation

- Acreage targets and/or limits by habitats/cover types: There are no specific acreage targets and/or limits by habitats/cover types in the Intensive FMU.
- Retardant or foam use restrictions /constraints: The Refuge Manager or designated Agency Administrator must approve retardant or foam use on the Refuge, prior to use except in case of imminent threat to life, safety or loss of homes, facilities or infrastructure.
- Equipment or aircraft use limitations/application of Minimum Impact Suppression Techniques (MIST):
    - *Do not use aerial retardants and foams within 300 feet of waterways or water bodies.*
    - *Do not allow more than 40 people in a single fire camp in the wilderness.*
    - *Repair ground disturbed by suppression activities to pre-incident condition.*
    - *The Refuge Manager must approve heavy equipment use (dozers) prior to use except in case of imminent threat to life, safety or loss of homes, facilities or infrastructure.*
    - *Inform the Regional Archeologist of cultural sites discovered during fire operations.*
    - *Use MIST to the greatest extent possible in wilderness and sensitive cultural areas.*
- Staff wildfires during active burning periods until controlled.
- In this FMU, the management strategy is to monitor wildfires by aircraft (and by ground when needed), until a season-ending event. Management Action Points (MAPs) will be established for incidents with potential to spread to, and impact values to protect and management actions defined and initiated to mitigate fire impacts.
- The FMP and a delegation of authority provide a general strategy to an IC, who has discretion to select and implement appropriate tactics within the limits for the FMU(s), including when and where to use MIST unless otherwise specified.
- In this FMU, prescribed fires will be used in conjunction with herbicide treatments as specified in other refuge plans to help control invasive species and reduce the build-up of hazardous fuels.
- Natural recovery is the preferred choice for recovery following wildfires. However, when natural recovery is not likely, Emergency Stabilization (ES) treatments may be needed to prevent further degradation of cultural and natural resources in the burned area. Any seeding will use seeds from natural sources whenever feasible.

3.2.4.4 Intensive FMU - Safety Considerations

- Difficulty of movement in marshes/wetlands: marshes, peat bogs, lake and river margins and other riparian/wetland habitats are common in all five areas of the Intensive FMU.
- Entrapment in flashy fuels: *Calamagrostis canadensis* (aka, Canada bluejoint or bluejoint reedgrass) meadows and grasslands are the most common and hazardous flashy fuel type on the Refuge and present in all five areas of the Intensive FMU.
- Public evacuation/closures during fire operations: during wildfire or prescribed fire operations, it might be necessary to close affected areas within the FMU and/or evacuate Refuge visitors. During past wildfire incidents, specified trails, roads or other access points in the Refuge have been temporarily closed for public safety reasons. During a wildfire incident in any one of the five units in the Intensive FMU, public evacuation and/or area closure would be a very real possibility.
- Smoke impacts on highway safety: smoke from large wildfires or prescribed fires in any of the three Wilderness areas could impact the Sterling Highway, local communities and air traffic, depending upon fire intensity, wind direction and atmospheric conditions. Smoke management objectives need to be identified in incident management plans and prescribed fire plans and air quality/smoke conditions should be monitored. The Alaska Department of Environmental Conservation is the point of contact for all air quality and smoke-related issues.

- Gas lines, power lines, and mine shafts: there are miles of natural gas and oil pipe lines and power lines within the Swanson River and Beaver Creek Oil/Natural Gas Fields, and there are power lines along the Sterling Highway and Funny River Road, and in the Refuge Headquarters administrative area. There are no mine shafts in the Intensive FMU.
- Unexploded ordnance (UXO): it is possible that unexploded ordnance exists in this FMU, especially discarded small arms ammunition from hunters or UXO left over from previous military exercises and/or seismic exploration activities. While it is also unlikely that UXO would be encountered on any given wildfire or prescribed fire, firefighters and fire managers should always be alert to possible UXO hazards, take steps necessary to control identified hazards and mitigate risks to fire personnel and the public.
- Repeater locations/radio dead spots: The Refuge maintains four radio repeaters, from north to south along the western slope of the Kenai Mountains: the Trapper Joe Repeater on a ridge just east of Trapper Joe Lake; two repeaters on Hideout Hill (the Hideout and Swanson Repeaters), just north of Hidden Lake; and, the Tustumena Repeater on a ridge just south of the southeastern end of Tustumena Lake. All of the repeaters are above the tree-line and powered by batteries with solar panel charging systems. All four provide both narrowband digital and analog radio communications capabilities to the Refuge. The Hideout Repeater is the primary repeater for most Refuge radio communications. The Swanson Repeater is located on the same site to provide redundancy for the Refuge Radio System and an alternate repeater for emergencies. The Tustumena Repeater is the only one located within designated Wilderness (Andrew Simons). Despite this very reliable radio communications infrastructure, there are radio dead spots across the Refuge, especially in deep canyons and depressions or low-lying areas distant from any repeater. There is no Service radio coverage in areas of the Refuge south of Kachemak Bay.
- Hazards from poisonous plants, venomous animals and predatory animals, illegal dump sites, illegal drug operations: while there are no poisonous plants like poison oak or poison ivy on the Refuge, there are poisonous mushrooms and berries that should not be consumed by humans. There are no snakes or other venomous animals but healthy populations of black and brown bear are present throughout the Refuge. Refuge employees are required to carry 12-guage shotguns with rifled slugs, and other bear deterrents like pepper spray and air horns, while working in bear country. Refuge employees receive bear safety training and firearms training and are annually certified to carry the shotgun. Refuge employees often provide bear guard services to visiting firefighters on large wildfire incidents. Occasionally, illegal dump sites are found along the road system, though the Refuge makes every effort to clean up those sites as soon as possible. Illegal drug operations such as marijuana plantations or Meth labs, though not common, are known to occur on the Refuge.

4.0 WILDLAND FIRE OPERATIONAL GUIDANCE

The policy and procedures in the corresponding chapters of the current Interagency Standards for Fire and Fire Aviation Operations (Redbook) are part of this FMP, and must be followed.

4.1 Management of Wildfires

Guidelines for determining the standard wildland fire response are provided in the Alaska Interagency Wildland Fire Management Plan (AIWFMP). That plan provides for a range of fire management responses to wildland fires that protect human life and property and other identified resources and developments, balance costs with values at risk, and are in agreement with Refuge resource management objectives. Initial action on fires is largely pre-planned with "wildland fire management option" designations described in the AIWFMP.

Evaluation and selection of a response to a wildfire will include consideration of risks to public and firefighter safety, threats to the values to protect, costs of various mitigation strategies and tactics, and potential resource benefits (Refer to FMU section(s) for specifics.).

Protection responses will range from aggressive initial attack to surveillance/monitoring to indirect containment or any combination of the former. The level of suppression action will depend upon the fire management option pre-identified for the FMU, available resources, time of year, fuel type and conditions, cost, terrain and other factors related to the management of a fire.

Managers will use the Wildland Fire Decision Support System (WFDSS) to guide and document wildfire management decisions. The Jurisdictional and Protecting Agencies will work together to develop strategic options to manage a fire when the fire: (1) escapes initial attack, (2) threatens to escape from a Limited fire management option area into a higher management option area, (3) warrants suppression actions but did not receive action due to resource shortages, (4) is beyond the capabilities of initial attack forces, or (5) fire and /or resource management objectives are not being met and a significant change in strategy/action is required.

The FMP and a delegation of authority can provide a general strategy to an IC, who has discretion to select and implement appropriate tactics within the limits described for the FMU(s). All resources, including mutual aid resources, will report to the IC (in person or by radio) and receive an assignment prior to tactical deployment.

Fires occurring in Limited management option areas will normally be assigned to Surveillance and Monitoring status and AIWFMP protocols will be followed. Within the Limited fire management option areas of each FMU, a detected ignition will initiate a monitoring response unless the Refuge Manager specifies otherwise. Ignitions within all other fire management option areas (Modified, Full and Critical) will trigger the response outlined in the AIWFMP. Non-standard responses (other than the designated, pre-planned fire management option response) to wildland fires are also available to the Refuge Manager.

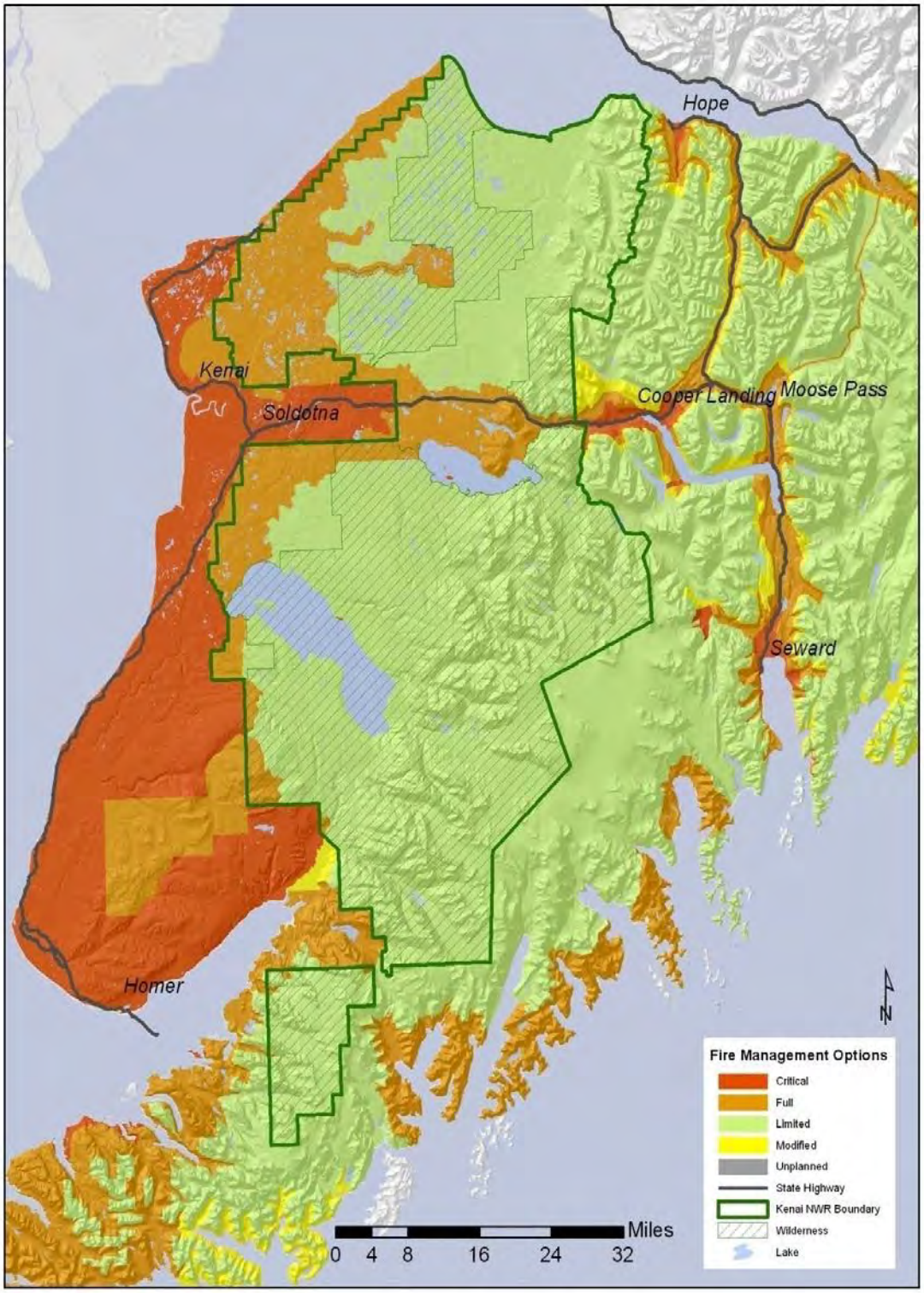
Within the Refuge Fire Management Units, AIWFMP Fire Management Option areas delineate the default fire management (suppression) responses. The selection of the appropriate fire management option and the respective response actions, for any given area of the Refuge, is based upon: the values at risk, management objectives, and the management strategies selected for various vegetation communities within the Refuge. Variables such as time of season, fuel type, fuel loading, fuel moisture, weather and topography will be used to inform the decision-making process on wildfire incidents. However, predetermined management direction for each FMU will be based on the threat to life, property, and resources of value. **Figure 8 – Kenai Peninsula Fire Management Options** shows the Fire Management Option boundaries on the Refuge: Critical, Full, Modified, and Limited. Per CCP direction, designated Wilderness areas of the Refuge are primarily assigned the Limited Fire Management Option, though there are exceptions. Where wildland-urban interface or intermix areas abut Wilderness, a Full Fire Management Option buffer exists between Critical and Limited areas.

Evaluation and selection of a management response to a wildfire will include consideration of risks to public and firefighter safety, threats to the values at risk, costs of various mitigation strategies and tactics, and potential wildfire benefits.

Wildfires will be staffed or monitored during active burning periods as needed to ensure that appropriate mitigation actions can be made to protect threatened values.

Structural fire protection is the responsibility of local governments. Federal agencies may assist with exterior structural protection activities under formal fire protection agreements that specify the mutual responsibilities of the partners, including funding. (Redbook 01-3)

Figure 8 – Kenai Peninsula Fire Management Options



All lands within the Kenai National Wildlife Refuge are designated by one of the following Fire Management Options:

Critical - Fire Management Option

- ***Critical - Description***
  Within the Refuge boundaries, there are a total of 1,192 acres of land designated as Critical Fire Management Option areas. Critical areas are found within or immediately adjacent to all four of the FMU's. These management option areas cover or border sections of land with a high intensity of public uses, management activities and/or communities. Substantial vegetation manipulation is allowed, including prescribed fire and mechanical treatment.

  The acres in this fire management option are designated private lands with structures (potentially inhabited) within the Refuge boundaries. A variety of vegetation types and age classes are represented. Age classes vary from early growth (0-20 years) to intermediate growth (41-70 years).

- ***Critical - Values to protect***
  The objective of the Critical Fire Management Option is to protect life and property by prioritizing Protecting Agency suppression actions for wildfires threatening human life, inhabited private property, and designated structures. Firefighter safety is always the first priority and wildfire incidents in Critical receive the highest priority in terms of suppression resource assignments.

- ***Critical - Default Management Response***
  ` Fires occurring in or immediately threatening lands in Critical will receive the highest priority for protection by immediate and continuing aggressive actions dependent upon the availability of suppression resources.

  An Initial Attack response by the Protecting Agency and its cooperators and/or closest Refuge fire-qualified personnel will occur as soon as possible. The Refuge Fire Management Officer and Agency Administrator receive immediate notification from the Protecting Agency, upon fire detection. After the initial response, the Refuge and the Protecting Agency may select a response ranging from full suppression to monitoring fire behavior, depending upon the values at risk and other considerations. These decisions are documented using the interagency WFDSS.

Full - Fire Management Option

- ***Full - Description***
  The Full Fire Management Option covers the second largest area within the Refuge - 363,141 acres. The Full option is found in all four of the FMU's and it typically encompasses developed areas, infrastructure and other areas of high resource value. The vegetation is mixed and age classes include areas of wetland, early, intermediate, mature (71-200 years), to sections of old growth (201+ years).

- ***Full - Values to protect***

The Full option has high value natural resources, cultural, and historical sites. The protection of uninhabited structures, private property, and valuable natural resources is addressed in this option. The Skilak Loop Wildlife Recreation Area, the Moose Research Center, the Swanson River Oil & Gas Unit, the Beaver Creek Oil & Gas Unit and wildland-urban interface and intermix areas around Peninsula communities are designated Full on the Refuge. Lands and structures in Full receive the second highest priority in terms of suppression resource assignments.

- ***Full - Default Management Response***
  Wildfires in Full should receive aggressive initial attack to minimize the acres burned. Initial attack suppression response by the Protecting Agency and its cooperators and/or closest Refuge fire-qualified personnel will occur as soon as possible. The Refuge FMO and Agency Administrator should receive immediate notification from the Protecting Agency, upon fire detection. After the initial response, the Refuge and the Protecting Agency may select a response ranging from full suppression to monitoring fire behavior, depending on the values at risk and other considerations. These decisions are documented using the interagency WFDSS.

Modified - Fire Management Option

- ***Modified - Description***
  The Modified Option currently covers the least acreage of all the fire management options on the Refuge – 11.9 acres. These acres are managed the same as the acres in the Full Option until the area converts to Limited after the *conversion date* (the first conversion date is July 10, annually). Before the conversion date, the Protecting Agency and Jurisdictional Agencies jointly decide if the situation warrants conversion from Full to Limited. If the decision is to remain in Full, a later date will be selected to re-assess the situation and decide for or against conversion. Once a Modified area is converted to Limited, it remains in Limited until the end of the fire season.

  The vegetation is mixed in this unit and age classes are early (0 – 20 years) and intermediate (21 -40 years).

- ***Modified – Values to Protect***
  The only Modified Fire Management Option area on the Refuge encompasses an In-holding in the southwestern corner of the Andrew Simons Wilderness, in the Caribou Hills area, just north of Caribou Lake. It is known as the Ptarmigan Head In-holding by Refuge staff. Officially, it is known as Patent #4722 at T2S, R11W, in Sections 24 and 25, Seward Meridian. There are no structures or other values at risk on the parcel. There is no road or trail access to this site. It can be accessed by snow machine in the winter.

- ***Modified - Default Management Response***
  Fires in Modified Option areas receive an initial attack response depending on available resources, unless the Agency Administrator chooses otherwise and documents the decision through the WFDSS process. The Refuge FMO and Agency Administrator should receive immediate notification from the Protecting Agency, upon fire detection. After the initial response, the Refuge and the Protecting Agency may select a response ranging from full suppression to monitoring fire behavior, depending on the values at risk and other considerations. These decisions are documented using the interagency WFDSS.

Limited - Fire Management Option

- ***Limited – Description***
  The Limited Fire Management Option is the selected fire management option on about 82% (1,622,583 acres) of the Refuge. 1,281,494 acres of designated Wilderness are in Limited. The Limited Option is found in all of the FMU's except Intensive. The vegetation is mixed and all age classes are represented in this fire management option area.

- ***Limited - Values to Protect***
  While natural resource values (wildlife, habitat, air quality, water quality, etc.) and Wilderness values exist in Limited areas of the Refuge, the presence of natural fires in these areas is deemed desirable in order to maintain natural conditions and ecological processes. Where Limited Option areas abut Modified, Full and Critical Option Areas, consideration must be given to the values at risk from wildfire in those areas, when making fire management decisions.

- ***Limited - Default Management Response***
  The default fire management response for fires in Limited is surveillance and monitoring, allowing natural fires to burn within predetermined areas. If this is not possible, a suppression response by the Protecting Agency or closest Refuge fire qualified personnel is initiated as soon as is feasible. The Refuge FMO and Agency Administrator should receive immediate notification from the Protecting Agency, upon fire detection. After the initial response, the Refuge and the Protecting Agency may select a response ranging from full suppression to monitoring fire behavior, depending upon the values at risk and other considerations. These decisions are documented using the interagency WFDSS.

  Review of fire management options should be completed between September 30th and March 1st annually. All fire management option changes will be coordinated with the Protecting Agency and recorded in the AIWFMP Map Atlas (maintained by the Protecting Agency) by April 1st. Fire management option boundary changes are not encouraged during the fire season. However, if a change of the selected management option is requested and can be accommodated by all affected land manager/owners and by the Protecting Agency, it may be accepted and documented in the Map Atlas.

  Each year prior to the active fire season, the Refuge FMO will discuss fire management strategies for the upcoming fire season, with the Refuge Manager, the Deputy Refuge Manager and the Protecting Agency FMO.

  The Refuge will adhere to regional and national preparedness levels. A **Refuge Preparedness Plan**, which is prepared in collaboration with the Protecting Agency and based upon local fire danger, is attached as **Appendix J**. It will be updated periodically as historic weather data is accumulated and contact information changes.

  4.1.1 Preparedness

  The official Fire Season in Alaska is from April 1 to August 1. However, the fire season on the Kenai Peninsula can begin as soon as any area is snow-free (typically, early- to mid-April). Early-season fires tend to burn rapidly through dead or cured surface fuels and may involve forest canopies (especially black spruce). These fires tend not to penetrate the ground fuels due

to high soil and duff moistures. In periods of drought, when winter snowpack is minimal and spring precipitation is low, extreme fire behavior and catastrophic fires are possible.

As the fire season progresses through June and July, the long days and short nights limit humidity recovery. This can cause extreme fire behavior, particularly in black spruce. Fires that occur during this time can have flame lengths ranging from less than foot with a slow, steady rate of spread, to crown fires with 200-foot flame lengths. The potential for extreme fire behavior increases as relative humidity drops below 35 percent. Typically, the peak of fire season occurs in late June and early July on the Kenai. During this time, suppression resources may become limited, due to fire activity elsewhere in Alaska.

The Kenai National Wildlife Refuge and other fire management agencies in Alaska use the Canadian Forest Fire Danger Rating System (CFFDRS) for evaluating fire danger and predicting fire behavior conditions. This system's key indices include:

- Fine Fuel Moisture Code (FFMC): moisture content of litter and fine dead fuels; the approximate equivalent of 1-hour time lag fuel moisture; however the values do not represent percent fuel moisture.
- Duff Moisture Code (DMC): moisture content of the upper duff; the approximate equivalent of 10- and 100-hour time lag fuels combined and an indicator of resistance to control. The values do not represent percent fuel moisture.
- Drought Code (DC): moisture of the duff 4-8 inches down; the approximate equivalent of 1000-hour time lag fuel moisture and a measure of mop-up difficulty; however the values do not represent percent fuel moisture.
- Initial Spread Index (ISI): a rating of fire spread immediately after ignition; the rough equivalent of Spread Index.
- Build Up Index (BUI): a representation of fuel available for consumption; the rough equivalent of Energy Release Component.

Table 5 – CFFDRS Index Breakpoints shows the key breakpoints for each index. These indices typically reach their highest levels in June and July. During the peak of fire season, these indices often reach extreme values, making the control and mop-up of wildfires more difficult.

Table 5 - CFFDRS Index Breakpoints

	FFMC	DMC	DC	ISI	BUI	FWI
Low	0-80	30-70	<150	0-2	30-70	0-3
Moderate	81-86	70-80	150-350	2-5	70-80	4-13
High	87-90	80-90	350-400	5-10	80-90	14-23
Very High						24-28
Extreme	90+	90+	400+	10+	90+	29+

Over the past ten years, the Kenai NWR has averaged about seven wildfires per year. While most Refuge fires are human-caused, lightning has played a significant role in the large fire history of the Refuge. A late fire season with less potential for extreme fire behavior can occur in late August through September.

The roles of the various agencies involved in fire management on the Kenai NWR and all other lands in Alaska are described in the Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement (Master Agreement) and Alaska Statewide Annual Operating Plan (AOP). Under the Agreement, the Alaska Division of Forestry (ADOF) Kenai-Kodiak Area Office (KKAO) is the designated Protecting Agency, providing fire suppression services to the Kenai NWR.

However, this does not relieve the Refuge of its responsibilities for all fire management activities occurring on Refuge lands. The Refuge Fire Management Officer or a designated Duty Officer will be available by phone and/or radio to the ADOF and other cooperating emergency management agencies around the clock during the fire season. Notification will be made to the ADOF/KKAO when the Refuge Duty Officer changes. Qualified Refuge personnel will normally participate in prevention patrols during periods of high fire danger, and will participate in initial and extended attack suppression activities on Refuge fires.

4.1.1.1 Training and Qualifications

A Refuge team of permanent, fire-funded personnel consisting of: a permanent full-time Fire Management Officer (FMO), a permanent full-time Assistant Fire Management Officer (AFMO), a permanent-seasonal Prevention & Mitigation Technician (PMT), and a permanent-seasonal Fire Operations and Prescribed Fire/Fuels Technician (FOT), conduct fire program management activities under the direction of the Refuge Manager, who has the line authority and responsibility to manage wildland fire management operations on the Refuge (See: **Appendix H - Refuge Fire Management Organization Chart**). Depending upon annual preparedness and fuels project funding, the Refuge may hire additional seasonal firefighters. Also, a variable number of non-fire-funded permanent and seasonal Refuge staff members provide collateral duty firefighting capabilities to the Refuge. All qualified firefighters are listed in the Refuge Dispatch Plan, which is updated annually (See: **Appendix I - Refuge Dispatch Plan**).

All Refuge fire personnel need to complete the following mandatory training courses to be qualified and available for fire assignment on or off the Refuge: Basic Wildland Firefighter training (I-100, L-180, S-130 and S-190); NIMS, an Introduction (IS-700); Annual Fireline Safety Refresher training; bear and firearm safety training; first aid; and must pass an annual Work Capacity Test at the position-appropriate level (Arduous, Moderate or Light). These training courses are normally offered in Alaska during the months of April, May and June, although now, the Basic Wildland Firefighter and NIMS training are available on-line. Additional Refuge, Agency or Interagency training is dependent on availability and demand, and may include: Watercraft Safety, Wildland Fire Chain Saws (S-212), Interagency Helicopter Crewmember (S-271), Basic Aviation Safety (B3), and/or Water Ditching and Survival (A-325R).

Standards for fire job position training and experience, annual refresher training, physical fitness testing, and medical examinations will follow the guidelines of the Red Book, the National Wildfire Coordinating Group (NWCG), the Service, and the Region (for agency-specific positions). Training and physical fitness testing for fire-qualified Refuge employees are coordinated by the FMO.

All fire training, qualifications and experience records will be maintained by the Area FMO in the Incident Qualifications and Certification System (IQCS). The Area FMO will be responsible for issuing current IQCS card, "red card".

The Kenai-Kodiak FMO should have sufficient training to assist decision-making, and to plan and implement prescribed fire projects. Training may include fire behavior prediction, smoke management, and aviation safety, and will meet current Departmental, Service, and NWCG requirements. The Alaska Department of Forestry (ADOF) provides fire detection/protection services on the Refuge and trains its staff to meet NWCG standards.

4.1.1.2 Delegation of Authority to Fire Management Officer

Delegations of Authority to the FMO will be included in **Appendix K – FMO Delegation of Authority**. These may include specific duties related to program management, management of wildfires, or prescribed fire programs. There are future plans to complete an inter-refuge agreement that outlines the roles and responsibilities of the Kenai Kodiak FMO. When completed, this plan will be added as an appendix.

4.1.1.3 Readiness

Refuge fire personnel must maintain themselves and their wildland fire equipment in a state of readiness. Appropriate personal protective equipment and other safety and firefighting equipment will be issued to each firefighter as needed. Helicopter gear is also available and will be issued to individuals depending on need. The fire cache will be stocked with: fire gear for a minimum of 20 firefighters, chain saws, equipment and supply inventory for restocking engines, and portable pumps, hose and hardware for hose lays and hose packs. It is the responsibility of the FMO to ensure annual readiness review are conducted and documented. Not all of the elements of a readiness review can be assessed due to the organization role as a Jurisdictional Agency but to support the Protecting Agency. Regional Readiness reviews will be performed by the regional fire staff on a rotating basis with other Region 7 Refuges.

Each spring, prior to fire season, the Fire Management Officer and/or the designated Cache/Equipment Manager will prepare the fire cache, pumps, saws and other equipment, and the engines for use. Each fall, all engines, pumps, saws and other gas-powered equipment will be refurbished and winterized for storage. Inventories are to be maintained for all vehicles, engines, first aid kits, and the cache in accordance with Normal Unit Strength. The Refuge schedule for preparedness/readiness activities is summarized in **Table 6 – KNWR Readiness Schedule**.

The Refuge FMO will determine if conditions require an adjustment in staffing to ensure adequate coverage during periods of high fire danger. The Refuge FMO, or a designated duty officer, will be available to the Protecting Agency by phone or radio, 24-7 during the fire season. A statewide Multi-Agency Coordination (MAC) group will be convened when the Alaska Preparedness Level reaches levels 4 and 5, to establish priorities for suppression resource allocation and to determine the need for a temporary change in the selected fire management options identified in the Alaska Interagency Wildfire Management Plan for specific geographic areas.
Current fireline qualified personnel will be available for fire assignments within Alaska and the

Lower 48 depending upon Refuge staffing needs, State and Federal Preparedness Levels and supervisory approval.

The Kenai-Kodiak FMO will attend meetings scheduled with the Alaska Department of Forestry, the Alaska Fire Service, or representatives of other agencies to discuss wildland fire management business as needed or requested.

Refuge Communications are primarily by radio during field activities. Refuge aircraft have an FM radio system through which radio contact is maintained with Refuge Headquarters during field operations. During fire operations on the Refuge, the FMO will need to evaluate the need for additional temporary repeaters.

The FMO is responsible for the annual fire budget for the Kenai-Kodiak Refuges. Requests for special fire funding for projects, training, and equipment will be completed by the Kenai-Kodiak FMO.

Table 6 - KNWR Readiness Schedule

Activities – Complete before end of month:	J	F	M	A	M	J	J	A	S	O	N	D
Update Interagency Fire Agreements/AOPs	**X**	**X**										
Winterize Fire Management Equipment										**X**		
Inventory Fire Engines and Cache				**X**						**X**		
Schedule Medical Exams			**X**	**X**								
Annual Refresher Training					**X**							
Annual Fitness Testing					**X**							
Pre-Season Engine Preparations				**X**								
Weigh Engines to verify GVW Compliance					**X**							
Prescribed Fire Plan Preparation	**X**	**X**									**X**	**X**
Review and Update Fire Management Plan				**X**								
Weather Station Maintenance and Calibration				**X**						**X**		
Begin Hiring process for seasonal employees	**X**											

4.1.1.4 Aviation Management

All fire-related aviation operations will follow applicable guidelines of the DOI Office of Aviation Services (OAS) and will have qualified personnel assigned based on the missions to be accomplished. Any detection or reconnaissance flights originated by the Refuge will be coordinated with the Protecting Agency. Flight following for Resource Ordered Refuge detection flights will be coordinated by the Protecting Agency.

The Refuge aviation program primarily supports law enforcement and resource missions and is not under fire management control. Refuge aircraft may sometimes be used to perform fire related missions including detection, fire reconnaissance, and logistical support at the request of the Protecting Agency. An (aircraft) number will be requested from the Protecting Agency if the Refuge seeks reimbursement for flight time in support of fire missions. Air crew and passengers will be appropriately briefed prior to performing fire related missions. Refuge personnel performing fire-related aviation missions in cooperator aircraft will additionally comply with cooperator policy and procedures when they are more stringent than DOI policy. More information concerning ordering/use of FWS aircraft on incidents can be found in Chapter 20 of the Alaska Interagency Mobilization Guide (AIMG) <http://fire.ak.blm.gov/content/aicc/aimg/aimg.pdf>.

Prescribed fire projects that will utilize fixed wing or rotor wing aircraft will have a completed Aviation Safety Plan approved by the Burn Boss, included in the Prescribed Fire Plan and filed at the Refuge, with the following information:

- Supervisor
- Project name and objective(s)
- Justification and a brief project description
- Projected dates
- Location
- Projected costs of aviation resources
- Aircraft
- Pilot
- Flight and duty time
- Participants
- Flight following, communication plan, and emergency search and rescue plan
- Hazard analysis and mitigation
- Risk analysis chart (Appendix G)
- Hazardous materials
- Protective clothing and equipment
- Fueling requirements
- Load calculation and weight and balance
- Passengers and cargo
- Equipment checklist

4.1.1.5 Fire Detection

Detection activities on the Refuge are considered part of the protection services and are provided by the Kenai-Kodiak Area Office. Visual fire detection is provided by aircraft. A lightning

detection system is in place that displays ground strikes and aids in planning detection flights. Detection flights are scheduled based on area lightning detections and the fire danger rating, and are often combined with reconnaissance of ongoing fires.

Refuge aircraft are often in the field during fire season and can provide supplemental, incidental detection. New fires detected by the Refuge will be reported to the Protecting Agency as soon as possible.

The KNWR is a vast, remote area surrounded by private, State and other federal lands. And while there is a well-established fire history on the Kenai Peninsula, there are no established fire lookouts or regularly scheduled aerial fire detection flights. The costs of such fire detection programs are prohibitive, given the large scale of the burnable landscape. Fortunately, most wildfires are detected and reported by local residents, Refuge visitors, and private or commercial aircraft flying over the Refuge.

While the Protecting Agency is primarily responsible for fire detection under the AIWFMP, Refuge employees often discover wildfires on and off the Refuge and report those fires to the Protecting Agency.

The Kenai National Wildlife Refuge has two fixed wing aircraft that are both on floats during the Alaska fire season. These planes are: Interior 67 (Cessna 185, tail number N56581) and Interior 79 (Piper PA 18-150 Super Cub, tail number N784). While Refuge planes are not designated or available for full time fire detection, they are usually made available for confirmation of reported fires on the Refuge. Detection flights by Refuge aircraft are normally requested by the Protecting Agency or the Refuge FMO and a number issued for flight time payment. Availability for detection flights is based on several factors, including but not limited to: availability of Refuge pilots and planes, adverse weather conditions, lightning activity, the time of day, and the number of duty hours remaining for pilots.

4.1.1.6 Initial Report of Fire and Initial Attack (Response) Dispatching

Upon discovery, the Protecting Agency is responsible to determine, verify and document the incident location, management option, and cause, and implement the initial response based on the management option designation as described in the AIWFMP and mapped in the Map Atlas.

Notification procedures are addressed in the AIWFMP and in the Master Cooperative Wildland Fire Management Agreement, Exhibit C, Alaska Statewide Annual Operating Plan. Clause 25 of the Alaska Annual Operating Plan (AOP) can be summarized as follows:

Fire notifications are required to the Jurisdictional Agency for any fires occurring on federal lands and Alaska Native village and regional corporations lands. A WFDSS entry by the Protecting Agency is required as part of the notification process. A Fire Notification form may also be used when the Jurisdictional Agency does not have WFDSS access.

The Kenai Interagency Dispatch Center (KIDC) will be responsible for initial attack dispatching on all Refuge fires occurring between April 1 and July 31. During this period the Center will operate from 08:00 to 18:00 hours, 7 days per week. Center season and hours will be extended as needed and an after-hours contact protocol will be included in the Refuge Annual Dispatch/Preparedness Plan.

Initial response actions for wildfires are described for each fire management option and summarized in **Table 7** below (more information can be found in section 2.1.5). Management option designation is the main factor that determines initial response to a wildland fire, through the use of decision charts in the AIWFMP. All actions are dependent on the Fire Management Option, availability of resources and other factors - weather and current and expected fire behavior.

Table 7 Management Option Designation and Response to Wildland Fire*

Fire Management Option	Appropriate Initial Response	Suppression Objectives
Critical	Aggressive initial attack--usually direct attack	1. Protect inhabited property and designated developments. 2. Usually continue control tactics until fire is declared out.
Full	Aggressive initial attack--usually direct attack	1. Protect designated sites and values. 2. During initial attack--minimize acreage burned.
Modified, before conversion to Limited	Initial attack--use of indirect attack to contain the fire is encouraged	1. Prevent fire from spreading into Full and Critical management option areas. 2. Protect designated sites.
Modified, after conversion to Limited	Surveillance	1. Prevent fire from spreading into Full and Critical management option areas. 2. Protect designated sites.
Limited	Surveillance	1. Prevent fire from spreading into areas with Full and Critical management option designations. 2. Protect designated sites.

***Common to all fire management objectives is the top priority of <u>protecting human life</u> and secondarily, protecting property and natural/cultural resources.**

The AIWFMP states that "non-standard responses" may be made for initial response to any fires in any of the Wildland Fire Management Option areas. The Refuge Manager (or designee), Protecting Agency FMO, or initial attack Incident Commander may select a more aggressive response because of firefighter or public safety concerns, or a lesser response due to lack of resources, threat to areas with higher management option designation, anticipated failure of strategy, unusual conditions in a geographic area, or other compelling reasons. The decision and rationale for non-standard response requests from the Jurisdictional Agency and actions taken by the Protecting Agency will be documented and communicated in a timely manner.

Upon notification of a new fire by the Protecting Agency, the Kenai-Kodiak Area FMO will consult with the Refuge Manager (or designee) regarding special concerns and specific direction. The Wildland Fire Decision Support System (WFDSS) or other decision support tool will be used to document the course of action chosen and the decisions made by the Refuge Manager and the Kenai-Kodiak Area FMO. All WFDSS documentation for Refuge fires initiated by the Kenai-Kodiak Area will be transferred (ownership) to the Refuge FMO or designee.

The Kenai Interagency Dispatch Center (KIDC), located at the Kenai-Kodiak Area Office of the Alaska Division of Forestry in Soldotna, is the local area dispatch center for the Refuge. The Geographic Area Coordination Center (GACC) for the Alaska Region is in Fairbanks – the Alaska Interagency Coordination Center (AICC).

The Refuge FMO/AFMO or designated Fire Technician will provide a **Staffing and Availability Report** (**Appendix L**) of initial attack resources by 1000 Hours every day to the KKAO and the Chugach National Forest Seward Ranger District from April 1 to July 31 (these dates may be adjusted depending on fire danger).

Fires discovered on the Refuge or adjoining lands can be reported to the KKAO (907) 260-4200, or by calling 9-1-1. The person at the Refuge, who receives the report of a wildfire, will immediately provide the contact information for the Protecting Agency.

The assignment of KNWR initial attack resources is coordinated by the Refuge Fire Management Officer and the Protecting Agency FMO. Upon receiving a report of a fire on Service lands, the person receiving the report will contact the KNWR Fire Management Officer immediately. The FMO is responsible for notifying the Protecting Agency, Refuge Managers and Regional Office personnel of the situation (for all fires with potential to escape initial attack). The Refuge FMO is responsible for prioritizing resource needs and assigning resources as necessary to meet Refuge fire management objectives.

4.1.1.7 Incident Commander Responsibilities (for all incident types)

Operational control of a Refuge wildfire is the responsibility of the Kenai-Kodiak Area Office (KKAO). The KKAO FMO will assign a qualified Incident Commander and provide supervision and support including oversight, direction and logistical support. When a fire is not staffed, the KKAO FMO (or designee) will retain operational control and will be the de facto Incident Commander. KKAO will be responsible for fulfilling daily interagency incident reporting requirements and communications with the Refuge as directed in the Master Cooperative Wildland Fire Management Agreement, Exhibit C, Alaska Statewide Annual Operating Plan and will complete the final fire report which will be provided to the Service.

The IC is a single individual responsible to the Kenai-Kodiak Area FMO for all incident activities, including the development of incident management strategies and tactics, and the ordering, deployment, and release of resources.

The FMP and a Delegation of Authority provide a general strategy to an IC, who has the discretion to select and implement appropriate tactics within the limits described for the FMU(s), including when and where to use Minimum Impact Suppression Tactics (MIST) unless otherwise specified. More than two-thirds of the Refuge is designated Wilderness. Therefore, the use of MIST is required for suppression activities on Refuge lands whenever feasible. These tactics should be used to meet management objectives with the least amount of cultural and environmental impact. Guidelines for these tactics can be found in **Appendix M – MIST Guidelines**. The use of minimum impact tactics requires the assessment of both long and short–term values at risk and a comparison of suppression costs. This can be a difficult, subjective process and should therefore be documented in the WFDSS process.

Minimum impact tactics can be facilitated by assigning an Agency Administrator's Representative and an agency Resource Advisor (READ) to the Incident Management Team on large wildfire incidents, briefing overhead and crews on minimum impact tactics to ensure full understanding and implementation, including MIST Guidelines in the Incident Action Plan (IAP), and ensuring that all command and general staff officers (Command, Planning, Logistics,

Operations, etc.) are briefed on their responsibilities where minimum impact tactics are used. At no time should the use of minimum impact tactics supersede the safety of firefighting personnel.

The IC will notify the Protecting Agency and Refuge FMO, who will in turn notify the Refuge Manager, whenever it appears a fire will escape initial attack efforts, spread beyond Refuge lands, or when fire complexity is expected to exceed the capabilities of current command or operational forces. The Refuge FMO will provide the following assistance to the Protecting Agency FMO and to the Refuge Manager in preparation for, and during extended attack operations:

- Assist the Refuge Manager in the use of the Wildland Fire Decision Support System (WFDSS)
- Assist the Refuge Manager in the completion of a Delegation of Authority to the Incident Commander, if needed.
- Assist the Protecting Agency FMO in preparing WFDSS documentation and providing Refuge resources as necessary to successfully manage the incident.

4.1.2 Incident Management

4.1.2.1 Dispatching Beyond IA

As appropriate or needed, representatives from the Bureau of Indian Affairs, native villages and corporations, the Alaska Department of Forestry and/or the local Alaska Department of Fish and Game staff will be consulted for input/concerns regarding specific fire management strategies by the Protecting Agency.

The Refuge will work collaboratively with the Protecting Agency and any other affected Jurisdictional agencies to develop the complexity analysis and provide strategic goals and constraints to ensure land and resource management objectives are met and documented. The Incident complexity analysis will be based on Red Book criteria. The NWCG has adopted the Organization Needs Assessment as a replacement for the Type 1, 2, and 3 Complexity Analysis within WFDSS. The transfer of authority for suppression actions is done through the execution of a written delegation of authority to the Incident Commander, and provides specific guidance and constraints.

For large or complex fires requiring a Type I or Type II Overhead Team, Refuge staff will take an active role in providing direction with KKAO and the Incident Management Team (IMT). Refuge staff (primarily the Kenai-Kodiak FMO) will help prepare the decision support documents. The Refuge Manager will approve the course of action and incident objectives. Refuge staff will also have input into the Delegation of Authority, which transfers authority for fire management activities to the Incident Management Team and provides specific guidance and constraints on the suppression effort. The WFDSS (or other decision document) will be re-validated utilizing a periodic assessment completed by the Refuge Manager (or designee), and the Protecting Agency FMO to ensure the current course of action is still valid. The validation may be delegated to the Kenai-Kodiak Area FMO.

Type I and Type II incidents occurring on the Refuge may have an Agency Administrator's Representative or Resource Advisor designated by the Refuge Manager to provide and maintain a conduit of communication between the Incident Management Team (IMT) and the Refuge Manager, as well as between the local Protecting Agency and the Refuge Manager. The Kenai-Kodiak Area FMO may function as the line officer's representative, but in the case of multiple incidents, other staff may also be assigned. Refuge staff will articulate Refuge resource management concerns and agency strategic direction, not tactical direction.

All Type I and Type II fires that occur on the Refuge will have a debriefing scheduled prior to demobilization of the overhead team. The Refuge Manager, Kenai-Kodiak Area FMO, and the Protecting Agency will attend the fire critiques. Other individuals may be requested to attend depending upon the complexity of the incident. Critiques on other fires may be scheduled if problems or events occur which warrant scheduling a critique.

4.1.2.2 Delegation of Authority to Incident Commander (IC)

The Master Agreement will serve as the Delegation of Authority from the Refuge Manager to Kenai-Kodiak Area DOF to implement initial response activities in accordance with the AIWFMP. A Delegation of Authority will be provided to any Type 3 or higher level IC. See the current Red Book for supporting guidelines which include Agency Administrators Briefing to IMT, and a Sample Delegation of Authority from Agency Administrator to Incident Management Team (IMT). More details are listed under 4.1.2 Incident Management.

Delegations of Authority will be jointly developed and signed by the Jurisdictional and Protecting Agencies and will document procedures and criteria that specify direction, authority, and financial management guidelines to Incident Commanders. A Refuge example of a **Delegation of Authority to the Incident Commander** is provided in **Appendix N.** The Agency Administrator and Kenai-Kodiak Area FMO (at a minimum) will participate with incoming IC/IMT in-briefings as well as IMT close-outs and evaluations.

4.1.2.3 Resource Allocation and Prioritization

Resource allocation priorities are set through the Alaska Interagency Mobilization Guide and local Protecting Agency Dispatch. Under Preparedness Levels 1-3, the Protecting Agencies' fire operation leads set resource allocation priorities. Priorities may involve the Alaska Multi-Agency Coordination Group (AMAC) during periods of extreme fire activity and resource shortage (Preparedness Levels 4-5).

Resource allocation priorities are set through the local **KIDC Annual Operating Plan (Appendix – D)** and Operations Committee meetings. Emerging initial response fires will receive the highest priority. Prioritization may involve a local Multi-agency Coordination Group (MAC) when there is significant fire activity on the Peninsula.

4.1.2.4 Regulatory Compliance for Managing Wildfires (unplanned ignitions)

National Environmental Policy Act (NEPA) - analysis is not conducted on wildfires because they are unplanned events. Suppression activities are Categorically Excluded from NEPA (516 DM 8.5(5).

Endangered Species Act (ESA) - Wildfire may impact endangered species and destroy critical habitat and this is considered a disaster or an act of God in the sense of 50 CFR 402.05. Emergency consultation may be conducted on the response to a wildfire.

Wilderness Act - Routine operations within the Refuge wilderness will be conducted using non-motorized means. Motorized equipment may be used in emergency situations that involve risk of human life and safety or other significant values to protect, - natural, cultural, or physical.

Clean Air Act - Impacts to non-attainment areas may limit management options for unplanned ignitions or require aggressive suppression actions during period of air quality alerts. Otherwise, Clean Air Act regulations generally apply to planned events such as prescribed fires rather than unplanned ones.

Smoke assessments are the responsibility of both Kenai-Kodiak Area DOF and Kenai NWR. The need for air resource advisors is increasing and additional technical expertise for addressing air quality and health related issues may be available through the DEC. The AWFCG-approved "Smoke Effects Mitigation and Public Health Protection Protocols" are available at http://fire.ak.blm.gov/administration/awfcg.php. For current smoke information, forecasts, regulations, advisories, and educational materials, refer to the DEC website http://www.dec.state.ak.us/air/anpms/index.htm. The *Alaska Enhanced Smoke Management Plan for Planned Fire* (ESMP) was developed by DEC in coordination with the AWFCG Air Quality Committee. The ESMP and its appendices are located at http://fire.ak.blm.gov/administration/awfcg_committees.php. The ESMP outlines the process and identifies issues that need to be addressed by DEC and federal and state agencies or private landowners/corporations to help ensure that prescribed fire activities minimize smoke and air quality problems. The ESMP Appendices provide additional assistance for interagency sharing of information, the applicability and availability of current smoke management techniques, monitoring protocol, public education strategies, and emission reduction techniques.

Wildfire may impact endangered species and/or destroy critical habitat. This is considered a disaster or an act of God in the sense of 50 CFR 402.05. Emergency Endangered Species Act (ESA) consultation may be conducted during the response to a wildfire.

Routine fire management operations within Refuge Wilderness areas will be conducted using non-motorized means, whenever possible. Motorized equipment may be used in emergency situations that involve risks to human life and firefighter safety or other significant values.

Minimizing potential smoke incursions into air quality non-attainment areas or to protect public health may require aggressive suppression actions.

4.1.2.5 Use of Decision Support Tools

The Wildland Fire Decision Support System (WFDSS) will be used to inform and document line officer decisions for all wildland fire incidents and will support the objectives listed in the

Refuge Fire Management Plan. The Kenai Interagency Area Dispatch Center (KIDC) will initiate the WFDSS process by entering the required information into the Incident Information tab in WFDSS. Kenai-Kodiak Area DOF will transfer the "ownership" as defined within WFDSS to the Refuge WFDSS contact; both Kenai-Kodiak Area Office and the Refuge will work collaboratively to complete an organizational needs assessment to determine level of incident complexity and prepare documentation as required.

The Agency Administrator will be briefed on the current fire situation and will validate if the initial pre-planned response is meeting the strategic objectives for that incident. If the pre-planned response is followed, a further course of action may not be necessary, however if the fire is expected to burn for multiple days, a decision is required of the Agency Administrator. In these cases the incident may stay in the pre-planned response throughout the entire duration of the incident. The Kenai-Kodiak Area FMO will provide timely updates on the incident status to the Agency Administrator and obtain concurrence that the incident is still meeting resource objectives. This will be validated in the periodic assessment part of the decision support documentation.

If the pre-planned response is not meeting the strategic objectives or if there are site specific incident objectives that must be met, a new course of action and incident objectives will be developed and this decision documented in WFDSS. On-line tools within the WFDSS system (FSPro, STFB) can be used to inform the decisions that the Agency Administrator must make. Once a decision is published, a periodic assessment schedule will be set to re-validate that the chosen course of action is still meeting strategic objectives. Whenever a course of action is no longer meeting strategic objectives, a new course of action and decision will be required. This sequence continues for the duration of the incident. Once the incident has been declared out, WFDSS reports may be generated to document the progression of the incident and the decisions made during its course. The electronic WFDSS documents are maintained under Federal Records Management Policies as permanent records.

Kenai-Kodiak Area DOF will develop and implement incident tactics based on verbal approval from the Refuge FMO or Refuge Manager while WFDSS approvals are being finalized. Financial/Funding approval authority for WFDSS decisions are subject to change so it is necessary to consult the current Redbook for updated amounts. The Kenai-Kodiak Area FMO will notify the Refuge when costs are approaching approval thresholds. AFS will carry forward approvals for cost thresholds identified in the Redbook through the BLM officials with a copy forwarded to the FWS Alaska Regional Director.

For all incidents:

- Public and firefighter safety issues will continue to be the primary consideration.
- Kenai-Kodiak Area and the Refuge will jointly complete a complexity analysis (or Organizational Needs Assessment) to determine the management level of the incident.
- Kenai-Kodiak Area will authorize and provide oversight for all incident resources regardless of the complexity level.
- Operational guidelines for special management considerations are contained in the AIWFMP and in this FMP.
    - No retardant will be used on federal lands without prior approval of the agency administrator unless there is an immediate threat to life.

    - Each agency's structure and site protection policies will be reviewed and applied as directed by the Refuge Manager and based on priorities, the overall statewide fire situation and resource availability.
- IMT in-briefings and close-outs will be conducted jointly with Kenai-Kodiak Area as the lead.
- WFDSS documents that go to decision due to being a non-standard response or extended attack beyond the initial response require approval by the Refuge Manager and State of Alaska Regional Forester.

4.1.2.6 Wildfire Reporting Requirements

In addition to the national standard (found in the Red Book), AICC requires ICS-209's for all fires that have a commitment of 17 or more personnel for more than one burning period (overnight). Kenai-Kodiak Area is responsible for completing ICS-209's in the event that the Incident Commander fails to submit one. The AICC may also request ICS-209's for other fires not covered by the above criteria as determined by the Predictive Services Section. ICS-209's are the primary source of Alaska fire activity information for national fire managers. Alaska ICS-209's should be submitted by 10:00 p.m. (2200 hrs.) Alaska Daylight Time (ADT).

Fire reports are to be completed and entered into the FWS Fire Management Information System (FMIS). The Kenai-Kodiak Refuge FMO will complete an FMIS entry for the following types of fires within 10 days of a fire being declared out: [Final fire reports can be downloaded directly from Alaska Dispatch for this purpose. Official final fire reports from DNR will be routed through AICC for incorporation into the official state wide fire database maintained by AFS.]

- All wildfires fires on FWS lands (Fire Reports are required to be completed by the Protecting Agency and submitted to the R7 Regional Fire Staff)
- All wildland fires (including prescribed fires) on which Refuge Fire staff takes action (on or off Refuge)
- All escaped prescribed fires
- All false alarms responded to on FWS by Protecting Agency or Refuge staff

Fires that achieve resource management objectives will also be documented in the National Fire Plan Operations & Reporting System (NFPORS) by the Refuge FMO or designee. The FMO will ensure that a complete project record will be compiled and retained for each wildland fire on the Refuge. Each record may contain the following items:

- Decision support documentation
- Project maps
- Monitoring summaries
- Photographs/photo points if available
- Funding codes used and cost
- Overall project summary including the narrative, daily log, periodic assessments, contacts, decision records, orders and what and how objectives were met (Fire Report completed by Protecting Agency).
-

Reviews and investigations are used by wildland fire and aviation managers to assess and improve the effectiveness and safety of organizational operations. Brief descriptions of various reviews and associated procedures and requirements, including those for serious wildland fire accidents, entrapments, and fire trespass are listed in the corresponding Red Book Chapter.

An annual Fire Management Accomplishments Report is prepared by the Kenai- Kodiak Area FMO to keep the Regional Fire Management Coordinator apprised of all Refuge fire management activities.

Incident Commanders and Single Resource Bosses will ensure that After Action Reviews (AARs) occur in a timely manner and that any significant issues are brought to the attention of the Refuge FMO or Refuge Manager.

4.1.2.7 Suppression Damage Repair

Repairing the impacts of suppression activities is the responsibility of the Incident Commander and is funded by the wildfire account. Such work should be completed by incident resources prior to final demobilization whenever practical. However, it may be more cost-effective and practical to delay repairs to improve the probability of success. It is the responsibility of the Refuge Manager/line officer to ensure that suppression activity damage repair is completed.

Repair of suppression damage will occur prior to crew release from the fire, including:

- Removing all trash from incident facilities, work areas and firelines,
- Replace soil dug from firelines to refill them to level; add water bars as needed,
- Fell and buck up hazard trees and snags,
- Flush cut stumps as close to ground level as practicable,
- Roll back and compact sod overturned by plowing (with a grader or by hand) to preserve native grass root stock.

4.1.3 Emergency Stabilization (ES)

Natural recovery is the preferred choice for site recovery following wildfires. However, when natural recovery is not likely, ES treatments may be needed to prevent further degradation of cultural and natural resources in the burned area and downstream impact areas from erosion and invasion of undesirable species. Per the AIWFMP, the Jurisdictional agency is responsible for determining the need for, developing, and managing Emergency Stabilization and Burned Area Restoration activities.
ES uses emergency appropriations and activities must be completed within one year of fire containment. An IC may initiate ES actions before the fire is demobilized, as delegated by the agency administrator.

4.1.3.1 ES Planning and Post-Fire Assessments

Responsibility for ES plan preparation, compatibility with Service/Refuge management goals and objectives, and NEPA/regulatory compliance lies with the Refuge Manager. The Refuge Manager is also responsible for ES Plan implementation. Plans must be developed at the Refuge level, approved at the Regional level, and submitted to the National Fire Program Office in Boise for review by an inter-Departmental review group.

Because of the emergency nature of the fire event, the Emergency Stabilization Plan (ES) must be developed expeditiously and is frequently developed by a local unit or designated burned area ESR team. The Refuge Manager/Agency Administrator is responsible to order or assign teams to develop ES plans. The first step in developing a plan is to review available data about the fire and affected resources. Field inspections will likely be necessary to assess values at risk as a result of the fire. The Refuge may not have sufficient expertise to conduct burned area assessments; resource specialists from cooperating units or from the Region may be needed to assist in developing a plan. The Regional Fire Ecologist will be the primary contact person for ES activities in Region 7 and should be consulted if a plan is anticipated.

The ES Plan specifies treatments approved to implement post-wildfire emergency stabilization on a single incident. The plan specifies only emergency activities and treatments to implement within one year of wildfire containment, although emergency stabilization funding can be used for up to three years following containment of the fire in order to monitor treatment effectiveness or to replace/repair emergency stabilization treatments if failure to do so would imperil watershed functionality or result in serious loss of downstream values. Funding beyond the first year requires an approved amendment to the plan. Funding beyond the first year cannot be used to continue seeding, plantings, or invasive plant treatments. The plan must be completed within 7 calendar days of wildfire containment and approved within 6 business days of receipt by the approving office. This plan is prepared by an interdisciplinary team during or immediately after wildfire containment. Information and a plan template are at http://fire.r9.fws.gov/ifcc/esr/home.htm.

A DOI Memo dated September 5, 2007, regarding Emergency Stabilization Cost Containment states that "all Emergency Stabilization planning must adhere to Department of the Interior policy (620 DM 3.6.B), requiring that standard treatments are to be used that have been validated by monitoring data from previous projects, or when there is documented research establishing the effectiveness of such actions". All plans must "Justify proposed treatment(s) with existing research or monitoring documentation that demonstrates that the proposed treatment(s) are significantly more effective in achieving the emergency stabilization objective than natural recovery…" Reports of previous stabilization efforts in Alaska may be consulted for information about techniques.

4.1.3.2 ES Post-Wildfire Issues and Values to Protect

Wildfire damage to improvements is a concern. Developments are typically protected from fire damage, but dispersed improvements such as fences, public use facilities, and gates are likely to be damaged by severe or large fires. A partial list of Values to Protect is in section 3.2.2.

ES actions likely to be needed deal with erosion, invasive plant infestation, or loss of sensitive and protected species habitat or native vegetation post-fire, as identified in 620 DM 3, include:

- 3.7 M (2) placing structures to slow soil and water movement,
- 3.7 M (7) seeding or planting to prevent permanent impairment of designated Critical Habitat for Federal and State listed, proposed or candidate threatened and endangered species,
- 3.7 M (10) direct treatment of invasive plants,
- 3.7 M (12) monitoring of treatments and activities for up to three years.

4.2 Burned Area Rehabilitation (BAR)

4.2.1 BAR Planning

A BAR plan is a document that specifies treatments required to implement post-fire rehabilitation policies. This plan may be programmatic (prepared in advance) and applicable to clearly defined types of incidents and situations, or prepared by an interdisciplinary team of specialists during or immediately following the containment of a wildfire. Information and a BAR plan template are at the DOI - ESR website at:

<http://fire.r9.fws.gov/ifcc/esr/home.htm>.

4.2.2 BAR Regulatory Compliance

Two Categorical Exclusions (CX) may apply to BAR. The first is a DOI CX (43 CFR Section 46.210), and the second is a FWS CX (516 DM 8.5(5).

When utilizing the FWS CX, the Refuge/unit staff will complete and submit the most recent version of the NEPA Compliance Checklist (FWS Form 3-2185) with the BAR plan. Before using the DOI CX, consult with the Regional Office regarding its use.

BAR projects must comply with NHPA. Plans will be submitted to Regional archeologist for review and cultural / archeological clearance. To the greatest extent possible, project implementation will follow recommendations of the Regional archeologist and/or SHPO.

BAR projects that may affect Threatened & Endangered species/their habitats must comply with Section 7 of the ESA. Any such projects will be submitted for Section 7 consultation.

Routine BAR operations in the wilderness will be conducted using non-motorized means to the extent practical. Motorized equipment may be used in emergencies.

4.2.3 BAR Monitoring Protocols

Monitoring protocols will be included or referenced in the BAR plan. They will follow DOI policy and will use standard protocols developed for similar bio-physical regimes.

4.2.4 BAR Contact Information

Refuge Biologists and the GIS Specialist would be involved in creating and implementing a BAR plan. Assistance would also be sought from the Regional Fire Management Coordinator and the Regional Fire Ecologist. See: **Appendix O** for specific names and contact numbers.

4.2.5 BAR Public Information and Public Concerns

A meeting to inform the public of planned activities, obtain input from local communities and neighbors, and identify issues needing further discussion and resolution should be held early in the BAR plan development process.

4.2.6 BAR Reporting Requirements

An Annual Accomplishment Report is required for funding in years two and three. Detailed Annual Accomplishment Reports will be completed by fiscal year end to document actual accomplishments, costs and monitoring results. Reports will be kept in field unit project files, with a copy of the Annual Accomplishment Report sent to the Regional office. Annual accomplishments are also summarized and reported in the NFPORS treatment/activity form.

Planned data entries into the NFPORS Rehabilitation and Restoration Module are the responsibility of the National Burned Area Coordinator. NFPORS Accomplishment updates are the responsibility of the field unit; they are to be completed by the 23rd of every month and at the end of the fiscal year until the project is shown as completed.

4.2.7 Previous Treatments and Costs

The Refuge applied for, and received BAR funding only once in its history. The 2004 Glacier Creek Fire was one of many large fires in Alaska during that record fire season. A BAER Team was dispatched to multiple burned areas in Alaska, including the Refuge, and developed a statewide stabilization and rehabilitation plan (Burned Area Emergency Response Team 2004). The Emma Lake Trail is the primary route to a popular Kenai Refuge historical public use cabin and provides important access to subsistence big game hunting areas on the refuge. The Glacier Creek Fire damaged the entire 3-mile route rendering the trail and surrounding area completely impassable due to downed trees, standing snags and a completely obscured trail tread. In response to this damage, the Refuge received funds for emergency stabilization and rehabilitation of the trail in the years 2005 – 2007.

The work in 2005 included locating, flagging and reclaiming the original route. Deviation from the historic route was considered only when it was determined that the original location and alignment would not contribute to overall trail sustainability. Short re-routes were planned to reduce the grade (percent slope), improve drainage and prevent potential erosion issues. A seasonal trail crew of 6 people spent 2-weeks clearing downfall, removing snags and other hazard trees along the entire 3-mile route.

Approximately 2 miles of new trail tread was constructed. Construction standards included developing an 18” tread free of all roots, rocks, stumps and other obstacles. “Full-bench” or “side hill” construction techniques were used to traverse steep slopes and tread was shaped with an out-sloping alignment to encourage proper drainage. Rocks and other debris was scattered on down-slopes to help anchor loose soils and minimize potential “sloughing”.

The new tread construction was followed up with the construction and installation of drainage features and structures including grade dips, trenches, water bars and timber bridges. Due to the Wilderness designation of the area, native materials were used exclusively and structures of limited size, scale and number were developed only to protect trail infrastructure and resources.

The final work was completed in 2005 and included brushing and trimming the last 1 mile of trail corridor. Trail damage was intermittent on the upper sections of the trail, leaving unburned segments that required very little attention between segments that were heavily damaged and needing intensive restoration.

The stabilization and rehabilitation costs for this first year were $35,968.06.

In 2006 the refuge was given $7,000.00 to continue work on the Emma Lake Trail restoration project. With this money the refuge cleared the entire 3-mile route of downfall (approximately 75 trees) and continued efforts to remove snags and other hazard trees adjacent to the trail corridor. The crew constructed approximately 65 feet of rustic timber bridges (elevated boardwalks) using native materials and installed approximately 40 additional rock and timber water bars to accommodate drainage and manage run-off. The crews constructed/rehabilitated ½ mile of partially burned trail tread and removed rocks and roots from newly constructed trail tread. Crews also rehabilitated several short sections of trail showing early signs of erosion by backfilling and installing appropriate drainage features and/or structures, and performed routine maintenance along the entire route.

In 2007 the refuge received $6,091.04 and focused efforts primarily on removing down trees from the trail corridor and eliminating snags that were predicted to cause future trail blockages. Crews also maintained and/or repaired drainage structures to facilitate drainage and manage run-off. Work involved clearing debris and slough from water bars, re-anchored or re-positioned log and rock water bars.

Treatment Effectiveness

The newly constructed portions of Emma Lake Trail completed in 2005 remain stable. Vegetative re-growth in the area is dramatic and is contributing to overall stability of the trail and surrounding steep slopes. Management of run-off seems effective and drainage structures are proving to be functional. Only minimal routine maintenance was required to restore a few drainage structures to their original functional level. New trail construction appears sustainable. Exposed trail down-slopes comprised of loose unconsolidated soil and ash are now supporting substantial re-growth of fireweed and other pioneer plant species. No major “sloughing” has occurred. Trail tread is nicely compacted through visitor use and vegetative re-growth has visually reduced the width of the trail corridor to an appropriate Wilderness standard. Newly constructed timber bridges spanning an area of saturated soils near the trailhead are effectively protecting surrounding vegetation. Resource impacts noticed last year at the same location were barely discernible at the end of this year’s field season. Currently Lake Emma trail is open with overall safety and accessibility significantly improved.

4.3 Management of Planned Fuels Treatments

Refuge planning of fuels treatments is developed through the strategic placement of projects, based on risk from wildfire, or desired vegetation change for habitat treatments. The overarching goal of the fuels program is to allow fire to play its natural role in the ecosystem while providing for the safety of surrounding communities. Maintaining the largely natural and intact fire regime on the Refuge into the future will be dependent upon the strategic placement of, and effectiveness of hazardous fuels treatments.

Communities surrounding the Refuge have developed CWPP’s, identifying the areas of highest concern. Most of the CWPP’s contain significant areas of risk from fires moving off the Refuge and into communities. Concern about resource benefit fires threating local communities is reduced with an active hazardous fuels program. The majority of hazardous fuels projects should contain a mix of on-Refuge treatments and cooperator treatments in the highest risk areas.

Habitat treatments utilizing the fuels treatment suite of vegetation manipulation techniques are proposed for those areas deemed beneficial for various species of wildlife. The 1996 Moose Management Plan used to be the core of this program. But the Moose Management Plan is now more than fifteen years old and outdated as a planning document. Future habitat treatment plans for the Refuge will require new

site-specific or area analysis and will need to relate directly to the goals and objectives identified in the Revised CCP. Ideally, future habitat management and CWPP's will overlap, leveraging the hazardous fuels and habitat treatment benefits overall. In general, allowing natural fire on the greater Refuge landscape provides the best opportunity for disturbance of large areas. In areas at risk from wildfire, more intensive project design will be necessary to accomplish both hazardous fuels and habitat maintenance or enhancement objectives.

4.3.1 Processes to Identify and Prioritize Hazardous Fuels Treatments

Hazardous fuels treatments are based upon the risk to values from wildfire. Much of the Refuge is virtually surrounded by at risk communities, with critical response areas abutting Refuge full response areas. Wildfires occurring near the boundaries of these response zones could easily move off Refuge lands and into communities within a single burning period. Each of the communities adjacent to the Refuge has a completed CWPP. Within each CWPP area, the highest risk zones with the highest risk fuels (black spruce, Calamagrostis grasslands, and areas of beetle-killed spruce) have been identified. Black spruce fuels often act as fire pathways directly into the communities at risk. In general, projects that reduce crown fire initiation risk in black spruce are preferred.

The Refuge has identified the development of a Hazardous Fuels Treatment Plan as a high-priority objective in the FMP (Sections 3.1.1 and 3.1.2). A comprehensive risk assessment of the Refuge's wildland urban interface and intermix areas will identify areas of concern and the potential for fire and non-fire treatment areas. Any Refuge risk assessment and hazardous fuels treatment plans should consider: the resources at risk (type and value), treatment effectiveness and longevity, treatment cost, the potential impacts of no action, along with national, regional, and refuge policies/guidelines.

Several existing risk assessments are available to aid hazardous fuels treatment project design and placement. Current risk assessments in each of the CWPP areas will provide a starting point for project area design under the Hazardous Fuels Treatment Plan. The assessment done for the Kenai Peninsula by the Kenai Peninsula Borough – Spruce Bark Beetle (SBB) Office (updated in 2007), is the foundation for additional risk assessments. Data gathered by the SBB was used to establish a geospatial risk/hazard layer, in which polygons are defined by primary vegetation species and structure. A collaborative process (as outlined in the current National Fire Plan Implementation Guide) is used to develop and implement all hazardous fuels treatment projects. Completed CWPP's within the Kenai Peninsula Borough (KPB), and those adjoining the Refuge can be found at the KPB Office of Emergency Management (OEM) website:
http://www.borough.kenai.ak.us/emergency-mgmt/521-community-wildfire-protection-plans

The Kenai National Wildlife Refuge 5-Year Hazardous Fuels Treatment Plan will be incorporated into the Revised FMP in (**Appendix P**).

4.3.2 Prescribed Fire Project Implementation

Prescribed fire implementation will follow the standards set forth in the FWS Fire Management Handbook, the current Redbook, and the Interagency Prescribed Fire Planning and Implementation Procedures Reference Guide 2008 (Prescribed Fire Guide), which is available for download at www.nifc.gov/fire_policy/rx/rxfireguide.pdf.

Prescribed Fire and Mechanical Treatment Program for Hazardous Fuels and Habitats

The Refuge uses prescribed fire and mechanical treatments as tools in two management programs – resource management (habitat) and hazardous fuels reduction. Resource management fuels treatments are used to restore, create, and/or maintain diversity of plant communities and to perpetuate native plant and wildlife species. The Refuge may use hazard fuel reduction treatments and prescribed fire within or near Refuge developments, sensitive resources, and wildland-urban interface or intermix zones to reduce or mitigate the risk of wildfire. To the greatest extent possible, hazard fuels reduction prescribed fires will only be used when they complement resource management objectives.

Prescribed Fire Season

The prescribed fire season for the Kenai National Wildlife Refuge typically runs from mid- to late-June through mid-September. Conducting prescribed fires during this period allows for the duff consumption required to meet objectives for the project plans. Pile burning normally occurs during the fall and winter.

Program Overview

In terms of prescribed fire, there are two levels of activity identified in the CCP. One level is minimal interference with natural processes. The Wilderness and Minimal FMU's together represent this level. Prescribed burning is allowed only to protect life, property, or resources in these FMU's. An example of this activity is a prescribed fire designed to regenerate a hardwood stand adjacent to a residential area, providing a 'break' in a continuous stand of black spruce, thereby reducing the likelihood of a wildfire entering the residential area. The CCP also states that the natural diversity of wildlife populations and habitats will be maintained on the Refuge. This natural diversity will be achieved by letting natural processes (i.e., lightning-caused fires, spruce bark beetle outbreaks, wind throw, avalanches, etc.) alter the vegetation in the more protective management categories. Prescribed fires may be planned in such areas to act as a surrogate for natural fire in altered fire regimes.

National Wilderness policy and the Refuge CCP allow the use of prescribed fire in designated Wilderness areas under certain conditions:

1. To restore the 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 fuel loads around structures and urban interface).
4. To mimic a natural fire regime (long-term) or restore (short-term) a significantly altered fire regime.

The second level of activity is a more intensive management strategy – hazardous fuels treatments and prescribed fires are allowed to meet resource objectives. An example of this activity is a prescribed fire or other treatment producing early successional vegetation to benefit species where early seral stages are desired. In the intensively managed areas, the full range of fuels treatment types should be considered. The chosen treatment types should be in alignment with the objectives of the FMU and goals of the project. The Modified and Intensive FMU's collectively comprise this elevated level of prescribed fire application. The emphasis is on using prescribed fire as a tool to accomplish Refuge land and fire management objectives.

The priority for either of these levels of prescribed fire management is to re-establish fire in the ecosystem at a level that resembles the past fire history of the area, while still accomplishing certain contemporary objectives such as reducing hazardous fuels.

Prescribed burning will be conducted in accordance with Service guidelines. Each prescribed fire will require a detailed and comprehensive prescribed fire plan, including objectives for the burn and monitoring to determine if objectives are met, that has been reviewed by a technical specialist and approved by the Refuge Manager.

All prescribed fires must comply with NEPA requirements. An EA must be prepared for each Prescribed Fire Plan unless: (a) the field office's approved FMP or planning documents and the accompanying environmental document adequately discuss the action; or (b) a categorical exclusion covers the activity. (621 FW 2)

Program Objectives

The 1996 Moose Management Plan recommended prescribed fire treatments on 2,000 – 4,000 acres per year in late-successional non-Wilderness habitats. These prescribed fires were to be used to maintain or improve the condition classes of selected acres. The CCP states that a moderate program of habitat manipulation would be undertaken in non-Wilderness forests to maintain or enhance diversity. This manipulation would take place mainly in forests less than 50 years old. These treatments might also benefit some species, especially moose. Finally, to reduce the threat of unwanted wildland fire in the wildland-urban interface, high-use recreation areas, and critical habitats through mechanical hazard fuel reduction, prescribed fire, and fire use projects.

Project Complexity

The prescribed fire complexity rating will be determined using the Prescribed Fire Complexity Rating System Guide, NWCG, January 2004. Prescribed fires on the Refuge have traditionally spanned the full range of complexity, from Type 1 prescribed fires to mastication of treatment units.

Effect of National and Regional Preparedness Levels

Prescribed fires may be ignited during National Preparedness Level 4 or 5 as specified in the National Interagency Mobilization Guide. Under these preparedness levels, regional and national approval will be needed.

For successful implementation of prescribed fire projects and to meet identified Refuge objectives, qualified personnel and essential resources must be available to implement prescribed burn plans. When the KKAO's suppression resources are committed to emergency or initial attack suppression response locally and statewide, the Refuge must obtain its own resources in order to accomplish prescribed fires. Administratively Determined (AD) or Emergency Firefighters (EFF), cooperators, contractors, and/or casual hires may be used to implement prescribed fires. AD or EFF must meet FWS standards. Cooperators, such as members of Volunteer Fire Departments, must have appropriate qualifications certified by their agency. Those who supervise FWS employees during prescribed fires must meet Service standards.

A prescribed fire must be declared a wildfire by those identified in the burn plan when that person(s) determines that the contingency actions have failed or are likely to fail and cannot be mitigated by the end of the next burning period. An escaped prescribed fire must be declared a wildfire when the fire has spread outside the project boundary, or is likely to do so, and cannot be contained by the end of the next burning period. A prescribed fire can be converted to a wildfire for reasons other than an escape. On these incidents, a planned incident management response will be prepared, implemented and

documented using the WFDSS process. The Refuge Manager will be notified as soon as possible of an escaped prescribed fire.

Public information for prescribed fires may occur through different media types: news releases, interpretive messages, and educational programs. Informing key stakeholders, the public, and other interested parties is critical to successful treatment implementation.

The Refuge uses a low complexity debris burn plan for debris disposal projects. The FMO will review the complexity of planned projects to ensure use of the plan is consistent with its intent. These projects fall outside the prescribed fire planning process by policy. The projects must meet the specific NEPA requirements for their program.

4.3.2.1 Prescribed Fire Planning

Prescribed fires must have a complete and approved Prescribed Fire Plan before implementation. Guidance provided in: Chapter 17 of the Redbook, the Interagency Prescribed Fire Planning and Implementation Procedures Reference Guide 2008, and in Chapter 17 of the Fire Management Handbook will be used when developing Prescribed Fire Plans and conducting prescribed fire activities.

In accordance with regional and national guidelines, individual prescribed fires and hazard fuel treatment projects must be identified in advance and entered into NFPORS for funding in out-years. In order to meet that requirement, the Refuge Fire Management Officer will coordinate with Refuge management to identify and develop a listing of projects for the Refuge's fire program.

Refuge employees may monitor habitat and wildlife populations in individual project or treatment units to meet specific monitoring objectives. When it is determined that fire would be an appropriate management tool for a given area of land to meet desired objectives, a site-specific Prescribed Fire Plan will be prepared in accordance with the National format. Each Prescribed Fire Plan will be reviewed by the FMO and other appropriate staff and approved by the Project Leader. Before the plan is implemented, the assigned Prescribed Fire Boss must certify that the prescription will meet the stated resource objectives. The plan can be amended by the Project Leader after it has been approved. A copy of the amended prescription and a justification must be signed by the Project Leader and attached to the plan.

The Refuge will implement its fire management program within the constraints of the Endangered Species Act of 1973, as amended, and Service policy, which requires that State threatened and endangered species and federal candidate species be incorporated into planning activities. The Refuge will take appropriate action to identify and protect from adverse effect any rare, threatened, or endangered species located within the Refuge. All Prescribed Fire Plans will also comply with Section 106 of the National Historic Preservation Act of 1966, as amended.

4.3.2.2 Prescribed Fire Operations

Cooperators, contractors, and casual hires (Administratively Determined (AD) hires) may be used to implement prescribed fires. AD's must meet FWS standards. Cooperators, such as members of Volunteer Fire Departments, must have appropriate qualifications certified by their agency. Those who supervise FWS employees during prescribed fires must meet FWS standards.

Operational Checklist:

- *At least thirty days prior to planned Burn Day, the Burn Boss will ensure all local, state, and smoke management permits are in place and current.*
- *At least two weeks prior to planned Burn Day, the Burn Boss will notify staff assigned to the project to ensure adequate planning of work and leave schedules.*
- *At least a week before Burn Day, all engines, tools, supplies, etc., will be checked.*
- *Off-site Burn Bosses will report to the Refuge Manager by the day before the Burn Day.*
- *Public and media contacts will be completed as designated in the burn plan.*
- *Warning signs and/or road guards will be used to advise motorists of a prescribed fire in progress, especially if smoke could reduce visibility.*
- *Refuge roads adjacent to burn units will be closed temporarily as needed.*
- *Test fires will be used to assess holding capability and smoke dispersal. Weather forecasts for the Burn Day and the next two forecast periods will be obtained.*
- *Prescribed fires will not be ignited until all contingency forces are confirmed as being in the required status specified in the burn plan.*

4.3.2.3 Prescribed Fire Public Notification

The public will be informed of the prescribed fire program through news releases, interpretive messages, and educational programs. Public notification of planned prescribed fire ignitions should be made when local/zone and regional offices are notified. Special notification should be made for neighbors with known physical ailments that could be adversely affected by smoke.

4.3.2.4 Prescribed Fire on Private Lands

The Refuge may assist private landowners with prescribed burning to improve the value of their land as wildlife habitat. A Wildlife Extension Agreement with a written provision for the use of prescribed fire must be approved prior to implementing prescribed fire or treatments on private lands.

4.3.2.5 Prescribed Fire Conversions and Reviews

All prescribed fires declared a wildfire will have an investigative review initiated by the Refuge Manager. The level and scope of the review will be determined by policy and procedures of the Interagency Standards for Fire and Fire Aviation Operations and the FWS Fire Management Handbook.

After Action and Escaped Fire Reviews

The Burn Boss will ensure an informal After Action Review (AAR) is conducted for each operational period on a prescribed fire, as in Red Book Chapter 18.

4.3.2.6 Planning, Preparing and Implementing Non-Fire Hazardous Fuels Treatments

Non-fire Hazardous Fuels Treatment Program

The Refuge Manager may implement the use of heavy equipment (e.g. dozer, excavator, hydro-axe, feller/buncher, and/or skidders), power saws, hand tools, or other equipment to mitigate accumulations of hazardous fuels, mimic fire processes, or recreate historical landscape conditions in

areas where prescribed fire is not feasible or in preparation for prescribed fire. A project plan will be prepared for each hazardous fuels reduction project. The plan should evaluate the objectives, possible fuel treatment options, short and long-term effects, and costs. The plan should include a monitoring section that assesses treatment effectiveness. Implementation of each project would be the responsibility of the FMO or a designee.

The potential treatment areas would be ranked in terms of priority for treatment and submitted for funding.

4.3.3 Hazardous Fuels Treatment Regulatory Compliance

All hazardous fuels treatments must comply with NEPA requirements. Also, regardless of the NEPA analysis level, all project NEPA copies need to be placed within the project documentation file. An EA must be prepared for each Prescribed Fire Plan unless:

(a) The field office's approved FMP or planning documents and the accompanying environmental document adequately discuss the action; or

(b) A categorical exclusion (CE) covers the activity. (621 FW 2)

By reference, this section incorporates the text of the Red Book related to Smoke Management and Air Quality and will follow recommendations of the latest edition of the NWCG Smoke Management Guide for Prescribed and Wildland Fire.

Individual prescribed burn plans will specify conditions required for burning that will minimize impacts to air quality from prescribed fire, including compliance with the requirements of State and local air quality regulatory agencies.

Smoke Management

As required by the Clean Air Act, all prescribed fire and wildland fire use on the Refuge will be managed in compliance with conditions set forth by the State of Alaska, in an air quality permit issued by the Alaska Department of Environmental Conservation (ADEC). There are no local or interstate air pollution control regulations. Prescribed fires will be closely monitored for smoke trajectory, ventilation factor, adverse impacts to known sensitive areas or resources, and overall air quality. Firing will begin only when conditions are expected to remain favorable for the dispersion of smoke.

If a project's smoke hampers visibility along paved public highways, in or around airports with scheduled carrier service, or significantly impacts or is expected to impact populated areas due to changes in weather, actions will be taken to reduce emissions and mitigate negative impacts. These may include but are not limited to: firing of unburned portions of a unit to reduce smoldering; terminating ignition; mop-up of smoldering portions of the unit; use of natural barriers or constructed fireline to halt fire spread. Warning signs will be posted along impacted roads, including reduced speed if necessary. Aviation and traffic control will be coordinated with the appropriate agencies.

Fire management projects will have approved plans that provide specific smoke management parameters for each individual project. All prescribed fire projects will be conducted under the supervision of a qualified Burn Boss. The Burn Boss will shut down ignition of their prescribed fire if air quality objectives deteriorate. The Refuge Fire Management Officer will shut down ignition of any and all burning on the Refuge for any reason deemed necessary, including air quality. The Kenai NWR will coordinate smoke management with ADEC and adjacent state and federal agencies that may be conducting prescribed fire activities on their lands, with potential to affect the same airshed.

Impacts to the public and the smoke produced during the course of prescribed fire activities must be evaluated in light of the impacts and smoke produced during uncontrolled wildfires. Public education programs on the Kenai National Wildlife Refuge will increase public understanding of the natural processes of fire, of fire's role on the Refuge, and of Refuge efforts to protect air quality while using fire as a land management tool.

There are no Class-I airsheds within or adjacent to the boundaries of the Kenai NWR. The nearest one is at Tuxedni Bay, located about 50 miles west of the Kenai Refuge boundary, on the west side of Cook Inlet and along the eastern boundary of Lake Clark National Park. The next most sensitive smoke target is the city of Anchorage and its surrounding communities.

4.3.4 Fuels Treatment Monitoring

The Burn Boss will review current and forecasted weather prior to Burn Day. On Burn Day morning, a spot weather forecast from the local National Weather Service will be requested, that will include time periods to complete ignition and holding and immediate mop-up needs.

Burn Day monitoring will document whether or not the fire is within prescription. Weather variables typically monitored are dry bulb temperature, relative humidity, mid-flame wind speed and direction, and cloud cover. Measurements are taken immediately prior to test fire ignition and at intervals specified in the burn plan.

4.3.5 Fuels Treatment Reporting Requirements

Completed treatments will be reported in FMIS and NFPORS within 5 days of completion.

Reports
The Burn Boss will complete an Individual Fire Report (DI-1202) with the FMO who will file this report within 10 days of the fire being declared out. The report will document conditions and fire behavior during the prescribed fire to assess how well actual fire characteristics fit those predicted, unanticipated difficulties encountered during implementation, and assessing how well the fire accomplished the intended objectives.

4.3.6 Fuels Committees and other Collaborative Groups

The Refuge FMO will report planned Refuge fuels projects and accomplishments to the All Lands All Hands Committee during committee meetings. Member agencies look for ways to assist each other in the accomplishment of fuels projects and treatments. The committee collaborates with each other and with local communities in planning, review and updating CWPP's.

4.3.7 Fuels Treatment Funding Processes

The fuels funding process is based on the multi-year treatment plan for the Refuge. Projects and treatments are identified in the plan, approved by the Refuge Manager, and entered into NFPORS. Individual projects are capped at $500,000 per year with no limit on the amount of treatments proposed. Projects are typically entered into NFPORS by April 1st.

Projects throughout the region are annually compared and prioritized according to FWS and DOI criteria. Project goals and objectives (i.e. WUI, Protects Treasured Landscapes, Hazardous Fuels, and Habitat) are extracted from NFPORS data entry and used in scoring the projects. The criterion for project scoring comes from the Office of Wildland Fire in negotiation with the DOI Bureaus and is subject to annual change. The Region's program of work (POW) is usually fully developed by August, with room for nominal project substitution in September. Refuge units should have an estimation of funded projects at the start of the fiscal year.

4.3.8 Debris Burning

Debris burning falls outside the scope of the fire management plan and will be implemented under the originating refuge program.

4.4 Prevention, Mitigation, Education and Public Information Programs

The objective of fire prevention activities is to prevent unwanted human-caused wildfires. The outreach goal is to enhance public knowledge and understanding of wildland fire management policies and practices through internal and external communication and education. In order to accomplish this, the FMO and the Refuge Fire Management Staff will do the following:

- Prepare a Refuge Fire Prevention and Outreach Plan to be incorporated into the Revised FMP in **Appendix Q**.
- Work collaboratively with other Refuge programs to effectively deliver fire management interpretive programs at Refuge Headquarters, at Refuge campgrounds, and at area schools.
- Inform the public about the important aspects of wildland fire management, including: the natural role of fire in the environment, wildfire prevention and mitigation, suppression, prescribed fire, hazardous fuels management, monitoring, and research. This outreach is critical to gaining public support for the fire management program. The Refuge FMO will coordinate the distribution of information to the press and or public.
- During wildland and prescribed fire operations, news articles and press releases will be written and released to local media in a timely fashion. Designated refuge personnel will perform the duties of information officer as qualified and as needed.
- Keep Refuge employees informed about the fire management program and on-going incidents/projects.
- Be trained in FireWise Community Action Plan implementation and outreach activities and actively share that knowledge with the public at every suitable opportunity.
- Develop and maintain a fire management information web page (as funding and policy permits), to inform stakeholders and other interested parties about: current and future fire management projects, fire prevention and mitigation information, wildland and prescribed fire incidents and projects, and links to other regional and national fire management websites.
- Distribute fire prevention and safety information to refuge visitors during fire prevention patrols on the refuge.

4.4.1 Wildfire Investigation and Trespass Policies

The Refuge will investigate all human-caused wildfires at the earliest possible time it can be safely done. Investigations may range from a documented determination of cause by an initial response crew to a criminal investigation by a qualified arson investigator. The Refuge Manager will determine the level of inquiry initially needed, in conjunction with law enforcement officers.

Fire trespass requires a legal/law enforcement investigation and the appropriate local law enforcement authorities should be contacted and standard criminal and/or civil investigative procedures and reports used. The Red Book and the Fire Management Handbook provide detailed information regarding investigation and trespass procedures.

4.4.2 Prevention/Mitigation Program

4.4.2.1 Mitigation Activities

The Refuge will accomplish the goals and priorities identified in the Refuge Wildfire Prevention and Outreach Plan and through the following efforts:

- Integrate the prevention message into interpretive programs conducted or sponsored by the Refuge.
- Make all staff aware of prevention efforts and be able to explain it to other interested parties and individuals calling the Refuge.
- Fire prevention will be discussed at safety meetings, prior to fire season and during periods of high fire danger.
- When available, Refuge employees will assist with local and regional Prevention campaigns.
- Articles concerning fire prevention will be made available for statewide release.
- The Refuge Manager may close areas of the Refuge to smoking, open fires, and access during periods of high/extreme fire danger. Notices will be posted at appropriate entrances, trails and through local radio and news releases.
- The Refuge Fire Management Officer will coordinate with other State and Federal Land Management Agencies in periods of extreme fire danger.

4.4.2.2 Prevention Analysis

As per the Fire Management Handbook, each field office is responsible for performing a prevention analysis. The completed prevention analysis determines the scope, contents and need of the fire prevention plan. Complete the prevention analysis for the same planning cycle used in developing the Fire Management Plan or for the most recent 5 years.

This analysis serves as a justification for increasing, decreasing, and modifying existing prevention activities and helps you determine if a prevention plan is required/or needed. The problems identified in the prevention analysis are addressed in a prevention plan along with recommended solutions.

4.4.3 Education / Outreach Activities

The outreach goal is to enhance knowledge and understanding of wildland fire management policies and practices through internal and external communication and education. Information about fire ecology and the differences between planned and unplanned ignitions will be

incorporated into outreach programs and informal contacts. Information and education are critical to increasing support for prescribed fires.

Education and outreach programs will include components of the nationally sanctioned FIREWISE program. Information about this program is available at: www.firewise.org.

4.4.3.1 Cooperative Meetings

Refuge fire management staff regularly meet with local cooperators identified in Section 2.3 to discuss wildland fire and emergency management topics including prevention, mitigation, education and outreach.

4.4.4 Public Information

Informing the public is an important part of fire suppression, fire prevention, and the FWS mission. During wildfires occurring on Service lands coordination among agencies is crucial in communicating with the public about fire. The following language in the Alaska Statewide Annual Operating Plan provides direction on how this coordination will occur:

- The Protecting Agency and the Incident Management Team, when assigned, are responsible for the release of operational and public safety information to the media and public during the initial response to and during ongoing wildfires.
- The Protecting Agency and Incident Management Team will coordinate with the Jurisdictional Agency on the release of fire information, specific Jurisdictional Agency direction will be stipulated in the Delegation of Authority. Releases will be approved by the Incident Commander prior to release and copies distributed to all stakeholders. Jurisdictional Agency policy and messaging will be included when requested by the agency administrator. Policy questions will be referred to the Jurisdictional Agency. A suggested format for incident news releases can be found in the Alaska Statewide Annual Operating Plan Appendix.
- The following actions may be used to inform the public as part of the Refuge fire prevention and suppression program:
    - Press releases
    - Interviews with local media
    - Signs and interpretive materials
    - Attendance at local volunteer fire department meetings
    - Personal contact with bystanders

5.0 MONITORING AND EVALUATION

5.1 Fire Management Plan Monitoring

Monitoring and evaluation are the functions used to determine if the FMP is being implemented as planned to meet its goals and objectives as well as to determine whether the goals, objectives, strategies, and procedures outlined in the FMP and other plans remain relevant. Through monitoring and

evaluation methods, we seek to better understand the relationships between fire and other Refuge resources. Monitoring also helps us improve our Hazardous fuels treatment techniques, and provides documentation to show how we address our performance measures. This chapter is divided into two primary sections:

- Fire Management Plan Monitoring - covers the five management components in this fire management plan, and provides guidance to insure that our actions within these areas meet the goals of the Refuge and are in compliance with other national and Service policies.
- Treatment Effectiveness Monitoring - focused on the ecological effects that result from fire management on the Refuge.

5.1.1 Annual FMP Review

The Fire Management Plan is monitored for compliance with the National Fire Plan and resulting performance standards, National Wildlife Refuge System, Wildland Fire Management Program Strategic Plan, Alaska Interagency Wildland Fire Management Plan; compatibility with Refuge plans; support of the applicable National Wildlife Refuge promises, and national and regional policies of the Fish and Wildlife Service.

To maintain currency, the FMP must be reviewed each year using the nationally established annual review process. The FMP must be revised when significant changes occur or substantial changes in management are proposed. Minor plan revisions may be accomplished through an amendment added to the plan and signed by the Refuge Manager and Refuge Fire Management Officer. Major scheduled revisions to fire management plans will follow the 15 year Comprehensive Conservation Plan revision cycle to provide consistency in objectives and management strategy formulation. Without a current FMP, prescribed fires cannot be conducted and response to unplanned ignitions can only consider suppression strategies. (FWS FMH 2010)

The following partners should be given the opportunity to review major revisions to the FMP:

- Alaska Department of Natural Resources, Division of Forestry, Kenai-Kodiak Area Office
- Kenai Peninsula Borough, Office of Emergency Management
- Chugach National Forest
- Bureau of Land Management – South Zone

Refuge Fire Management Option Updates

Refuge fire management option maps are reviewed annually. Any changes in response levels or boundaries are submitted to AWFCG by March 15 of each year to allow for incorporation into the Alaska Fire Service's atlas and the map atlas held in the Alaska Interagency Coordination Center for the upcoming fire season.

Refuge Fire Preparedness Plan

The Refuge Preparedness Plan will be reviewed and updated annually. Currently, this plan incorporates the *2013 Kenai-Kodiak Area Preparedness SA Guide* (See: **Appendix J**).

Refuge Known Sites Review and Update

A review of known sites on the Refuge and their default protection level will be completed annually by April 1. Changes will be submitted in accordance with procedures outlined by AWFCG.

The FMP outlines five potentially ground-disturbing fire management activities: suppression, managing wildfire for resource benefits, prescribed fire, hazardous fuels (mechanical) treatments, and emergency stabilization and rehabilitation. All require some level of monitoring and evaluation. These activities usually are conducted according to site-specific incident management or project implementation plans that define specific monitoring goals and objectives. The goals listed in this chapter are not exhaustive and additional goals may be added as circumstances dictate. The Fire Management Officer and staff are responsible for the accomplishment and documentation of monitoring objectives.

Suppression

Suppression activities can range from the surveillance monitoring of Limited fires to ground-disturbing suppression tactics like constructing fire lines with bulldozers to control unwanted fires. Monitoring for any suppression response involves two phases. Phase One is monitoring fire behavior while a fire is active. Phase Two, is monitoring the ecological effects of a fire. During phase one, document the cause, location, size, fuels, management option (Limited, Modified, Full, Critical), spread potential, weather, and smoke characteristics. In addition, document threats, tactics, constraints, public and firefighter safety, cultural resources and other sensitive natural resources. Throughout the duration of the fire, monitor spread, weather, fire behavior, smoke characteristics, potential threats, fire intensity and other information commensurate with the incident management response.

The Phase One implementation monitoring goals for suppression activities are:

- To ensure public and firefighter safety
- To determine if the suppression tactics being employed are compatible with the FMP, refuge plans, and the smoke management plan.
- To determine if there are any critical sites or natural resources threatened.
- To gather daily situation data to validate or change the selected WFDSS decision.

Phase Two, is monitoring the effects the fire had on natural resources (see Fire Effects Monitoring). For fires where ground-disturbing suppression measures are taken to control the fire, these additional monitoring objectives apply:

- Refuge fire staff will investigate the effects of firebreaks cut to mineral soil to determine if the risk of, or actual, erosion potential warrants stabilization measures. Surveillance of firebreaks will occur during the same season as the fire, if possible, and during the following summer.
- Firebreaks will be evaluated within one year of the fire to determine if rehabilitation activities are needed to meet refuge objectives.

Managing Fire for Resource Benefits

Managing a wildfire to meet land and/or natural resource management objectives, or for resource benefits, also involves two phases. Phase One, is monitoring fire behavior while a fire is active; and Phase Two, is monitoring the ecological effects of a fire.

The implementation monitoring goals for resource benefit fires are:

- To determine if the fire will remain within, or exceed the Maximum Manageable Area
- To determine short and long term implementation actions
- To make fire behavior and weather prognoses based upon current and historical fire behavior and weather
- Based upon periodic fire assessments, determine if current implementation actions are valid or need changing

- To determine if the fire is meeting FMP and CCP objectives
- To provide a data platform (in WFDSS) from which to make sound risk management decisions

In Phase Two, the same fire effects monitoring methods and procedures apply.

Emergency Stabilization and Rehabilitation
The implementation monitoring goals for emergency stabilization and rehabilitation are:

- To determine during a wildland fire event if stabilization efforts are required to prevent the further degradation of natural resources.
- To determine what actions of a non-emergency nature are required to rehabilitate a resource, whether man-made or natural.

Due to varied fire characteristics and the conditions under which they burn, monitoring elements should be determined by incident specific attributes. Refer to the Interagency Burned Area Emergency Stabilization and Rehabilitation Handbook.

5.1.2 Fire Effects Monitoring

The long-term monitoring of fire effects and treatment effects has occurred on the Refuge over the past several decades. **Appendix S – Fire Ecology and Fire Regime Shift due to Climate Change** summarizes those monitoring projects and provides maps of plot locations.

The general *goals* of fire effects monitoring may include the following:

- To understand the relationship of fire to the Refuge resources.
- To determine the natural variability of fires on the Refuge, including occurrence, extent, and severity.
- To better understand fire effects in different vegetation/fuel types to develop predictive capabilities for modeling fire distribution, spread, and behavior.
- To monitor the effectiveness of treatments to insure that objectives have been met or document unexpected results.

Specific fire effects monitoring on the Refuge may include the following *activities*:

Wildland fires*:* As described in Section 4.1, wildland fire management activities can range from surveillance/ monitoring of Limited fires to the use of ground-disturbing suppression techniques to control unwanted fires. Monitoring for any protection level involves two phases. Phase 1 monitors the fire while it is active and, for wildfires, is conducted by the Protecting Agency per guidance in the AIWFMP (see section 4.1). Phase 2 monitors the post-fire ecological effects.

During Phase 1, the cause, location, size, fuel model, fire behavior, weather index, potential threats, tactics, constraints, public and firefighter safety are documented. The purpose of monitoring active fires is to determine if the fire meets planning and resource objectives that have been set forth in the WFDSS or other decision document. Effective monitoring provides a basis from which to make decisions regarding risk, threats, and potential resource benefits. Phase 1 monitoring will be documented long-term in WFDSS or other decision documents, Final Fire Reports, and in the ICS-209 system for some staffed fires.

Phase 2 monitoring can examine both short and long-term effects of fire on vegetation, abiotic attributes, and wildlife. Current Refuge objectives are to only conduct post-fire vegetation monitoring if fire occurrence increases beyond the 30-year average (Section 3.1.1). Should this occur, the FMP will be updated with revised objectives and details concerning monitoring methods. Post-fire monitoring may also occur in response to a specific event and may be completed under the auspices of a BAER or BAR plan, as described in sections 4.1 and 4.2 of this document.

The following sources are available for guidance if a post-fire monitoring program is implemented:

- AWFCG Fire Effects Monitoring Protocol. Contains Alaska-specific guidance. http://fire.ak.blm.gov/administration/awfcg_committees.php or http://frames.nacse.org/5000/5585.html
- FWS Fuel and Fire Effects Monitoring Guide. http://www.fws.gov/**fire**/downloads/**monitor**.pdf
- National Park Service Fire Monitoring Handbook. http://www.nps.gov/fire/download/fir_eco_FEMHandbook2003.pdf

Prescribed Fires: As described in Section 4.3, prescribed fire activities are project specific and will include monitoring of site characteristics that influence fire behavior, and whether burn objectives have been met. The prescribed fire plan document should specify the level and elements that will be monitored.

All activities involving fire must be monitored to ensure compliance with the Alaska Enhanced Smoke Management Plan.

5.2 Treatment Effectiveness Monitoring

Prescribed Fire

Prescribed fire will be monitored both during ignition and post burn. During ignition, the Burn Boss will monitor weather, flame length, fuel moistures, rate of spread and spotting component. These parameters are outlined in the individual prescribed fire plan. A visual post burn evaluation of first order fire effects will determine whether objectives such as mortality, hazard fuel loading reduction and mineral soil exposure, were met. The prescribed fire plan will contain an area for a post-burn write up documenting results of the evaluation. More specific monitoring may be done on selected sites. Permanent or semi-permanent plots may be established, or are already established in some areas of the refuge. These plots allow for consistency in measuring pre- and post-burn fuel consumption, fire effects on soils, vegetation and woody fuels, and a variety of other elements.

The implementation monitoring goals for prescribed fire are:

- To determine if prescribe fires are compatible with refuge goals and objectives.
- To determine if prescribed fire plans are adequate to perform a prescribe fire.

Prescribed fire activities are project specific and will include monitoring of site characteristics that influence fire behavior. The following types of information should be obtained pre-burn: fuel loading; topographic influences; drought index, anticipated fire behavior, potential threats to people and resources etc. Prescribed fires will constantly be monitored during the burning phase as outlined in the

projects monitoring specifications. Post-fire assessment would include documentation of fuel reduction and vegetative change including whether the fire meet resource objectives. The level of post fire effects monitoring may be similar to that of suppression or fire use however the burn monitoring plan should specify the level and elements that will be monitored.

All activities involving fire must be in compliance with the Smoke Management Plan (Lawton, 2003).

5.2.1 Fire Effects Monitoring

Fire effects monitoring applies to all aspects of the fire program that involve ground disturbance. The goals of fire effects monitoring are:

- To understand the relationship of fire to refuge resources, especially those dependent on advance seral stage habitats.
- To determine the natural variability of fires on the refuge, including occurrence, extent and severity.
- Establish long-term monitoring sites in vegetation communities or fuel types prevalent on the refuge and under-represented in existing state-wide monitoring efforts.
- Understand fire and treatment effects in different vegetation/fuel types to develop predictive capabilities for modeling fire distribution, spread and behavior.
- Refine fire regime and condition class maps of the refuge as new information becomes available.
- Monitor the effectiveness of our treatments to insure that we have met our project objectives or can document unexpected results.

Until long term monitoring plans are developed, fire effects monitoring is typically limited to collecting pre-burn or pre-treatment data, and for documenting effects within 1 year of the burn or treatment. Project plans should include discussions of which monitoring level would be implemented and should specify funding for monitoring to meet their objectives. The *minimum* variables of the 3 monitoring levels are described below. An approved long-term monitoring plan must be completed if fire funding will be used to monitor sites beyond 1 year from the burn date.

Fire effects monitoring guidelines were developed to complement preliminary recommendations for monitoring by the interagency Alaska Fire Effects Task Group (FETG) as well as FWS monitoring guidelines. Although fire effects monitoring plans need to be designed to meet the specific objectives defined in burn or treatment plans, or in long-term monitoring plans, these guidelines describe the *minimum* set of variables to monitor in 3 levels of monitoring intensity (Levels I – III). Recommended protocols for collecting data for these monitoring variables are found in the FWS Fuel and Fire Effects Monitoring Guide (available on the web at http://fire.r9.fws.gov/ifcc/monitor/RefGuide).

Documentation of burn severity is a useful measure to understand fire effects and to predict vegetation response. Remote sensing techniques may be used to develop burn severity maps for fires greater than 300 acres. The normalized burn ratio technique developed by the NPS is described on the FIREMON website at http://fire.org/firemon/lc.htm. Developing burn severity maps may be applied under monitoring levels II or III described below; however, because of the costs associated with this technique, regional office approval will be obtained prior to implementation. Ground truthing methodology may follow either the NPS protocols or a modified approach that allows for greater sample size depending on the objectives for monitoring.

Level I – Reconnaissance Monitoring. This is the lowest level of monitoring intensity that includes specified variables to be collected for any monitoring project. Level I monitoring is the minimum monitoring level for any prescribed fire or mechanical treatment project. Monitoring of these variables is quickly completed, requiring little or no equipment besides a camera, compass or GPS, and occasionally a shovel. This level of monitoring is appropriate for reconnaissance, and for documentation of well-established treatment techniques that have had more intensive monitoring on past implementation projects on the refuge. Additional variables may need to be included to verify that contract objectives have been met for treatments. These monitoring objectives will be described as part of the treatment plan.

Five variables are identified for rapid data collection in this monitoring level:

- General Site Characteristics
- Latitude and Longitude coordinates
- Representative photos
- Vegetation Classification (Viereck's level V or IV plus ground cover description)
- Fire Regime Condition Class

If monitoring is scheduled to occur within a day or hours of a burn, then duff moisture and fire weather data should also be collected. An estimate of burn severity using Viereck's burn severity classes should be included in post-fire monitoring.

Level II – Moderate Intensity Monitoring. The four variables that are identified for rapid data collection in the low-intensity monitoring category are also included in Level II monitoring with no changes. The differences between the two levels are that more additional vegetation information is collected which can better document the changes in vegetation and fuels. The intent is for these sites to be quickly sampled using primarily ocular estimation techniques.

Level I variables
Tree density (both of live and dead trees), height average by class, and canopy closure
Shrub canopy cover
Species composition (herbaceous/mosses/lichen cover estimates)
Duff depth
Fuel model/type
Burn severity assessment (if applicable)

Duff moisture and fire weather data should also be collected if monitoring is occurring within a day or hours of burning.

This level of monitoring is likely to be the most frequently applied for refuge projects. Additional variables may need to be added to document the effectiveness of treatment activities and will be identified in the monitoring objectives of the project plans.

Level III – Comprehensive Monitoring. This is the most comprehensive monitoring level and would provide the greatest amount of information to track the effects of fire or mechanical treatments over time. This level of monitoring requires a much greater commitment of time and energy. If the objectives are to track changes through time, then an approved long-term monitoring plan should be in place. The variables described in Level I and Level II are included in this monitoring level as well,

however, rather than relying on ocular estimates, the variables are measured more rigorously to improve the data quality.

General Site Characteristics	Shrub canopy cover/density
Latitude and Longitude coordinates	Ladder fuel height
Photo points	Species composition (herbaceous/mosses/lichens – cover estimates)
Photo points	Stand age
Viereck's Level V vegetation class	Height to live crown
Duff depth	Brown's Fuel transects
Tree diameter of live and dead trees	Tree cookies (optional for fire history)
Tree canopy height (measured)	Active Layer depth (season dependent)
Tree canopy closure (by class)	Soil type (if expertise is available)
Tree seedlings/re-sprout density	

An evaluation of burn severity should also be made when monitoring is conducted within a year of burning. For long-term monitoring sites detailed information on burn severity should be collected (for example, the Composite Burn Index protocols by NPS: http://fire.org/firemon/lc.htm).

5.2.2 Non-fire Effects Monitoring

Hazardous Fuels Treatment

These are typically mechanical treatment activities designed to reduce the level of hazardous fuels or to alter vegetation structure and composition to meet refuge resource objectives. The plan implementation monitoring goals for non-fire fuel applications are:

- To determine if non-fire fuel applications are compatible with refuge goals and objectives.
- To determine if fuel treatment plans are adequate to perform a treatment activity.

Fuel treatment activities are project specific and will include monitoring of site characteristics that relate to fuel loading, vegetation change, residual vegetation density, and the anticipated amount of fuel reduction. Fuel treatment activities will constantly be monitoring during the implementation phase as outlined in the project's monitoring specifications. Post-treatment assessment will include documentation of fuel reduction and vegetative change including whether the treatment met resource objectives. The level of post treatment fire effects monitoring may be similar to that of suppression, fire use, or prescribed fire however the treatment monitoring plan should specify the level and elements that will be monitored.

5.2.3 Collaborative Monitoring with other Disciplines

For invasive plant issues and monitoring and control actions, refer to the CCP and the Refuge Integrated Pest Management Plan.

5.2.4 Fuels Treatment Performance Targets

Annual prescribed fire treatments are expected to average between 10 and 100 acres. Prescribed fire plans typically include multiple treatment blocks that may total 200 acres or more in the various treatment blocks. Treatment blocks may be shifted to a new year if conditions or other circumstances do

not allow planned treatments as initially scheduled. Non-fire fuels treatments are expected to average up to 400 acres per year.

5.3 FMP Terminology

The NWCG Glossary provides definitions for many of the technical terms used in this FMP: http://www.nwcg.gov/pms/pubs/glossary

A list of terms used in this FMP includes:

ADEC = Alaska Department of Environmental Conservation
ADF&G = Alaska Department of Fish and Game
AIWFMP = Alaska Interagency Wildland Fire Management Plan
AFS = Alaska Fire Service
AMAC = Alaska Multi-Agency Coordination (Group)
ANCSA = Alaska Native Claims Settlement Act
ANILCA = Alaska National Interest Land Conservation Act
AWFCG = Alaska Wildland Fire Coordinating Group
BIA = Bureau of Indian Affairs
BLM = Bureau of Land Management
BTU = British thermal unit
BUI = buildup index
CBI = Composite Burn Index
CCP = comprehensive conservation plan
CDI = Canadian drought index
CFFDRS =Canadian Forest Fire Danger Rating System
DC = drought code
Department = U.S. Department of the Interior
DM = departmental manual
DMC = drought moisture code
DNR = (State of Alaska) Department of Natural Resources
DOF = (State of Alaska) Division of Forestry
DOI = U.S. Department of the Interior
EA = environmental assessment
EFF = emergency firefighter
EIS = environmental impact statement
FFMC = fine fuel moisture code
FMO = fire management officer
FMP = fire management plan
FMU = fire management unit
FRCC =fire regime and condition class
HFPAS = Hazardous Fuels Prioritization and Allocation System
IMT = Incident Management Team
IQCS = Incident Qualifications and Certification System
MAC = multi-agency coordination
MIST = minimum impact suppression tactics
NEPA = National Environmental Protection Act
NFFL = Northern Forest Fire Laboratory

NFDRS = National Fire Danger Rating System
NFPORS = National Fire Plan Operations & Reporting System
NWR = National Wildlife Refuge
AMD = Aviation Management Directorate
Refuge = Kenai National Wildlife Refuge
RFMC = Regional Fire Management Coordinator
RH = relative humidity
Service = U. S. Fish and Wildlife Service
TES = threatened, endangered and sensitive (species)

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7.0 APPENDICES

A – Executive Summary: Projected Vegetation and Fire Regime Response
B – Categorical Exclusion Forms
C – Cultural Resources Review Request
D – KIDC Operating Plan
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Appendix A

Executive Summary for the Kenai National Wildlife Refuge: Projected Vegetation and Fire Regime Response to Future Climate Change in Alaska

June, 2009

Climate change, and its impacts on fire regimes and evolving vegetation patterns, will present land managers with unique challenges in the decades to come. This document provides a summary of predicted impacts upon the Kenai National Wildlife Refuge and a discussion of ongoing modeling activities aimed at providing definitive statewide and refuge-specific simulation results.

The project is part of a statewide analysis of future vegetation and fire regime response to projected future climate. This work is supported by grants from the National Science Foundation and the Joint Fire Science Program. Additional support has been provided by the UA Scenarios Network for Alaska Planning (SNAP) initiative and from the University of Alaska Fairbanks, US Fish and Wildlife Service, and the National Park Service.

In order to attempt to anticipate the changes likely over the next century, the study first simulated historic fire data based on an empirically derived relationship between climate and fire, and linked those simulated historic fires with the actual recorded fire perimeters for the same period. These "ground-truth-tested" historical simulation results were then applied to the five best performing predicted climate models for Alaska used by the Intergovernmental Panel on Climate Change (2007), as well as to a sixth model scenario that represents a composite of the previous five. These models have been downscaled from a global scale to one covering Alaska at 2km resolution using a well-established technique that incorporates elevation to refine the local models.

We currently hold the most confidence in the simulation results for the interior region of Alaska, which does not include the Kenai National Wildlife Refuge; although continued refinements to the model will increase our confidence in these results, major revisions to account for Kenai's unique position on the edge of two biomes are not currently anticipated. It should be noted that the predictions included in this study become less certain as we look farther into the future, and that it isn't possible, using these data, to simulate either the exact location of future fire occurrence or vegetation type.

These model results were generated using interactions within and between tundra, black spruce, white spruce and deciduous vegetation types; the model does not incorporate Sitka spruce, hemlock or account for the spruce bark beetle outbreak. Nevertheless, we believe that the results can provide some insight into the potential future changes expected on the Kenai Refuge.

In general, we expect climate change to result in substantial increases in landscape flammability during the coming century with temperatures rising approximately 3°C which is less than the 4°C change expected throughout most of Interior Alaska. Precipitation is expected to increase during this time period as well, however, that increase may not be sufficient to counter the increased evaporation and general drying resulting from the higher temperatures.

Preliminary results from the statewide simulations identify consistent trends in projected future fire activity and vegetation response. The simulation results strongly suggest that coniferous forest vegetation will maintain its dominance on the refuge though deciduous vegetation will increase in acreage as fire occurrence increases. The Kenai simulation domain results are similar to the state-wide results though more moderate in both the level of change and the timing of change. This may be due to the fact that the ALFRESCO model consistently underestimated fire occurrence in the Kenai simulation area. This underestimation is probably a result of the documented refuge's fire history which is incomplete in the state-wide large fire history database used in the ALFRESCO model.

Within the simulation area, the northern portion of the refuge region, and the area between Skilak and Tustumena Lakes would seem to be at highest fire risk especially in the latter half of the century. Fire managers should consider how land management objectives may be affected by the predicted changes to natural fire on the landscape. The modeling developed for this study can be used to simulate how changes in fire management may change the potential future landscape. It can also be used to assess how particular vegetation age classes (for example, young deciduous forests or concentrations of older spruce) that may represent habitat conditions for important wildlife resources (such as moose and caribou) may be affected by the fire, vegetation, and climate interactions predicted into the future.

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Appendix B

U.S. FISH AND WILDLIFE SERVICE, REGION 7
STATEMENT OF COMPLIANCE

Project Name:

Location:

Description:

National Environmental Policy Act:

Endangered Species: The proposed action will not affect listed, proposed, or candidate species or adversely modify critical habitat (see attached Section 7 consultation).

Coastal Zone Management Act, Section 307: The Division of Governmental Coordination, State of Alaska, has determined that the proposed action is consistent with the Alaska Coastal Management Program (State Identification No. 9804-19AA).

Coastal Barrier Resources Act, Section 6:

Subsistence Evaluation and Finding, Section 810 – Alaska Lands Act: (see attached Section 810 evaluation).

National Historic Preservation Act, Section 106:

Executive Order 11988 – Floodplain Management:

Executive Order 11990 – Protection of Wetlands:

Executive Order 12372 – Inter-governmental Review of Federal Programs:

Refuge Compatibility Determination:

Directors Order 172: Migratory Birds:

Wilderness:

Public Participation:

Prepared by: _____Date: _____

Reviewed by: _____Date: _____

Concur (Refuge Manager)_____ Date: _____

Attachments

NEPA COMPLIANCE CHECKLIST

Proposal: Date:

Nature of Action:

This Proposal _____is _____is not completely covered by categorical exclusion No(s)._____, 516 DM 6 Appendix 1. *(An appropriate categorical exclusion must be identified before completing the remainder of the checklist. If a categorical exclusion cannot be identified, or the proposal cannot meet the qualifying criteria in the categorical exclusion, an EA must be prepared)*

Exceptions – Will this proposal: (*check (√) yes or no for each item below)*

Have significant adverse effects on public health or safety.	No ____	Yes ____
Have an adverse effect on unique geographic characteristics, historic or cultural resources, park, recreation or refuge lands, wilderness, wild and scenic rivers, sole or principle drinking water aquifers, prime farmlands, wetlands, floodplains, or ecologically significant or critical areas, including those listed on the Departments National Register of Natural Landmarks.	No ____	Yes ____
Have highly controversial environmental effects.	No ____	Yes ____
Have highly uncertain and potentially significant environmental effects or involve unique or unknown environmental risk.	No ____	Yes ____
Establish a precedent for future actions or represent a decision principle about future actions with potentially significant environmental effects.	No ____	Yes ____
Be directly related to other actions with individually insignificant but cumulatively significant environmental effects.	No ____	Yes ____

	____	____
Have adverse effects on properties listed or eligible for listing in the National Historic Places.	No ____	Yes ____
Have adverse effects on species listed or proposed to be listed as endangered or threatened or have adverse effects on designated Critical Habitat for these species.	No ____	Yes ____
Threaten to violate Federal, State, local, or tribal law or requirement imposed for protection of the environment.	No ____	Yes ____
Have material adverse effects on resources requiring compliance with Executive Order 11988(Floodplain Management), Executive Order 11990 (Protection of Wetlands), or the Fish and Wildlife Coordination Act.	No ____	Yes ____

A "yes" to any of the above exceptions will require an EA be prepared
Attach any Supporting Documents:

Preparer's Name and Title:_____
Concur:_____Date: _____
Refuge Manager

U.S. FISH AND WILDLIFE SERVICE, REGION 7
INTRA-SERVICE SECTION 7 EVALUATION FORM[1]

Originator:
Date:

I. Service action:

II. Species list

4.3 Listed species and/or their critical/essential habitat.

4.4 Within the action area that will or may be affected:

2. Within the action area that will not be affected:

B. Proposed species and/or proposed critical habitat.

4.5 Within the action area that will or may be affected:

2. Within the action area that will not be affected:

III. Location and Land Status:

IV. Proposed project description:

V. Anticipated impacts of the action:

Appendix C

CULTURAL RESOURCES REVIEW REQUEST

U.S. FISH AND WILDLIFE SERVICE
REQUEST FOR SECTION 106 NATIONAL HISTORIC PRESERVATION ACT REVIEW

To: Regional Historic Preservation Officer (RHPO), Alaska Region

From: Regional Fire Management Coordinator, Fire Management Branch, Division of Natural Resources, Alaska Region Office

Request No._____ Refuge: _____

Proposed Action: _____Acres:_____

Description:_____
_____

Expected Start Date:_____

On Refuge lands: ____Yes ____No Off Refuge lands: _____Yes _____No

If off Refuge lands – Current Owner(s):_____
Address:_____
Phone Number:_____Fax:_____
Location: Section: _____Township: _____ Range: _____Meridian:____

If off Refuge lands – Current Owner(s):_____
Address:_____
_____
Phone Number: _____Fax:_____
Location: Section: _____Township: _____ Range: _____Meridian: ____

Nearest community:_____

U.S.G.S. Quad Map (attach copy):_____

Remarks: _____

_____ _____
Regional Fire Management Coordinator Date

Appendix D

KIDC Operating Plan

KENAI INTERAGENCY DISPATCH CENTER
STANDARD OPERATING PROCEDURES
2010

ADNR, DIVISION OF FORESTY
KENAI-KODIAK AREA

USDA FOREST SERVICE
CHUGACH NATIONAL FOREST

USDI FISH & WILDLIFE SERVICE
KENAI NATIONAL WILDLIFE REFUGE

DRAFT

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Kenai Interagency Dispatch Center
Standard Operating Procedures

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******* The Table of Contents is still being edited and will be included in a future draft *******

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Appendix B
Dispatch and Supply Plan

KENAI INTERAGENCY DISPATCH CENTER

STANDARD OPERATING PROCEDURES

Purpose: The purpose of this document is to provide guidelines for operation of an Interagency Dispatch Center for all Jurisdictional and Protection Agencies on the Kenai Peninsula. The function of the Dispatch Center is to facilitate preparedness, suppression and dispatch support of resources on the Kenai-Kodiak Area, Chugach National Forest, and U.S. Fish and Wildlife Refuge.

OBJECTIVES:

- Provide a single reporting point and information center for all incidents occurring on or threatening State, Private, Native or Federal Lands within the Kenai Peninsula and Kodiak Archipelago fire protection areas. Promoting efficient operations through interagency cooperation, standard procedures, and shared communications.

- Serve as the primary Dispatch center for the Chugach National Forest, Kenai-Kodiak Area State Forestry and the Kenai- Kodiak National Wildlife Refuges during wildland fire suppression activities.

- Assure that incidents are staffed utilizing the closest forces concept in the most efficient and safest manner possible. Emphasize public and firefighter safety as the top priority in all aspects of operation.

- Provide dispatching services that are sensitive to the different protection boundaries as dictated by the land management allocation and in compliance with management objectives.

- Provide travel coordination for fires, fire-related training, prepositioning of resources in high fire danger, along with the scheduling of administrative flights for all KIDC resources.

- Provide area FMO's with intelligence information for risk assessment, priority setting, staffing levels, and severity.

- Provide dispatch mobilization services for various local, state, federal, and borough resources for fire and other All-Lands-All Hands type incidents. KIDC will use the National Resource Order and Status System (ROSS) for moving all resources within in its boundaries and outside KIDC's area of responsibility.

AGREEMENT TERMS:

The Agencies mutually agree that:

1. The State of Alaska, Forest Service, and Kenai-Kodiak Fish and Wildlife share in the cost of operating and maintaining the Kenai Interagency Dispatch Center (KIDC) as determined by the Annual Operating Plan.

2. Nothing herein shall be considered as obligating any party to expend or as involving the United States in any contract or other obligations for the future payment of money in excess of funding approved and made available for payment under this interagency agreement and modifications thereto.

3. Contracting and disbursement regulations of each agency shall apply.

4. Designated representatives of the participating agencies will prepare, review and/or update an Annual Operating Plan for approval by March 1st of each year. The Annual Operating Plan shall become a part of this agreement.

5. This agreement does not change the terms or practices contained in other fire protection agreements between the said agencies or their fire cooperators.

6. The KIDC staff, regardless of agency affiliation, shall be supervised by the KIDC Center Manager for all matters related to the day-to-day operation of the Center. All Administrative matters shall remain the responsibility of the respective agency. (See Attachment in AOP).

7. An Operations Committee will be established to provide direction and oversight for the KIDC Center Manager. Members of the Operations Committee shall be the FMO's from the Kenai-Kodiak State Forestry, Chugach National Forest Zone/District, and Kenai-Kodiak National Wildlife Refuge.

8. Yearly cost estimates will be available for review by the Board of Directors prior to signing of the Annual Operating Plan.

KIDC LOCATION AND HOURS OF OPERATION:

Location:
42499 Sterling Highway, Soldotna, Alaska 99669

Directions:
From Anchorage travel south on Seward Highway to the Sterling Highway, turn west on the Sterling Highway to mile 92.5 (approximately 1.5 miles from Soldotna), turn left on Par, the State Forestry Offices is on the right and KIDC is located in the front of the second building on the compound.

Office hours:
KIDC will be staffed Monday – Friday 8:00 AM to 16:30 PM February through April 1st, office hours will change to 7 days a week during the Fire season. Fire season hours will be 8:00 AM to 18:00 PM April through August/September depending on the fire activity. Operational hours may be extended each day based on the weather indices and fire danger. The Dispatch center may be closed from October to February.

KIDC Phone numbers:

Fire Emergencies:	**907-260-FIRE (3473)**
Main Dispatch number is	907-260-4232
Center Manager	907-260-4230
Assistant Center Manager	907-260-4237
Dispatcher on Call cell	907-398-2183
After hours emergency call	**911**

After Hours Fire Reporting:
After hours fire phone calls go through Alaska State Troopers 911 dispatch. Troopers will notify a Dispatcher on call at 398-2183. The dispatcher for KIDC will notify the appropriate protection agency FMO.

Duty Officers

A duty officer list from each agency will be kept by the KIDC Assistant Manager. The duty officer's names from each agency and initial attack resources will be reported to KIDC daily. The KIDC Assistant Manager will maintain a current roster of agency duty officers on the resource status board in the IA area. The desk reference book will have the lists of duty officers from all the state and federal levels needed.

KENAI INTERAGENCY DISPATCH ORGANIZATION

KIDC is an interagency dispatch center. Programmatic supervision is provided by the Operations Group on behalf of the three agency administrators. The Fire Management Officers of these agencies: the Chugach National Forest, Kenai-Kodiak Area State

Forestry, and the Kenai National Wildlife Refuge comprise the Operations Group that supervises the Center Manager.

Direct supervision of KIDC operations and supervision of KIDC personnel is the responsibility of the Center Manager. The Assistant Center manager will assist the Center Manager with the direction of the initial attack personnel; develop work schedules, assignment of duties, training, technical assistance and support. The Center Manager will be responsible for the oversight of initial attack activities, fire business needs and large fire support, performance monitoring and evaluation feedback. Performance evaluations and personnel issues will be the responsibility of the employee's home agency. See Section __ KIDC Job Descriptions on page __ for more information on each position.

The employee's agency supervisor is responsible for managing hiring, payroll and other official personnel actions. Employees are subject to the policy and procedures affecting pay, leave, benefits, and other personnel factors that are established by their employing agency. Employee performance problems that may warrant official action will be referred to that person's agency. Each agency is responsible for certifying the red card qualifications of its personnel. Documentation of qualification is maintained at each agency. Red cards will be issued by the home unit training officers.

All positions from each member agency that are physically assigned to KIDC may also perform work that is specific to their employing agency. This work may take place at KIDC or other locations as the KIDC workload permits.

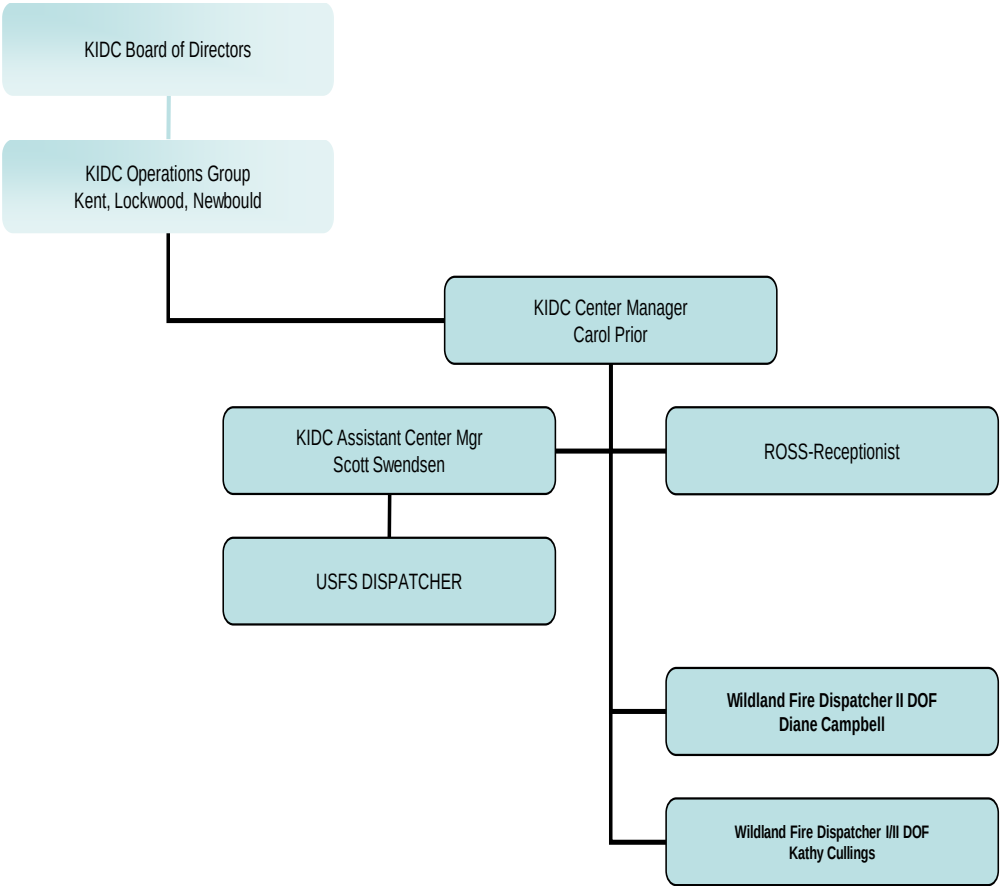
KIDC staffing for initial attack will be rotated with all qualified staff through the assistant center manager. Initial attack dispatchers will work collaboratively and cooperatively on an equal basis, without regard to agency affiliation or other status. The assistant manager will prepare a dispatcher schedule; make specific assignments to KIDC staff and direct work tasks based on volume and complexity of business. A **Dispatcher on Call** is assigned a weekly schedule developed by the KIDC Center Manager. The on-call dispatcher is responsible to be available 24-hours and may be contacted for any dispatch needs when the center is not staffed. The Duty Officer schedule will be made available to the on-call person when the schedule changes.

KIDC ORGANIZATION

KIDC is an interagency dispatch center. The direct supervision of KIDC projects operations and work assignments of personnel is the responsibility of the Center Manager.

A general organizational structure of KIDC is included.

Kenai Interagency Dispatch Center (KIDC) Organization Chart



Staffing and Scheduling

The Center Manager has the overall responsibility to ensure adequate coverage for the anticipated workload. The Center Manager and Assistant Manager will determine current and anticipated support needs to provide staffing commensurate to the agency preparedness levels typical of the season. Interim adjustments in schedules will be made as warranted by fire conditions or personnel needs, such as off-unit assignment, leave and illness.

Work schedules for KIDC personnel for the full operation period (April through September) and the spring/fall periods will be developed by the Assistant Center

Manager and provided to each employee and agency supervisor on a monthly basis. KIDC personnel will be given the opportunity to provide input regarding work schedules.

Extended Hours and Overtime

Whenever possible the Center Manager will plan, schedule and monitor work hours and anticipate extended duty requirements for appropriate staffing. Additional personnel such as support dispatchers, dispatch clerks, or a receptionist may be ordered when the need arises or fire conditions warrant.

Emergency work hours and overtime will be distributed among the staff based on duty-day scheduling, hours previously worked in the day and work/rest guidelines, and the need for specific assignments or task accomplishments. There may not be a correlation between the agency experiencing fire activity and the agency of the KIDC on-call personnel**. Overtime for preparedness staffing or other circumstances that cannot be directly charged to a fire incident must be approved by the respective employee's agency supervisor.**

Work-Rest and Length of Commitment:

The Center Manager will ensure that all center staff, including both regular and emergency support personnel, adheres to NWCG guidelines for work/rest ratio and length of commitment. Those guidelines require one hour of rest or sleep for every two hours worked. During periods of extended activity, employees will take a minimum of one full day off within 21 days.

Shift lengths for KIDC staff should not exceed 12 hours under most circumstances. When required by emergency fire situations or continuity of responsibility for the safety of personnel or resources, work shifts may exceed 12 hours. The Center manager or agency administrator's representative must provide written approval for all shifts that exceed 16 hours.

Each employee shall be allowed two (2) paid fifteen minute breaks in a normal work day. There will also be a lunch break of ½ hour unpaid each work day. Whenever a dispatcher leaves the dispatch area for breaks he/she must inform the floor supervisor so duties can be covered and the employee can be contacted if an emergency occurs.

Expanded Dispatch

At any time that the KIDC volume of business or complexity of business increases beyond the reasonable capability of the scheduled staffing level, the Center Manager or Assistant Manager will order additional personnel to extend the hours of operation or scope of operation to provide safe, effective and efficient service to the member-agencies.

For increased initial attack workload, the Center Manager will arrange for additional staff and hours of operation with adjusted scheduling for employees as required.

For support to one or more large incidents, the Center Manager will work through SLC (State Logistics Center) or local unit Managers to implement the KIDC Expanded Dispatch Operating Plan. (See appendix ___, Expanded Dispatch Plan.)

When the KIDC expanded dispatch organization becomes operational, the Center Manager will assume the supervision of both the initial attack dispatch organization and the local expanded dispatch organization, unless State Logistics becomes the Expanded Dispatch organization. The Assistant Center Manager will assume the direct supervision of the IA function and the KIDC organization under the direction of the Center Manager, while Expanded Dispatch is in operation.

Strategy for Increased Dispatch Work Load

During normal fire season dispatch staffing is set at a level to handle the routine administrative work and general fire occurrence.

If the fire load, volume or complexity, increases beyond the normal workload it will be necessary to increase KIDC staffing according to the Fire Preparedness Staffing and Action Guide. It is the responsibility of the Center Manager and Assistant Center Manager to monitor situations and obtain additional personnel or other resources; and notify the KIDC Operations Group.

The Center Manager will maintain a roster of local agency personnel who are qualified and available to assist with an increased workload. If necessary, additional personnel may be ordered from out-of-area through the resource ordering system. See Appendix ___ Expanded Dispatch Plan.

DISPATCH PROCEDURES:

Daily Procedures:

Daily procedures and instructions for the routine operations of KIDC as well as most job aides and forms used by dispatchers are available in the Kenai Interagency Dispatch Desk Reference Handbook. The Handbook can be found in the dispatch library and in the Center Manager's office. KIDC will follow all guidelines set in Exhibit C of the AMCWFM.

Interagency Resources:

All agency personnel will function under the host agency Health and Safety, Air Operations policies and procedures. During the fire season, each Jurisdictional and Protecting agency will determine what resources are available for IA or incident assignments and notify KIDC through a daily staffing information sheet.

KIDC dispatch center handles all initial attack dispatching of resources for the participating agencies. All radio communications are directed to Dispatch. KIDC is responsible for assigning resources to incidents based on the management fire protection level.

KIDC Initial Attack dispatchers will coordinate with the FMO and Suppression Foreman as soon as possible in assigning additional resources to respond to the fire call. **FIRE PERSONNEL SHOULD NOT SELF DISPATCH.** If someone becomes aware of an incident they should notify dispatch and provide as much information as possible so the closest resources can be dispatched. Responding units will be given instructions on location, and size-up as soon as the dispatcher gets the initial report. The first unit on the scene is responsible to give the best size-up they can, assign an Incident Commander and give the information over the radio so all responding personnel including dispatch, know what the conditions are. It is imperative that dispatch get latitude and longitude reading immediately to process requests for aerial support, fire numbers, and to determine land ownership and fire protection level.

During initial attack or extended attack situations, personnel may be asked to leave the dispatch area. Dispatch is confined to small spaces and the extra conversations are distracting and interfere with over-the-air transmissions. These background distractions affect the ability of the field personnel to hear instructions. Please refrain from entering dispatch unless requested to do so during a fire emergency.

In the event a situation becomes a possible Type I or II fire, and an Incident Management Team is needed, then KIDC may become the Expanded Dispatch Center or request the State Logistics Center to aide in the process of setting up an Expanded Dispatch. The Center Manager has the responsibility to contact the appropriate Agency Administrators and set the process in motion.

During an incident, the IC, or his representative, must notify dispatch of his intentions to stay out late, or overnight, by 18:00 so staffing can be adjusted to either keep a KIDC dispatcher on duty or on call by phone for the safety of field personnel.

Tactical Aircraft:

All agencies participate in a Statewide Tactical meeting to discuss the needs for the day and availability of tactical resources. That meeting is held on a conference call and starts at 10AM. **Mutual Support of Tactical** resources may be made by the Protection agency from a neighboring area for IA without a Resource order being processed for the first shift. All Incident orders must go through dispatch and are ordered through the TTY. The IC must be specific of any threats: primary residence, outbuildings, and fuel tanks, anything that can help determine the priority of resource allocations. (Helitack will be sent as soon as it is needed.) All other air resources need to be requested through the state TTY (teletype) system. Aircraft assigned to an incident will be flight followed in dispatch by radio and Automated Flight Following (AFF) until positive contact has been made at the incident. It is the IC's responsibility to notify dispatch when aircraft arrive on scene

and is in contact with the fire. It is the responsibility of the IC (or air attack) to notify dispatch of any aircraft leaving the incident. Pilots must check in by radio at least every 30 minutes while in flight to and from the incident. NOTE: If aircraft is on a USFS mission the pilot is required to check in every 15 minutes.

ORDERING:

Ordering procedures for an active fire will be established between the IC (or designated representative) and Dispatch as soon as possible. The IC must be specific on the types, numbers, date and times needed for resources to be ordered (i.e. Type 6 engine, Air-tanker, Air Attack, Type II Crew). Consolidate orders as much as possible; provide accurate instructions of where the resources are to be delivered and a contact name and number. The IC or his designee will establish a communication time with dispatch to relay resupply orders twice daily.

There may be a 24 hour delay for out-of-area resources. Name requests for personnel must be approved by the FMO and local supervisors. Crews that are not road-side accessible do not always come equipped. Dispatch should verify order for crews with the IC to assure whether the crews are to come equipped or if tools need to be ordered.

If the IC, or his representative, signs up any equipment on the incident, an initial inspection of the equipment, a rate of pay and start time must be agreed upon. If the IC needs help with the equipment sign up he/she should request assistance. There is only a 48 hour emergency hire after that time the equipment **must** be signed up under an EERA agreement. (Instructions for doing an EERA in the field can be found in Appendix ___.)

ROSS (Resource Ordering and Status System)

All resources, (overhead, crews, aircraft, equipment) will be ordered through the ROSS data system. It is the responsibility of the KIDC dispatchers to enter and status local resources into the data base. Incidents will be created in the system and all resources are tracked on each fire incident. Supplies orders will be submitted on hard copy and faxed to the Palmer warehouse for filling. Supplies will be discussed more in the Dispatch and Supply Plan. (Appendix B)

Resources ordered in ROSS must be backed by a General Message (ICS-213), or some other documentation that provides the origin of the request. It is imperative that a manager or Incident Commander generate the order. Documentation on the resource order must include date and time needed, delivery point, and to whom the order should be sent when filled. Initial attack orders that come over the radio must be documented on the radio log. The dispatcher will fill out a general message with items requested, who placed the order and who received the order.

EMERGENCY PROCEDURES

The KIDC will take the lead in any incident emergency medical evacuation. KIDC will work with the 911 Trooper Emergency Dispatch to send ambulance, medics, or any other medical needs. The nearest Life Flight Helicopter is based in Soldotna at Central Peninsula Hospital (Refer to the Medical Plan for the procedure and contact numbers.)

For Medical emergencies the Incident Commander will:

1) Declare an Emergency Medical Incident and request that non-emergency radio traffic be suspended.
2) Provide the name of the Medical Unit Leader or IC.
3) State clearly what your emergency is and what your needs are: i.e. medical transport, paramedics, etc. Do not state names of injured personnel over the radio.
4) Make sure that all fire-line personnel are aware of the Medical Plan and follow procedures.

Local fire departments must be dispatched through their 911 dispatch center to render aid. The IC must be specific on which fire departments to contact and the type of assistance needed from them. KIDC dispatchers will then notify the fire department's dispatch center.

FIRE RELATED TRAVEL

Fire travel for Overhead resources ordered will be handled by the appropriate sending agency KIDC dispatcher. The individual's agency dispatcher will set up travel with their travel agent for mobilization to a fire. KIDC dispatchers will be responsible for setting up air travel, car rentals, meals and lodging during travel. Approval for a rental vehicle, cell phones, or computers, must be documented on the resource order from the "ordering incident". Per diem or subsistence should be set up by the "ordering incident". Normally there is not enough time for travel advances so personnel should be able to subsist themselves until reaching the incident. When arriving at the incident, all resources will follow that agency's requirements when staying at the incident base or other location.

The incident dispatch and incident demob personnel coordinate return travel. Deviation from direct returns after release from an assignment requires the employee's supervisor pre-approval. Any additional expense associated with travel interruption or deviation from provided travel, including compensation for travel time, for employee convenience will be paid by the employee. Refer to the AIBMH, Chapter 9 for direction.

KIDC dispatchers will be responsible for arranging meals and lodging for out-of-area fire personnel on preposition orders. It should be the choice of the individual to be on subsistence or per diem except for lodging. There will be a dispatch log kept for lodging and meal coupons issued. Individuals are not automatically entitled to stay in a hotel/motel, eat meals at restaurants, or claim per diem. It will be the decision of the hosting unit.

DEMOB PROCEDURES:

The IC should give dispatch notice of demob plans as soon as possible. It is especially important during extended attack fires to provide dispatch at least 24 hour notice to set up transportation. The IC, or his designee, is responsible for closing out with all resources and completing evaluations, shift tickets, timesheets, and inspections. This should include all release dates and times of equipment, other agency fire apparatus, aircraft, and personnel. On small fires this may only involve notifying dispatch of the departure of the responding engine and crew. However, on large extended attack fires, sufficient lead time to dispatch becomes more important for the demob of all resources. Arrangements will be made for all fire-line hardware and equipment that was used to be sent directly to Palmer warehouse for rehab and not returned to the local cache.

The IC should notify the KIDC dispatcher when the fire is going to be called out or put in monitor status. Fires that are put in monitor status must be checked a minimum of two days after the last resources are off the fire. It should be declared out as soon as possible unless agreed with the local FMO to remain in monitor status. This helps to stay on target with the fire reports and not miss the IC's timeline to complete the field fire report.

FIRE INFORMATION/PREDICTIVE SERVICES

Fire information for the agencies included in the KIDC zone will be managed through the agency PIO's (Public Information Officers). Normally, KIDC will not assume the role to be the primary source for fire information. During low preparedness levels basic information regarding fire danger conditions and initial attack activity may be provided by KIDC personnel. The local Prevention or PIO will be responsible for providing incident information to the public when higher preparedness levels or the fire activity increases.

Fire Intelligence/ Predictive Services

There are several sources for current and predicted assessments of fire activity available. KIDC Dispatch can provide copies of State and National Situation Reports, Fire Weather reports, current Burning Information, and current preparedness levels.

Daily weather briefings are provided by AFS/AICC meteorologists by telephone and internet. KIDC dispatchers will keep daily weather records and enter information into the WIMS system for fire danger predictions. See the desk reference guide for the WIMS entry directions for each agency. Weather will be taken at 08:00 am and 14:00 pm at the manual station, and input into the online programs (WIMS, Google Docs Wx Obs) which feed into AICC and the National Weather Service. Special spot weather forecasts will be collected when needed for fire activity.

Preparedness Levels

Preparedness levels are established throughout the year. Preparedness levels are determined by burning conditions, fire activity, and resources available. Preparedness levels are established to guide fire management readiness and response actions at each level- National, geographic area, and local unit, to ensure the most appropriate response to existing and potential wildland fire occurrences. KIDC dispatchers will collect weather information and provide that information to the FMO's, who make the final decision on the preparedness level. DOF uses the "Fire Preparedness Staffing and Action Guide" and the USFS uses the "Zone Incident Management and Support Plan (ZIMS)".

Fire Dispatch Operations

KIDC Center Manager or Assistant Center Manager will insure landowner notifications are made as soon as possible on any land under Federal Jurisdiction of Alaska Native Land and a WFDSS entry by the Protecting Agency is required as part of that notification process. The landowners' representatives can make determination of proper suppression action if the incident is in Moderate or Limited protection. Refer to the Master agreement for proper notification procedures, (ASAOP 2010, C-20).

Automated Dispatch Procedures:

The state of Alaska, DOF has entered into an agreement to contract with the Selkirk-Systems Automated Dispatch program. Starting the spring of 2011 KIDC will use the new Selkirk program to do all dispatching. That means the IA dispatching will be done by using the computer system for the radio logs, Dispatch Fire Report, TTY reporting, and resource tracking. The incident commander (IC) is responsible for completing the Field Incident Report and submitting that document to the dispatch center within 5 days of the fire being called out. The IC will enter the report into the FRS for state fires the USFS dispatcher will enter information into the FIRESTAT reporting system. If any additional or specific information is required, it is the responsibility of the protecting agency to inform KIDC of what information is needed, and the standard for reporting it. KIDC dispatchers must have fire folders complete and sent to SLC within ten days on all state fires.

Closest Forces Concept:

The Protection Agency FMO will direct the KIDC dispatch of the closest available resources in accordance with the AIWFMP. Operation control of wildfires is the responsibility of the Protecting Agency FMO. The FMO will advise dispatch of the resources to assign and what additional resources are needed. However, it must be agreed ahead of time that the IA dispatcher has the latitude to send the closest resources for a quick Initial Attack response and then follow through with the FMO.

Decision Process:

Decisions for extended response, non-standard responses and escaped prescribed fires will be documented using WFDSS and will support the objectives listed in the AIWFMP and the Unit Fire Management Plans. (Alaska Master Cooperative Wildland Fire Management Agreement 2010, AOP, AppendixC,pg.C-21).

Fire Numbering System:
Fires will be assigned a statewide incident number for lands under state jurisdiction. (**Remember all incidents will need a Fire Code for the USFS dispatcher working the fire if it is not on Federal land**.) This number is assigned through AICC and is requested through dispatch on the TTY. It is important that the IC provide the correct Latitude and Longitude (in degrees, and decimal-minutes) to dispatch to check the management /protection level, ownership, and request a fire number. All fires are referred to by this number. A name may be given to the fire, however the State accounting system references the fire number for cost accounting records.

For fires located within the Chugach N.F. protection zone, fire charge codes are not assigned by AICC; however, the Forest Service will request a sequential fire number from AICC for tracking purposes. The CGF is annually assigned an ABCD Miscellaneous code to be used for: Initial attack, false alarms and extended attack fires that are <u>less than</u> 300 acres (except as noted below).

A unique P code will be generated from the Firecode program by a KIDC dispatcher for:

* Wildfire incidents of 300 acres or more
*Type I or Type 2 IMT is ordered
*Type 3 organization is used
* Fire Use Management Team is used.
*Trespass Fires
*Expected reimbursement
*Cost Share

A corresponding state fire number will be requested from AICC for any incidents that state personnel respond to outside of the Mutual Response Area (MRA) or for fires within the MRA after the first 24 hours.

COMMUNICATIONS

Radio Communications:

All agencies will adhere to all Federal Communications Commission and DOI office of Telecommunications policy and internal agency rules and regulations pertinent to utilization of Frequencies. Each Agency maintains a narrowband VHF radio system for the purpose of supporting fire management operations and non-fire administrative functions. This system is a “line of site” and/or “range” two-way radio that requires use of repeaters. Refer to the local Communications Plan for the details of the plan. When in operation, the KIDC will serve as the communication center for the Kenai Peninsula fire operations. The system provides a means of communication with all Agencies involved, through the local frequency sharing, and the new ALMR (Alaska Land Mobile Radio) system. The ALMR system is a trunked, VHF, digital radio system designed to provide secure communications for first responders and public safety personnel. ALMR is based on a cooperative partnership across federal, state and local jurisdictions to build and

operate an interoperable trunked radio system. It is possible to "Patch" in the local cooperator's frequencies when needed; however, ALMR limits the scanning capability.

Radio Traffic Priorities:

1. Communications involving injury, death, or imminent danger.
2. Public emergencies and threats to public safety.
3. New fire or smoke reports.
4. Active fire suppression communications.
5. Regular local operations and business.

Radio Communications Basics:

1. Follow radio traffic priorities.
2. Be familiar with local talk groups and coverage areas, (see the Frequency Guide Book produced annually).
3. Formulate a clear and concise message before you attempt to transmit. **Plain language (clear text) is to be used in all radio transmissions.** The use of codes tends to be Agency specific and can be a means of confusion and miscommunication.
4. Listen before you press the PTT (Press to Talk) switch to be sure the channel is clear. Wait 2-3 seconds after pressing the PTT switch before you begin speaking, holding the microphone 1-2 inches from your mouth.
5. In an emergency situation communications are absolutely critical and the need for clarity and understanding by all involved is imperative. KIDC dispatchers will declare that an emergency situation exists on an affected frequency and will ask that non-emergency traffic be suspended until notice of the end of the emergency is given.
6. Identify the unit you are calling, your call-sign and the channel you are transmitting on.
7. Sign-off and clear the channel when you are done.

Refer to the Communication Plan for a list of Frequency Groups. The USFS, USFWS and the State will share frequencies as already agreed upon in the Annual Operating Plan.

Resource Designators:

KIDC will be referred as **"KIDC Dispatch"** for radio communications. **DO NOT** use Soldotna Dispatch (AST designator), or Forestry Dispatch (USFWL, KNWR's designator). Last names will be used by field personnel (Smith, Jones) and Engines will use their unit designator; i.e. Engine K-60, Engine -31. Inform dispatch when you are changing channels or on a different repeater

Field Communications:

For safety reasons, field personnel are to maintain communications with the dispatch center at all times. Personnel should check in with dispatch via the radio when leaving the station, changing locations, arrival on and departure from the scene, and arrival back at the station. Use of cell phones is acceptable when radio communications are not clear, or the frequencies are busy with fire traffic.

Personnel should monitor their radios at all times in the field, or establish a regular check in time to receive critical safety information. Supervisors and crew leaders need to be sure that all personnel know how to use the communication equipment, how to make contact in an emergency situation and what medevac procedures would be in their specific location. If a medical emergency occurs, all effort should be made to prevent broadcasting the patient's name over the radio.

In the event field personnel encounter hostile individuals in the field and they require immediate assistance for personal safety, they should clearly broadcast the code word of "TROOPERS". When the code word has been used, KIDC dispatch will immediately alert 911-dispatch of the personnel's situation and location.

Communication Logs:

All radio and telephone communications to and from KIDC that relate to an incident or resource status and welfare, will be entered by the dispatcher handling the communication on the Selkirk system or local radio log. Each dispatcher will be provided with access to a computer and will maintain it during their duty period. The Center Manager or the Assistant Manager will monitor entries and ensure that all pertinent communications are documented and important information is properly emphasized in the documentation.

Command channel radio traffic will be recorded on tape and retained for 30 days or longer if needed for any incident. Telephone calls to report fires or to communicate other detailed information will also be logged by the KIDC dispatcher handling the call. Please note that all calls including false alarms, should be recorded the radio dispatch log, for future reference. The dispatch log becomes a legal document in any fire investigation. The log should be legible and consist of complete thoughts. If abbreviations are used due to time constraints, go back and clarify the abbreviations when the emergency traffic slows and time permits.

Cell Phones and Satellite Phones can be used when available to help cut down on radio traffic for non-emergency traffic. A cell phone is assigned to each engine as well as to the majority of the technicians. The satellite phones in dispatch are to be issued for fires only. Cell phones should be used for logistical requests, resource orders and delivery confirmations, communicating the information for the night reports or 209s, and any personal information. Use of cell phones in these instances will allow for less cluttered airspace and also for confidentiality if transmitting personal information. All cell phone communications with Dispatch will be documented on a unit log.

FAX and E-Mail:

Morning weather, staffing, and State and National Situation reports, should be transmitted to cooperating agencies either by Fax or E-mail. KIDC will establish and maintain a list of contacts for intra-office and interagency communications. Electronic

mail will be used to communicate routine correspondence; however when urgent communications requiring immediate awareness and action are required, the KIDC duty dispatcher will initiate those communications by telephone or radio. The duty dispatcher may follow up with an electronic e-mail and "cc" the message to all who should get the message, including themselves for records. The KIDC fax number is 907-260-4236.

Intra-Office Communications:

A critical component of the dispatch center is effective intra-office communications. It is imperative that the KIDC staff share information among themselves and others as needed. The Center Manager or Assistant Manager are responsible to ensure that dispatcher shifts and schedules include briefings of significant activities, events, work-in-progress, tasks to be carried forward and assignment of responsibilities. The KIDC staffing schedule will include at least one day a week that all regularly assigned dispatch staff are on-duty, during which the Center Manager will hold a staff meeting.

The Initial Attack dispatcher will represent dispatch at the morning briefings with Operations. Other dispatchers may attend depending on the workload. Dispatchers will provide information on the Tactical resources, weather information, situation reports, and the status of resources going on fire assignments. Those attending shall return with any updates to staffing changes or needs, job assignments for the day, and update dispatch staff and the IA boards accordingly. A minimal 15 minute briefing should be held after the OPS briefing to discuss any changes or work schedules.

Daily unit logs (ICS 214) will be kept to help debrief others when there is extended staffing, or double shifts working. The General Message (ICS-213) or the Transportation meals and lodging form will be used to track resources ordered, meals, lodging, and transportation needs, and reporting incident requests. Copies of phone logs or radio logs help keep track of activities during an incident, and will become part of the fire folder.

Computers:

Each station will have computer access to accomplish daily duties. It is the responsibility of each dispatcher to have the list of common web-sites to collect daily information, keep updated information on passwords, and be ready to share your station with others in extended fire activity. Each dispatcher will have security access to their e-mail accounts by setting up a separate user account for e-mail. The Center Manager and Assistant Manager will have a list of all computer passwords kept secure in case of emergencies. The ROSS computer will be kept especially for resource ordering and warehouse use as needed. When necessary, most of the ordering should be done at that station, unless expanded dispatch is activated.

Weather/WIMS

Daily weather briefing will be held at 9:30 AM and should be broadcast in the conference room for everyone to see. It will be the dispatcher's responsibility to download daily

weather maps and run the briefing. Dispatchers should print off the National weather for the local area every morning. The local weather readings from our RAWS station needs to be entered into the Google Docs both morning and afternoon. The weather entries for all the RAWS stations need to be entered into WIMS (Weather Information Management System), every day at 1400.

KIDC Desk Reference Guide

The Kenai Interagency Dispatch Center (KIDC) desk reference is a compilation of the standard operating procedures guide for personnel working in the KIDC center. The Desk Reference guide contains directories, lists, SOPs and other pertinent information used to accomplish routine daily procedures of the center.

KIDC Position Descriptions

****Position descriptions are still being developed and will be included in a future draft.*

Appendix E

Community Wildfire Protection Plan (CWPP) Base Maps:

- **Cooper Landing**
- **Diamond Ridge/Fritz Creek/Fox River**
- **Funny River**
- **Kalifornsky/Kasilof/Cohoe/Clam Gulch**
- **Kenai**
- **Nikiski/Salamatof/Grey Cliffs**
- **Ninilchik/Ninilchik Forties**
- **Soldotna/Ridgeway**
- **Sterling**

Community of Interest (COI) Maps

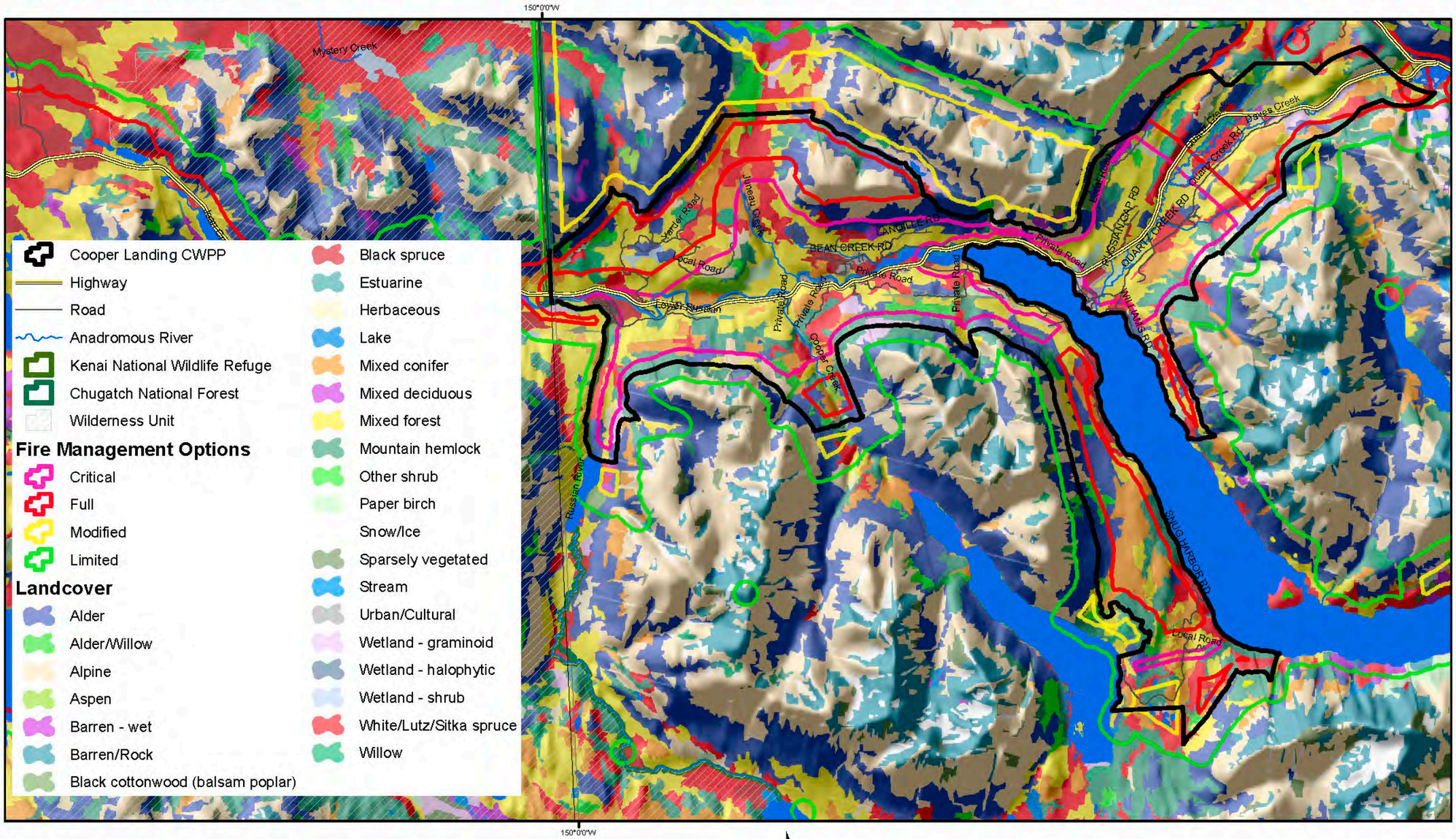
- **Swanson River Oil Field**
- **Beaver Creek Oil Field**
- **Moose Research Center**

Appendix E: Cooper Landing

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Cooper Landing CWPP Landcover



Produced By: Dawn Magness
11/28/2012

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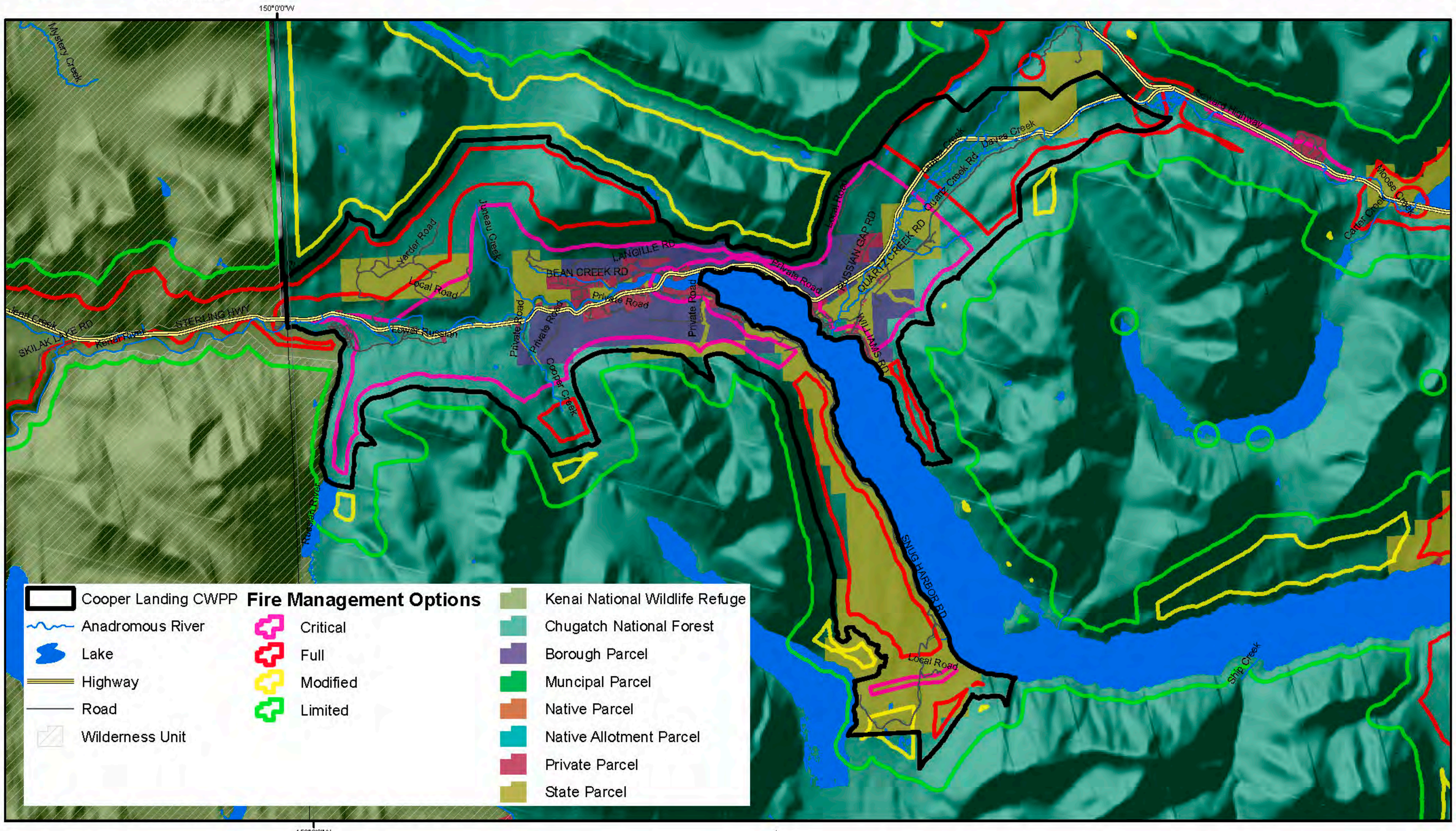
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Cooper Landing CWPP Landuse



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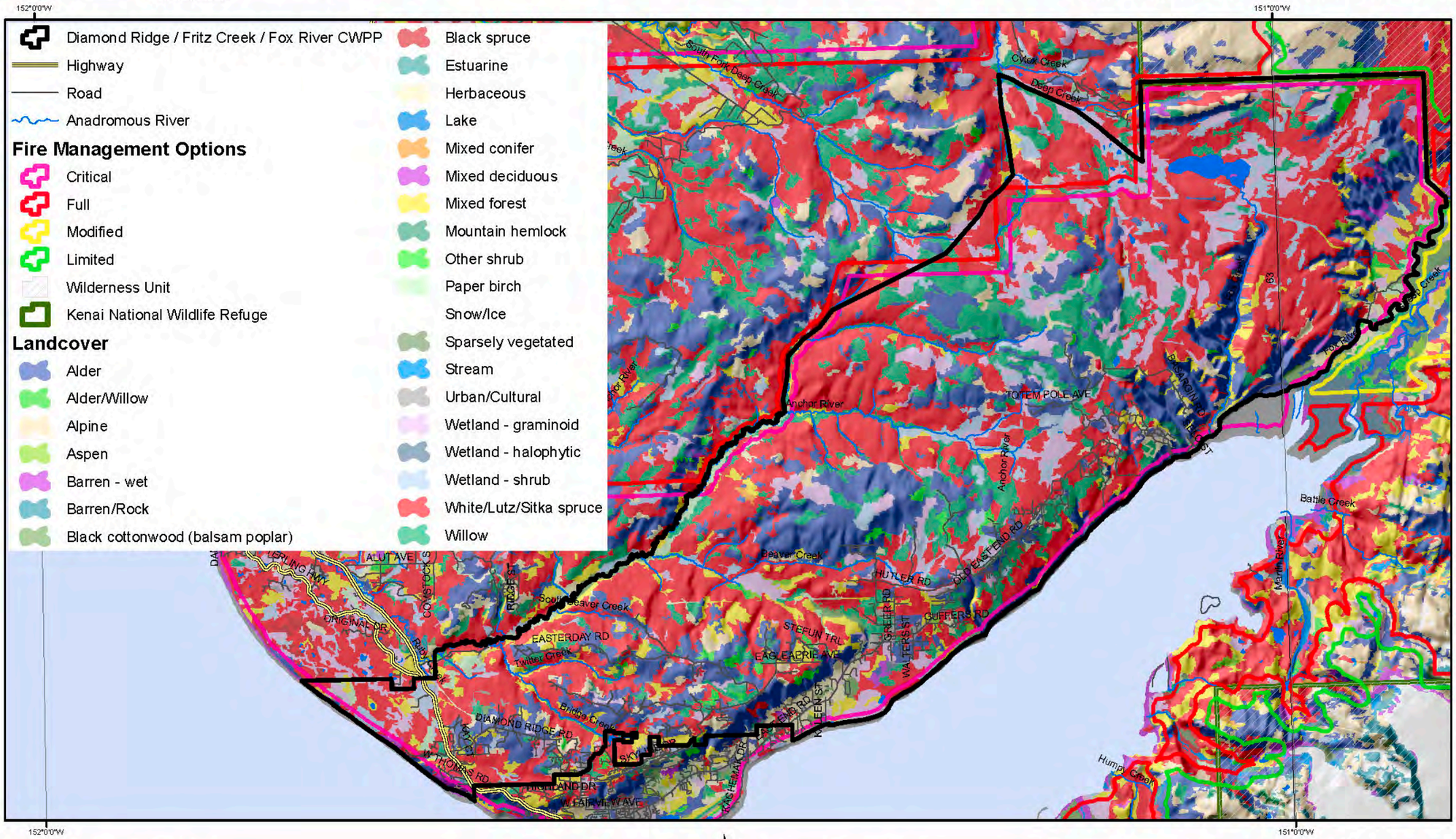
Appendix E: Diamond Ridge, Fritz Creek, and Fox River

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Diamond Ridge / Fritz Creek / Fox River CWPP Landcover



Produced By: Dawn Magness
11/28/2012

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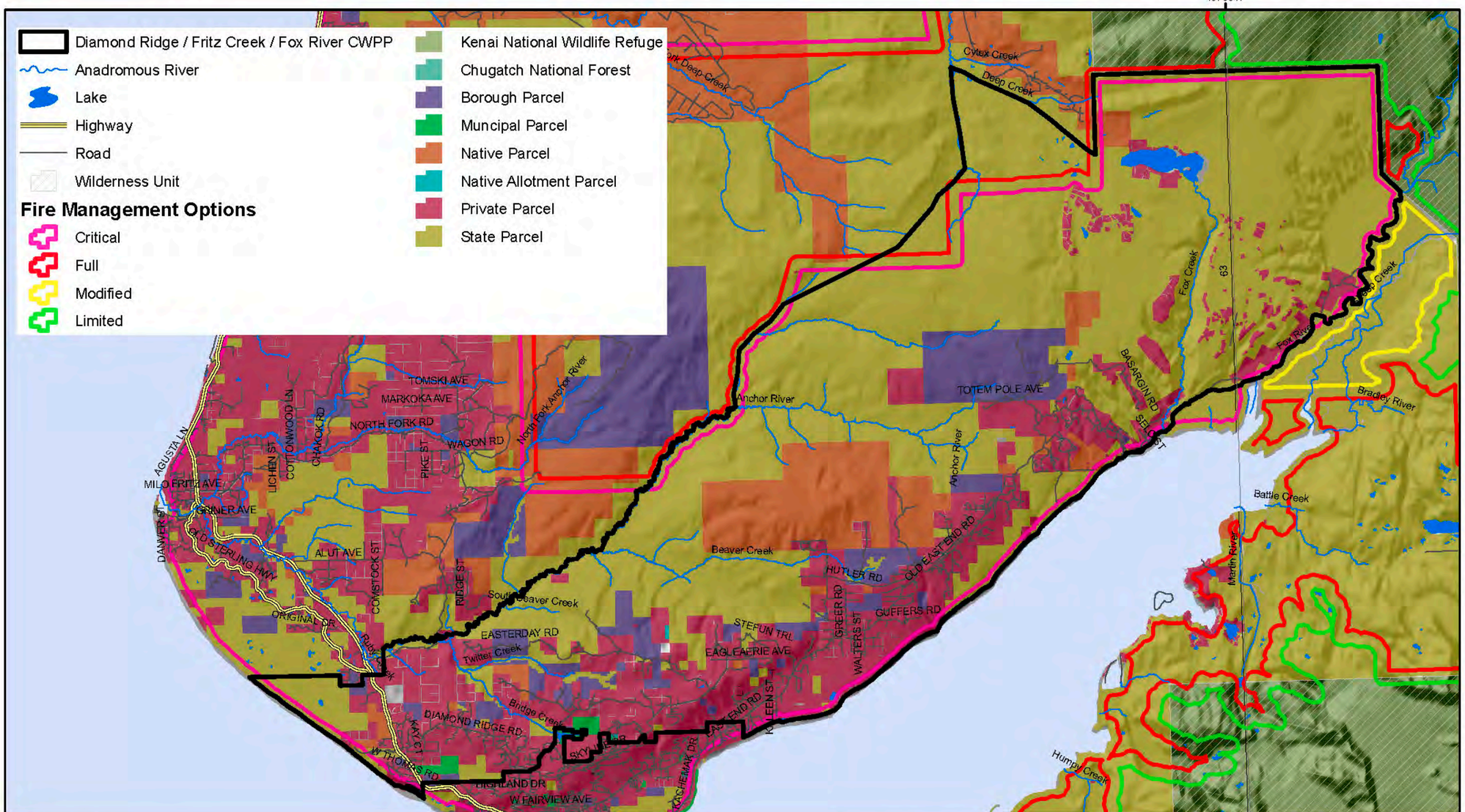
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Diamond Ridge / Fritz Creek/ Fox River CWPP Landuse



Produced By: Dawn Magness
11/28/2012

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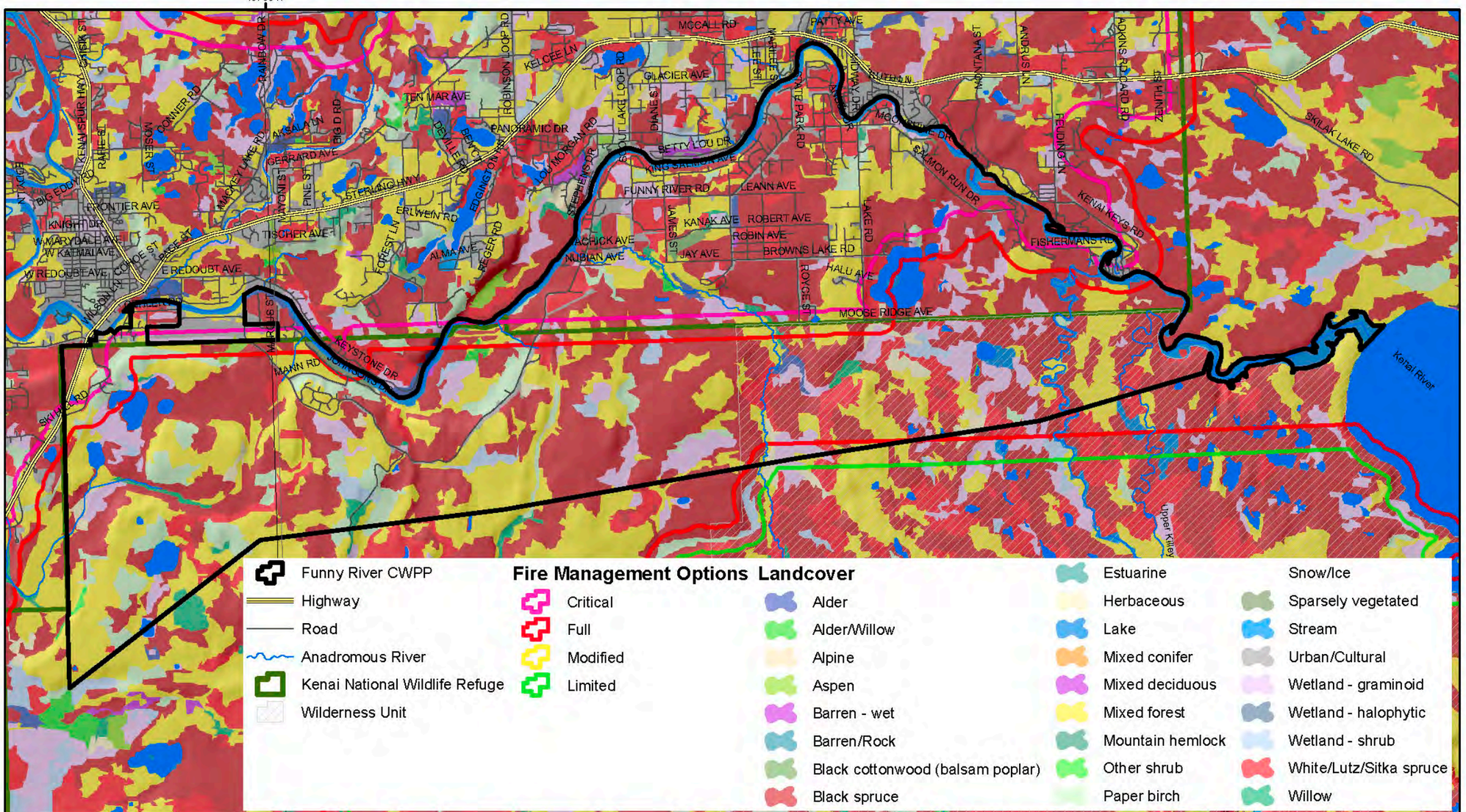
Appendix E: Funny River

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Funny River CWPP Landcover



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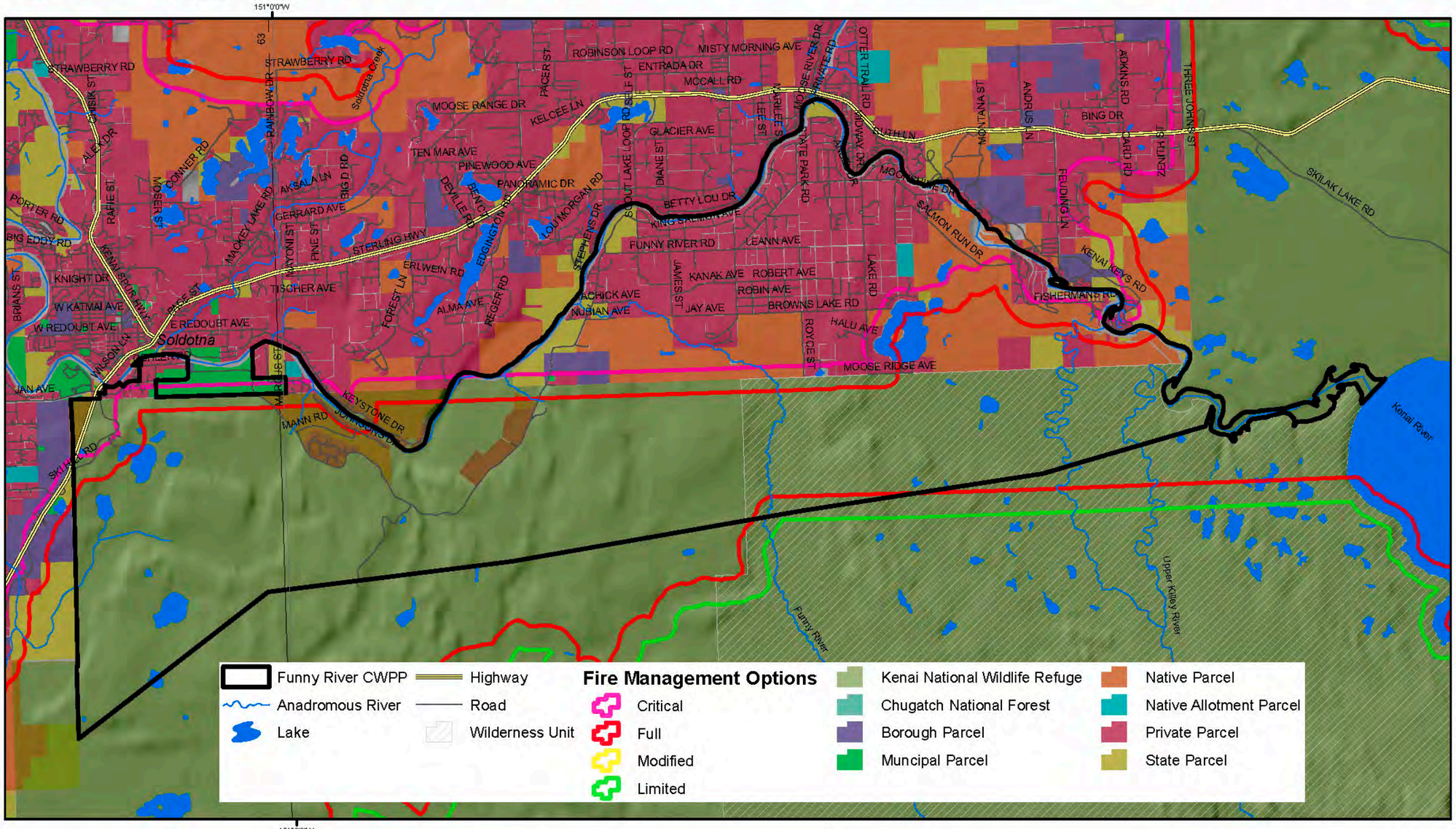
11/28/2012

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge

Soldotna, Alaska

Funny River CWPP Landuse



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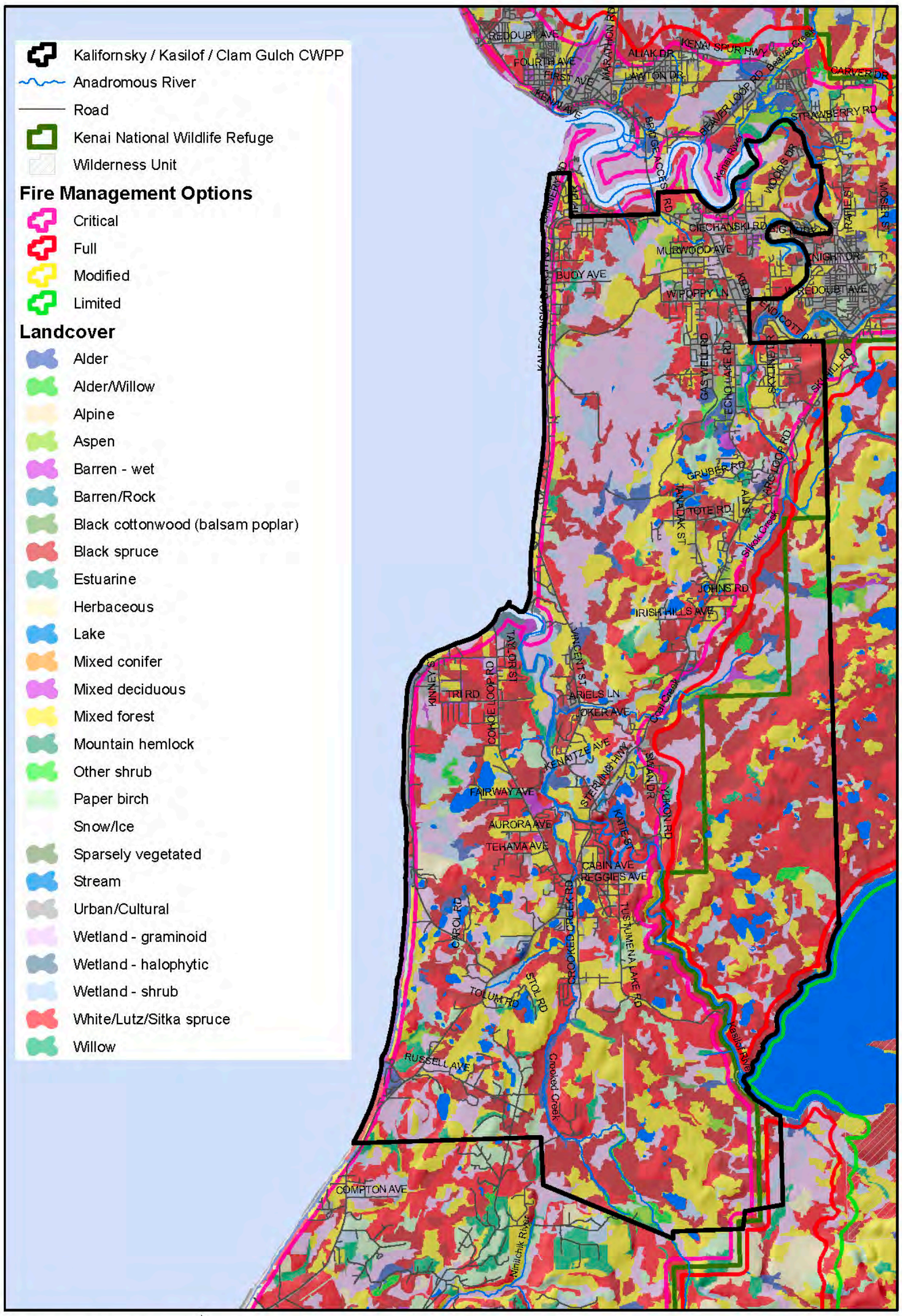
Appendix E: Kalifornsky, Kasilof, Cohoe, and Clam Gulch

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Kalifornsky / Kasilof / Clam Gulch CWPP Landcover



Produced By: Dawn Magness
11/28/2012

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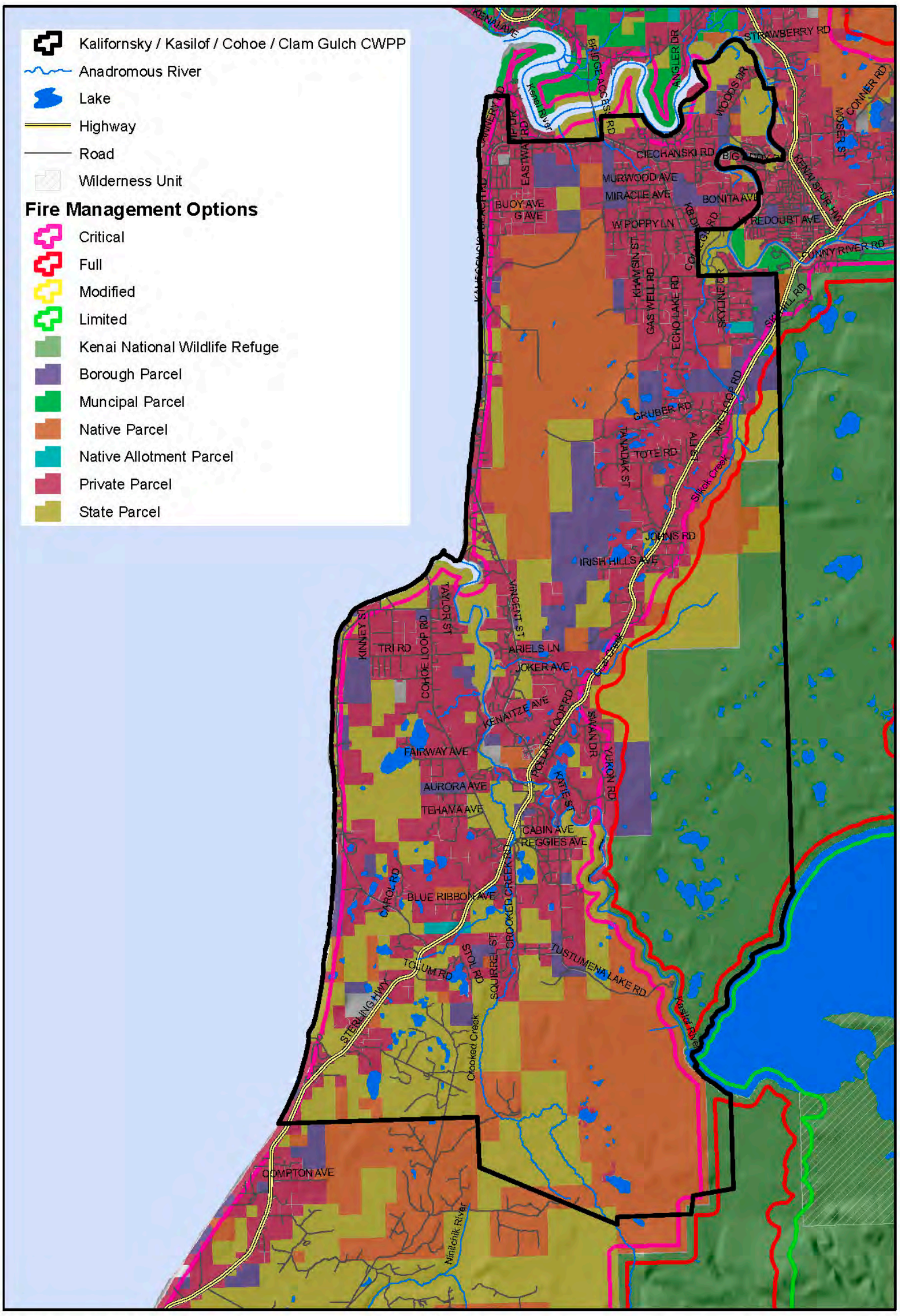
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Kalifornsky / Kasilof / Cohoe / Clam Gulch CWPP Landuse

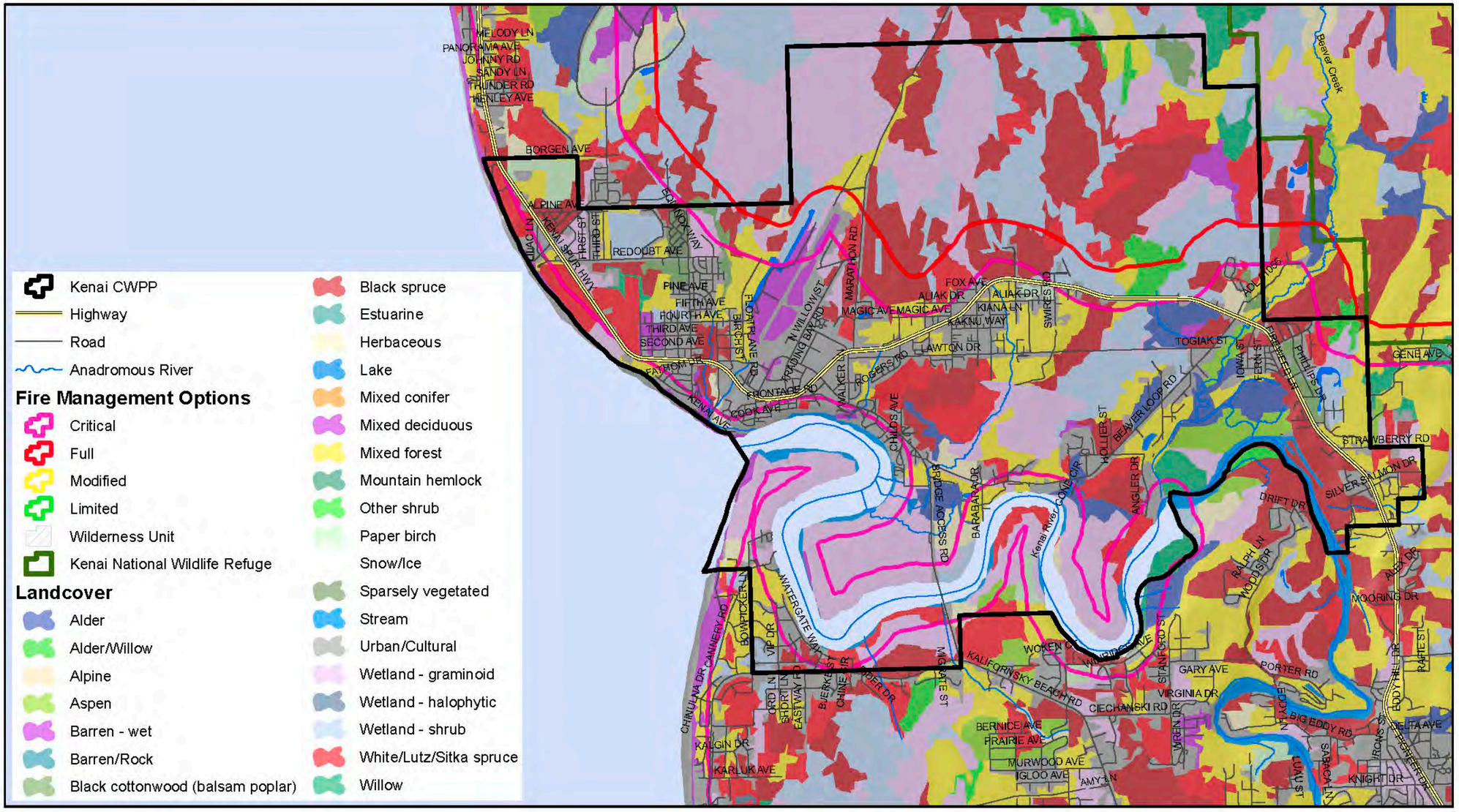


Appendix E: Kenai

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Kenai CWPP Landcover



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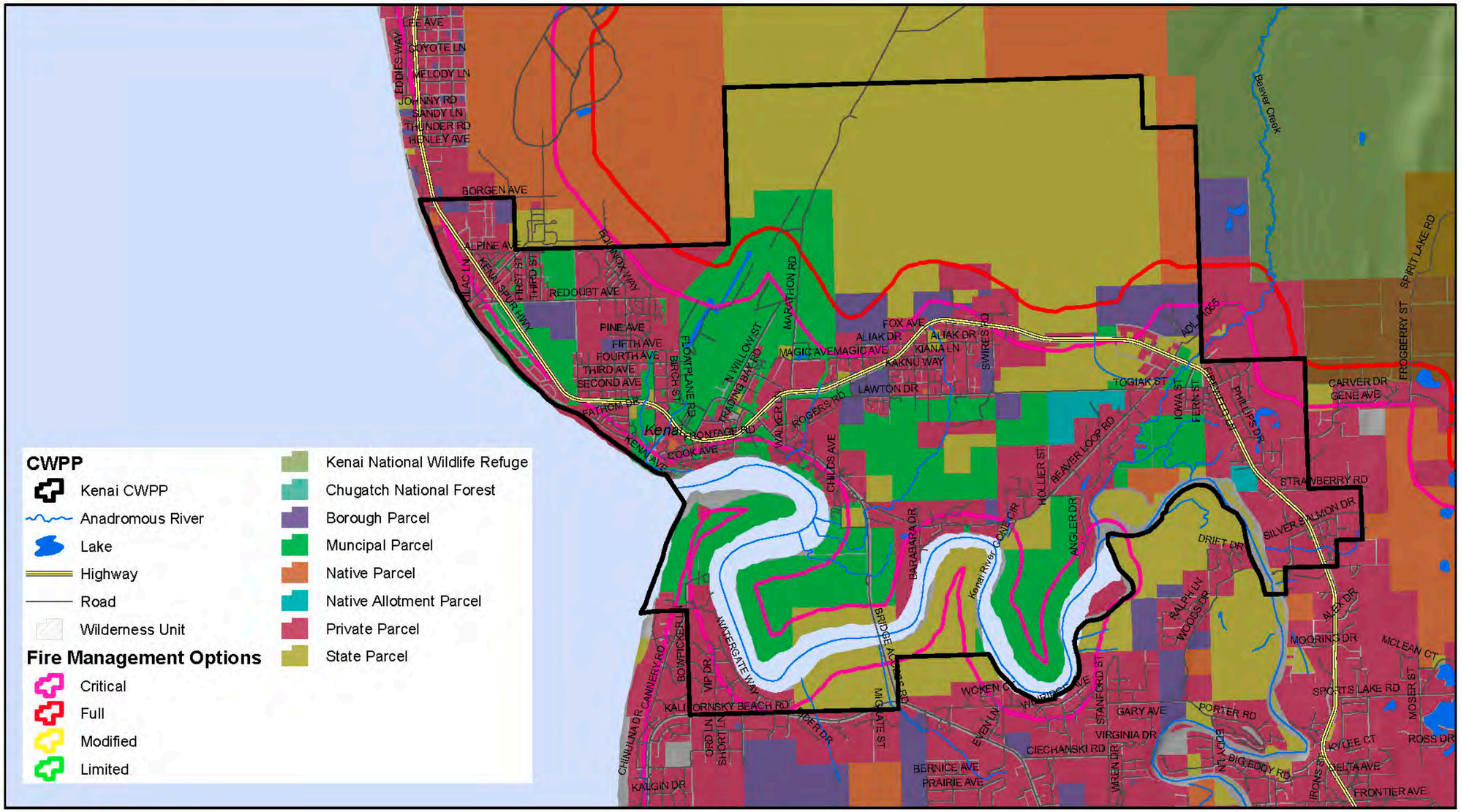
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Kenai CWPP Landuse



Produced By: Dawn Magness
11/28/2012

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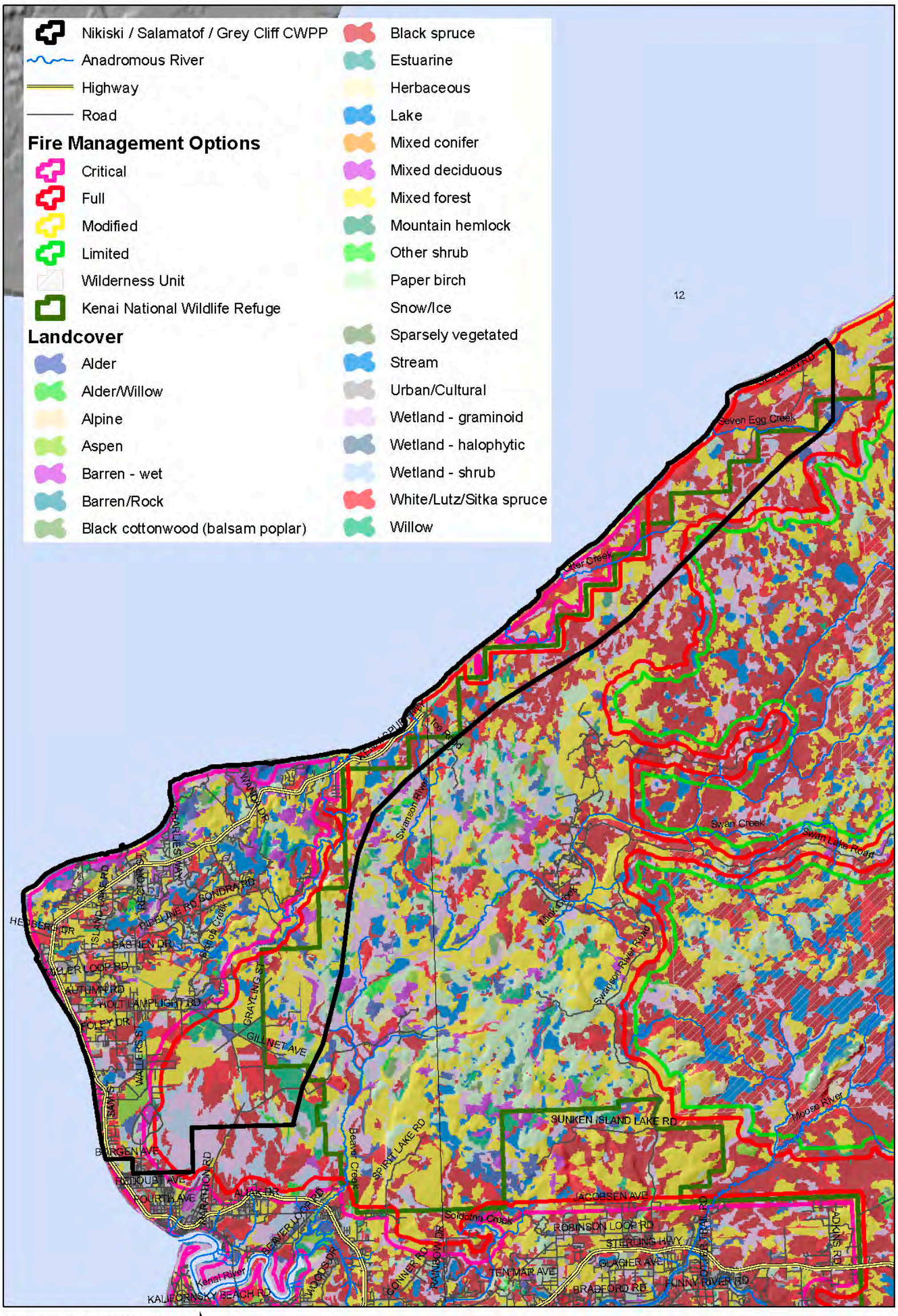
Appendix E: Nikiski, Salamatof, and Grey Cliffs

Nikiski / Salamatof / Grey Cliffs CWPP Landcover



Produced By: Dawn Magness
11/28/2012

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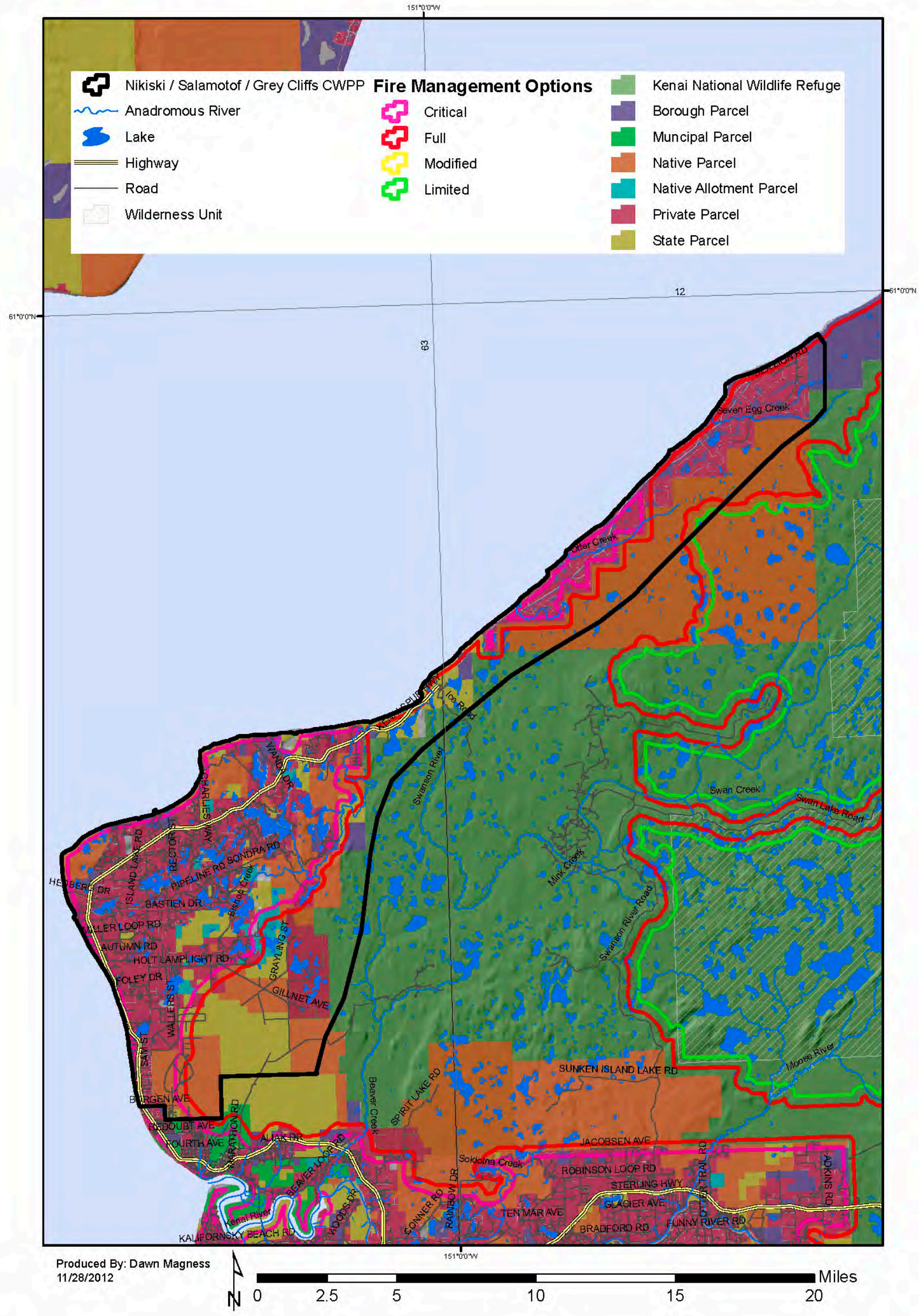
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Nikiski / Salamatof / Grey Cliffs CWPP Landuse

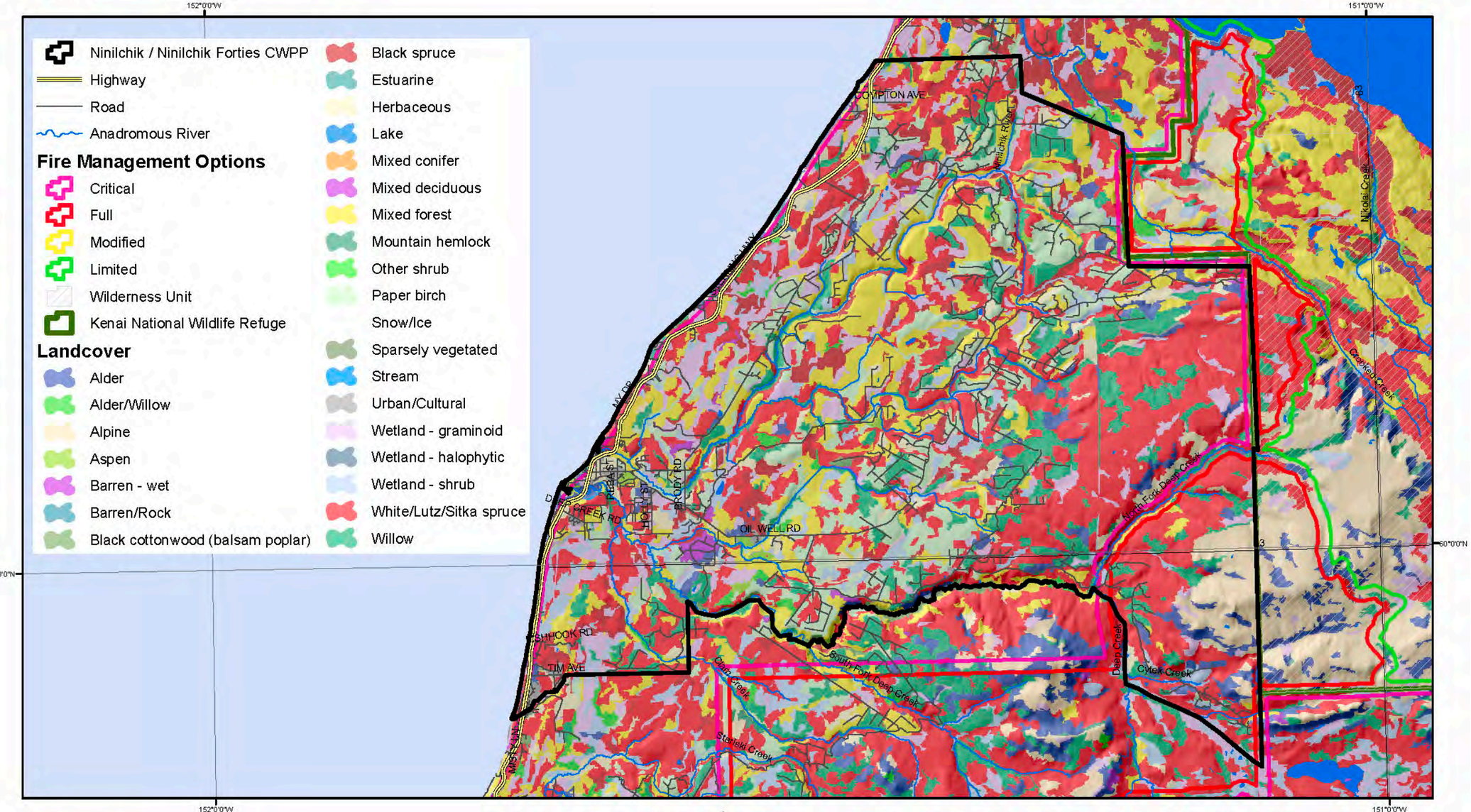


Appendix E: Ninilchik and Ninilchik Forties

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Ninilchik / Ninilchik Forties CWPP Landcover



Produced By: Dawn Magness
11/28/2012

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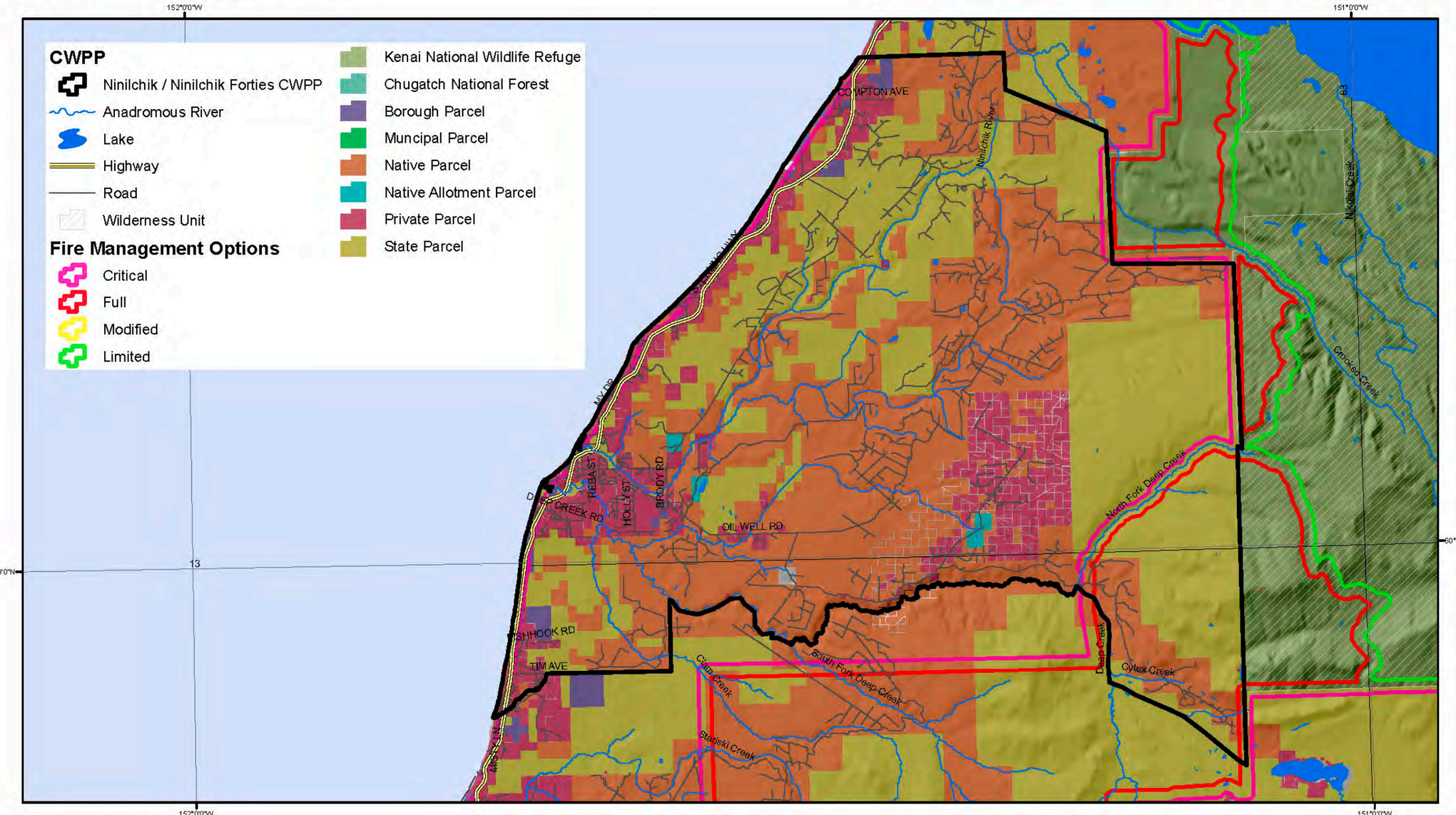
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Ninilchik / Ninilchik Forties CWPP Landuse



Produced By: Dawn Magness
11/28/2012

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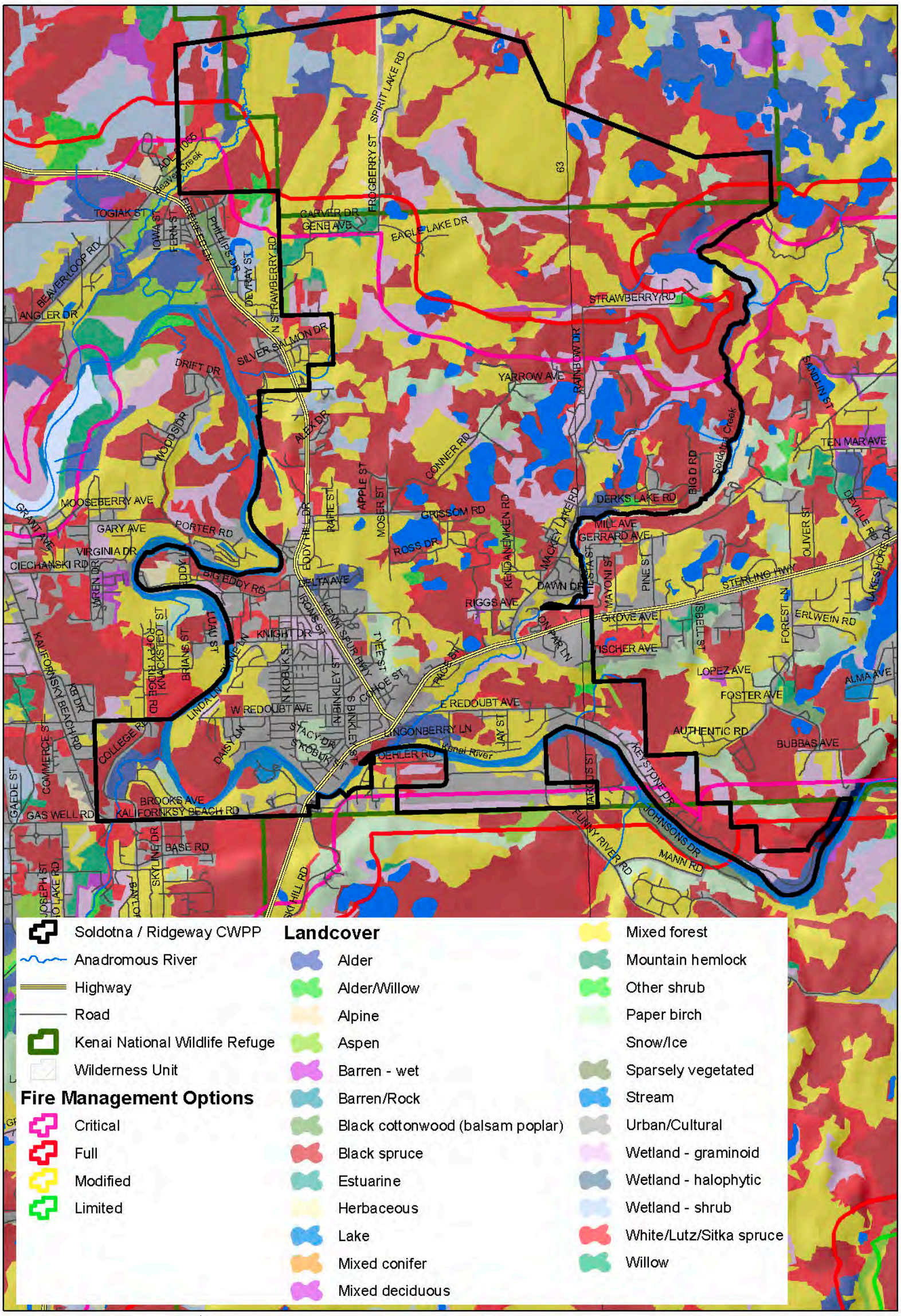
Appendix E: Soldotna and Ridgeway

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Soldotna / Ridgeway CWPP Landcover



Produced By: Dawn Magness
11/28/2012

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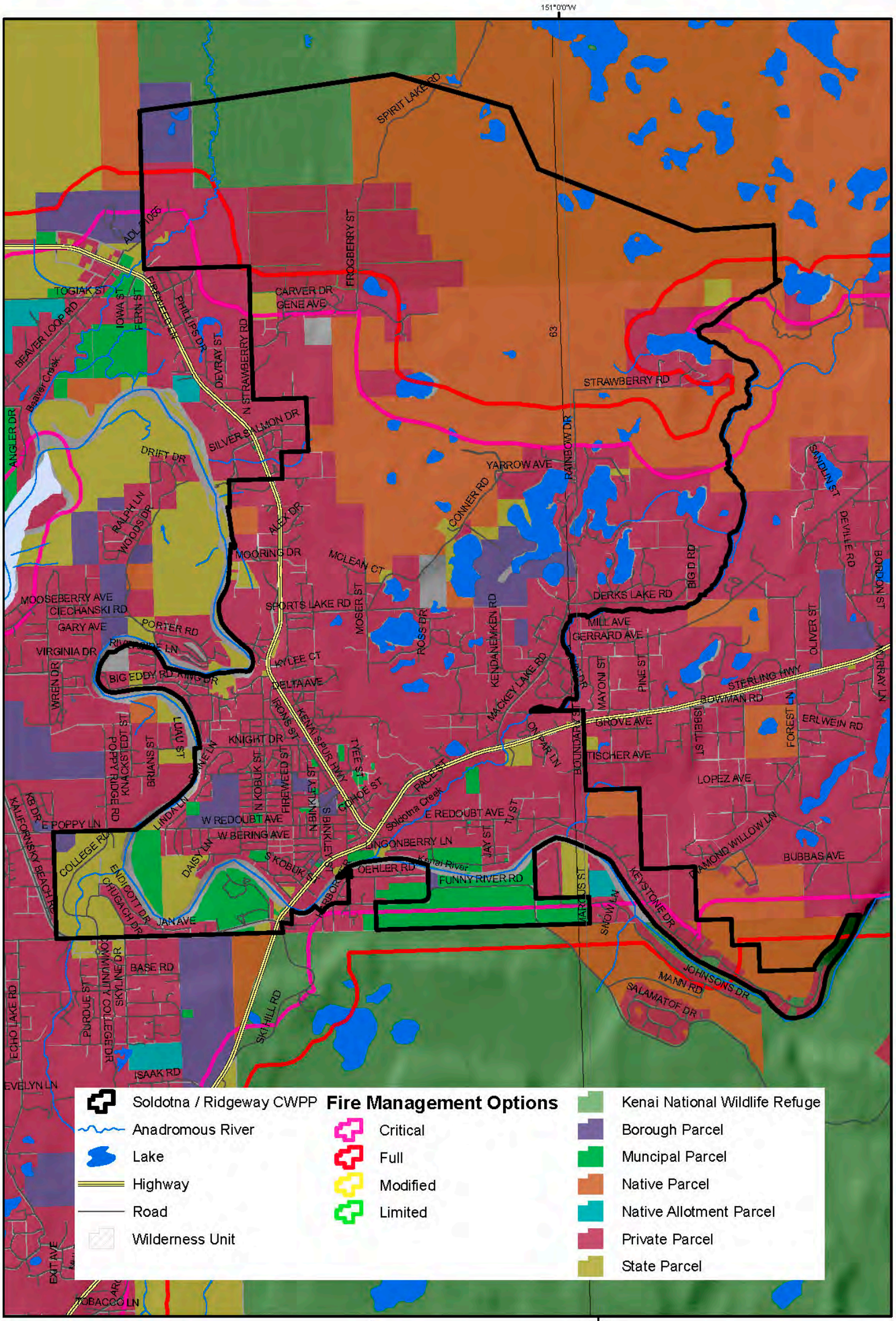
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Soldotna / Ridgeway CWPP Landuse



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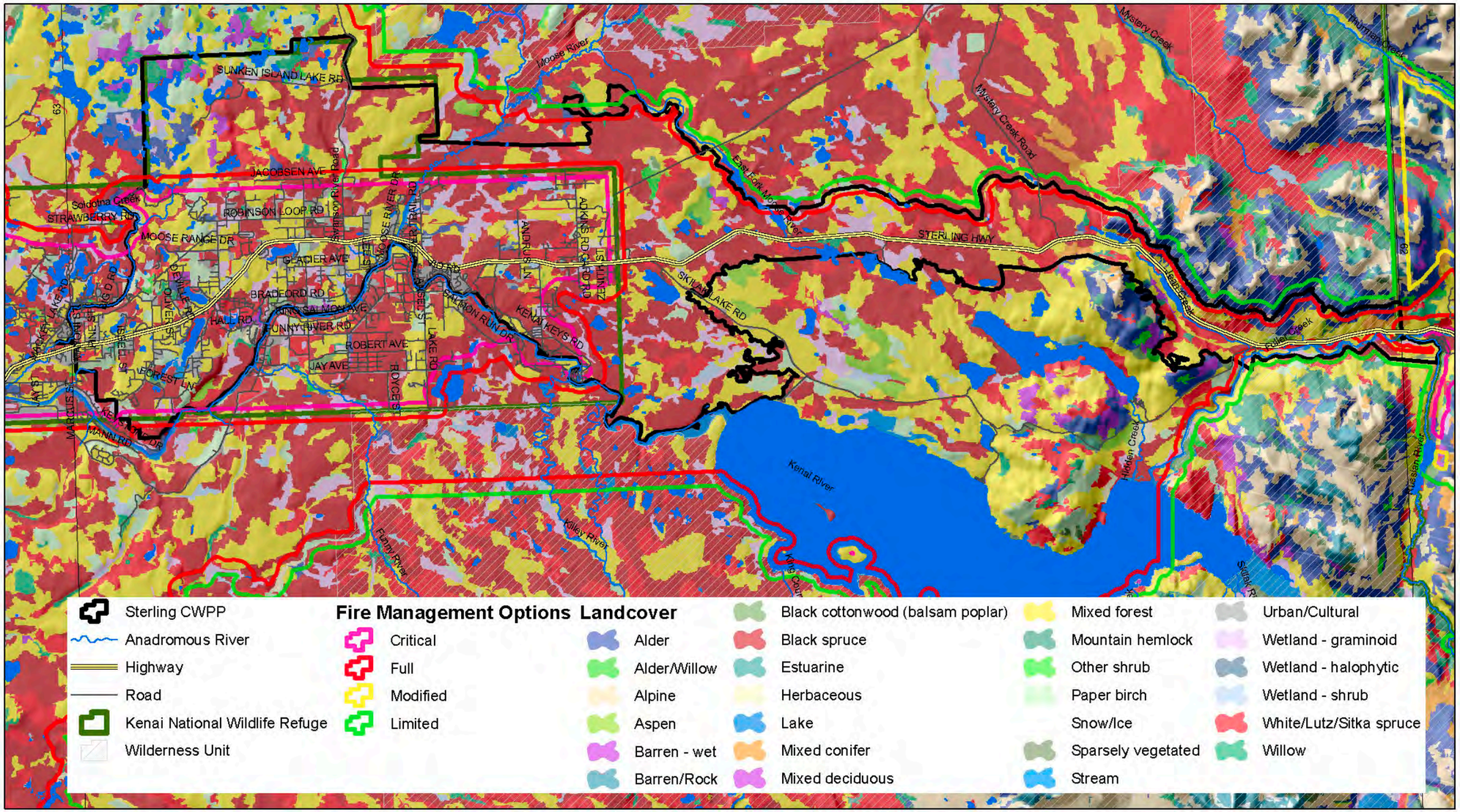
11/28/2012

Appendix E: Sterling

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Sterling CWPP Landcover



Produced By: Dawn Magness
11/28/2012

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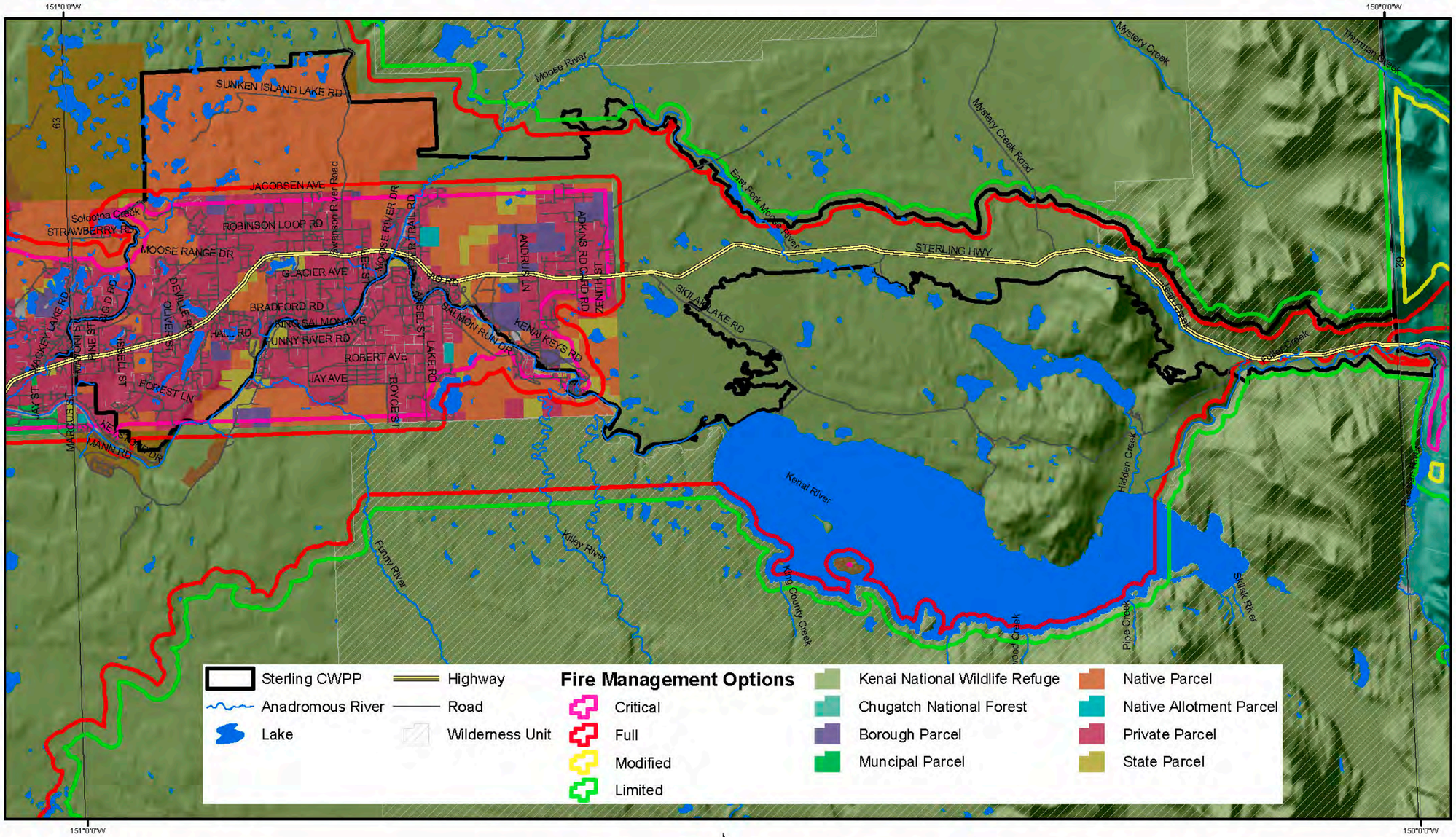
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Sterling CWPP Landuse



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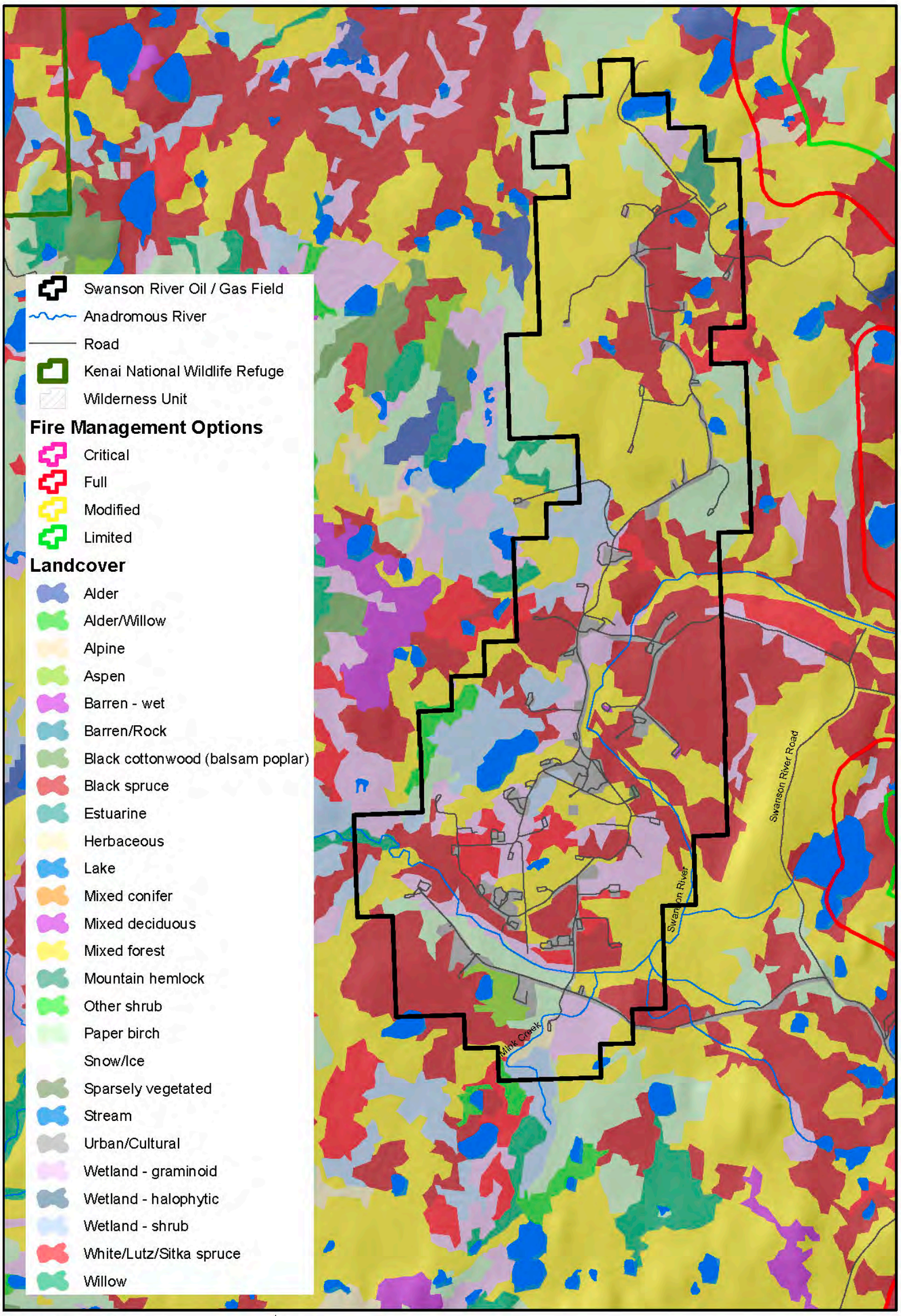
11/28/2012

Appendix E: Swanson River Oil / Gas Field

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Swanson River Oil / Gas Field Landcover



Produced By: Dawn Magness
11/28/2012

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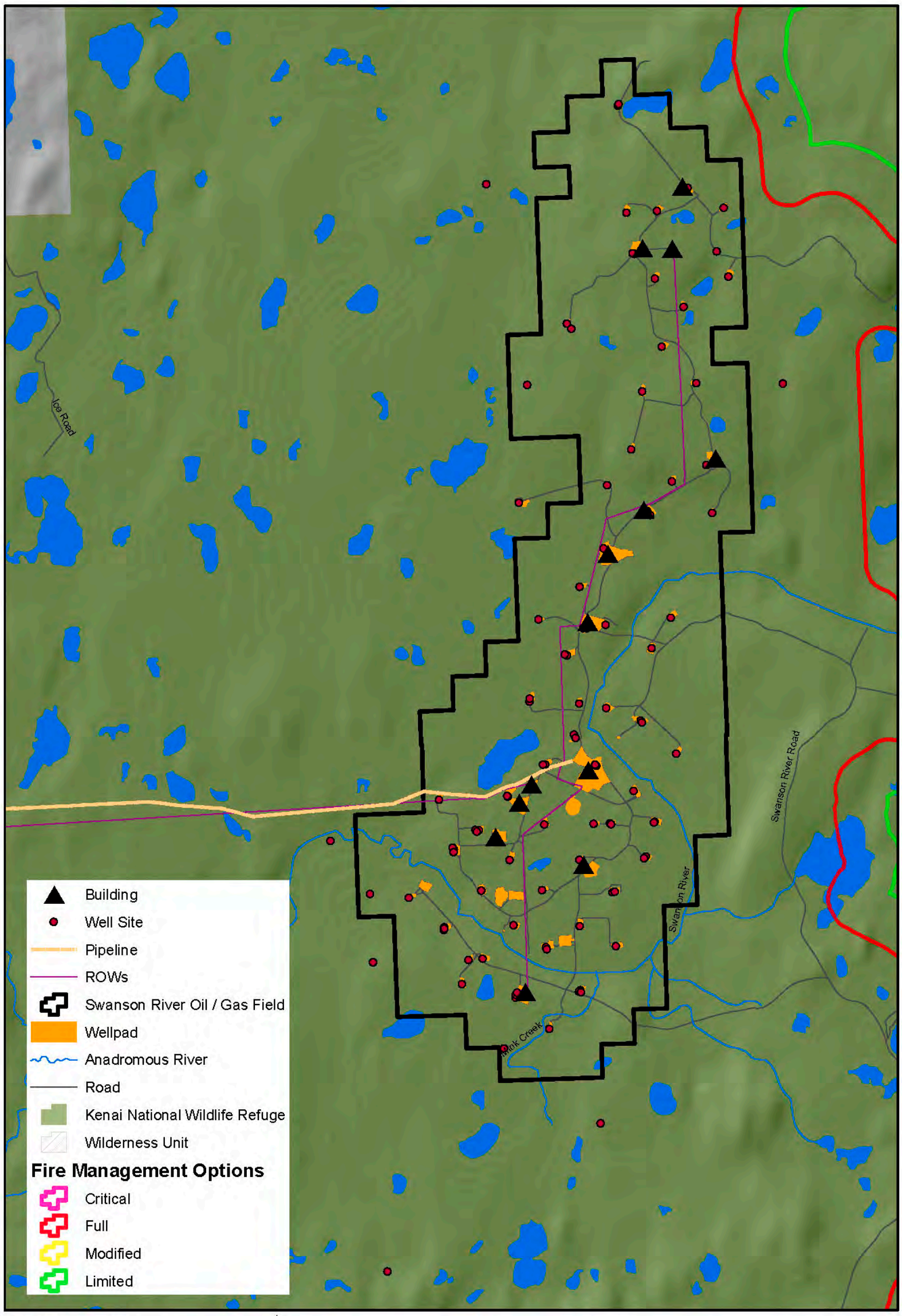
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Swanson River Oil / Gas Field Assets



Produced By: Dawn Magness
11/28/2012

N

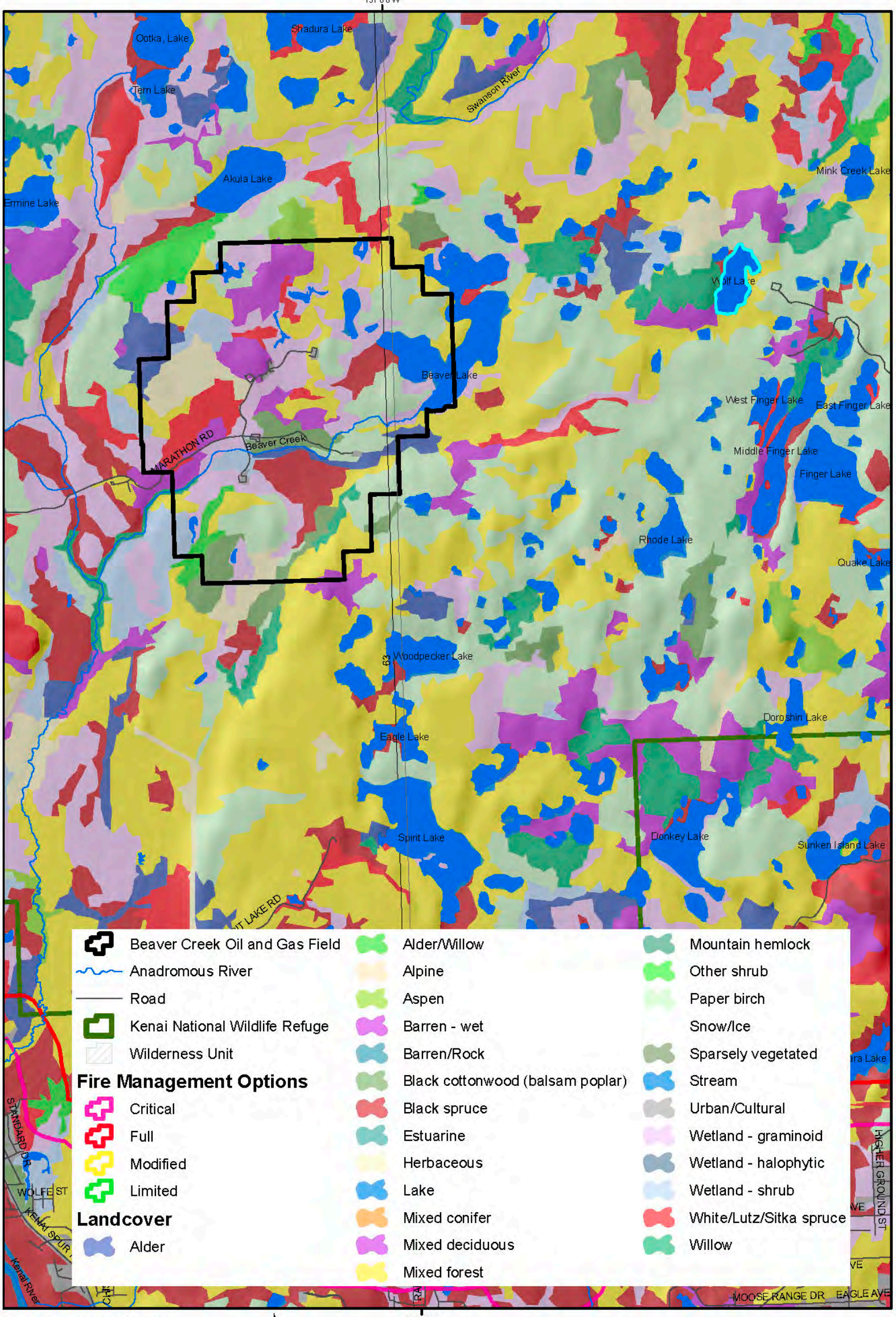
0 0.5 1 2 3 4 Miles

Appendix E: Beaver Creek Oil / Gas Field

U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Beaver Creek Oil / Gas Field Landcover



Produced By: Dawn Magness
11/28/2012

N

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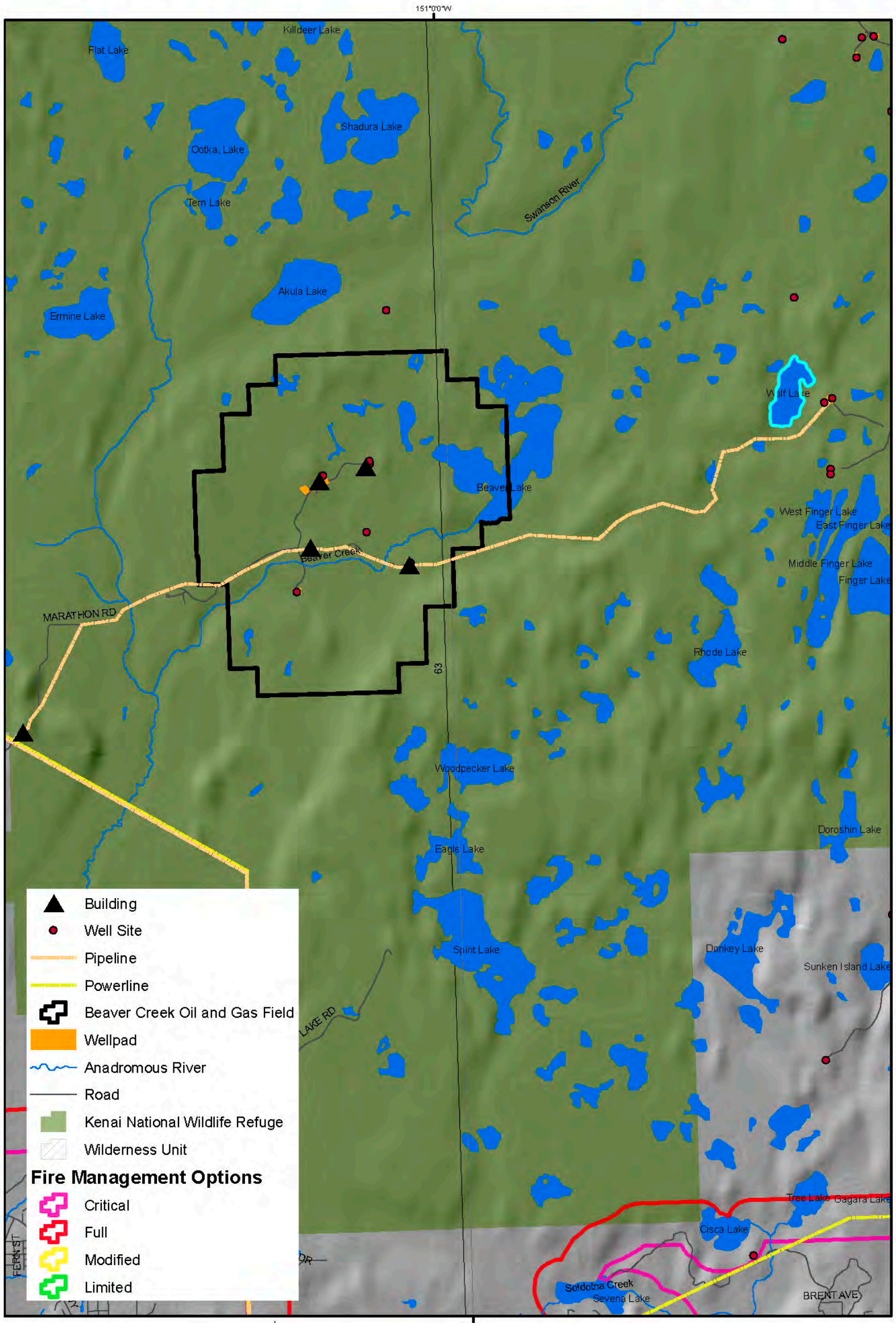
U.S. Fish & Wildlife Service

Kenai National Wildlife Refuge
Soldotna, Alaska

Beaver Creek Oil / Gas Field Assets



Produced By: Dawn Magness
11/28/2012

Appendix F

Refuge Fire History

Kenai National Wildlife Refuge

Fire History

1991-2011

This report summarizes the wildfire history of the Kenai National Wildlife Refuge for the last twenty years (1991-2011). In 2011, 7 wildfires (all human-caused) were suppressed, resulting in 1.6 total acres burned. Large wildfires occurring on the Refuge are listed in Table 1. Wildfire summaries for the previous two decades (1991-2000 and 2001-2010) are shown in Table 2 and Table 3. Fire history information is taken from the US Fish & Wildlife Service – Fire Management Information System Database.

Looking at the summaries for the past two decades, there are a number of interesting points that can be made:

- During the previous two decades, there were 72 Refuge fires reported in each.
- About 28,601 acres were burned from 1991-2000.
- The Refuge began managing selected lightning-caused fires, for resource benefits in 2001.
- Of the 72 wildfires and 68,945 acres burned from 2001-2010, 9 fires and 42,943 acres were managed for resource benefits. Or, 13% of the total number of wildfires, was managed for resource benefits, resulting in 62% of the total acreage burned during that period.
- There were 20 large fires (>10 acres) on the Kenai NWR over the past 20 years, totaling just under 100,000 acres burned.
- Of the 20 large fires, 11 were ignited by lightning.
- All of the large fires were stand-replacement fires.
- While human-caused fires are not managed for resource benefits, stand replacement fires on the Kenai Peninsula, typically reduce hazardous fuels and regenerate deciduous or hardwood species.
- Over the past twenty years, 6067.5 acres burned in GMU-15A, 42,730 acres burned in GMU-15B, and 48,680 acres burned in GMU-15C. These are just Refuge totals. At least another 60,000 acres of GMU-15C burned off the Refuge during the past decade.

Kenai National Wildlife Refuge

Fire History

1991-2011

Table 1 - Kenai NWR Large Fire History: 1991-2011

Fire Name	Year	Type	GMU	Acres	Cause
1. Pothole Lake	1991	W	15B	7356	H
2. Windy Point	1994	W	15C	2800	L
3. Glacier Lake	1994	W	15C	320	H
4. Crooked Creek	1996	W	15C	12860	H
5. Hidden Creek	1996	W	15A	5200	H
6. Mystery Creek	1997	W	15A	31	H
7. Thurman Creek	2001	RB	15A	15	L
8. Mystery Hills	2001	W	15A	697	L
9. Pipe Creek	2003	RB	15B	513	L
10. Glacier Creek	2004	W	15B	8600	H
11. Kenai River Trail	2004	W	15A	46	H
12. Moose Lake	2005	W	15A	13.5	L
13. Fox Creek	2005	RB	15C	26300	L
14. Irish Channel	2005	RB	15B	925	L
15. King County Creek	2005	W	15B	10131	L
16. Caribou Hills	2007	W	15C	6400	H
17. Swan Lake	2007	RB	15B	1960	L
18. Shanta Creek	2009	RB	15B	13221	L
19. Skilak River	2009	W	15B	24	H
20. McLain Lake	2010	W	15A	65	L
Total				97477.5	

Source:

FWS Fire Management Information System (FMIS)

Notes:

- Fire Type: W = Wildfire; RB = Fire Managed for Resource Benefits
- Game Management Unit (GMU): 15A (north of Kenai River); 15B (between Kenai and Kasilof Rivers); 15C (south of Kasilof River)
- Acreage listed is Refuge portion of fire total acreage
- Cause: H = Human; L = Lightning
- For this summary, a “large fire” is any Refuge wildfire greater than 10 acres

Kenai National Wildlife Refuge

Fire History

1991-2011

Table 2 – [1991-2000] Wildfire Summary

YEAR	FIRES	ACREAGE
1991	4	7361.5
1992	6	2.0
1993	9	4.8
1994	16	3126.9
1995	2	3.2
1996	10	18066.1
1997	10	32.2
1998	5	3.4
1999	5	0.5
2000	5	0.6
Total:	72	28601.2

Table 3 – [2001-2010] Wildfire Summary

YEAR	FIRES	ACREAGE	RB FIRES	RB ACRES
2001	10	713.9	1	15.0
2002	2	1.1		
2003	5	513.4	1	513.0
2004	16	8653.0		
2005	12	37379.3	2	27225.0
2006	2	2.1		
2007	10	8361.0	1	1960.0
2008	3	0.5		
2009	7	13255.0	4	13230.1
2010	5	65.4		
Total:	72	68944.7	9	42943.1

Notes:

- RB Fires are lightning-caused fires managed for resource benefits including hazard fuels reduction and ecosystem maintenance. The Refuge first began managing natural fires for resource benefits in 2001.

Appendix G

Fuel Model Crosswalk AWFCG (condensed)

Guidebook Group Number	Description	Primary Carrier of Fire	Fuel Model		
			40	13	CFFDRS
1	Closed Sitka Spruce-Western Hemlock Forest	compact needle litter	TL1	8	C6
2	Closed White Spruce Forest	feather moss, litter, duff	TU1	10	C3
3	Closed Black Spruce Forest	feather moss	TU3	9 ADJ	C2
4	Open Western Hemlock-Sitka Spruce Forest	litter	TL1	8	M4
5	Open White Spruce Forest	shrub & litter	TU5	10	C7
6	Open Black Spruce Forest	feather moss	TU4	9 ADJ	C1
7	Open Black Spruce-Tamarack Forest	feather moss & shrub	TU5	10	C1
8	Woodland Sitka Spruce-Pine	litter & shrub	TL1	8	M2
9	White Spruce Woodland	feather moss & shrub	TU5	10	C1
10	Black Spruce Woodland with tussock	shrub & tussocks	GR2	1	O1
11	Black Spruce Woodland with lichen-moss	feather moss & lichen	TU4	9 ADJ	C2
12	Closed Red Alder Forest	leaf litter	TL2	8	M2
13	Closed Black Cottonwood-Balsam Poplar Forest	leaf litter	TL2	8	M2
14	Closed Paper Birch-Quaking Aspen Forest	leaf litter & sparse grass	TU1	8	M2
15	Open Paper Birch Forest	leaf litter & grass	TU1	9	M2
16	Open Quaking Aspen Forest	leaf litter, grass, shrub & slope	TL2	8	D1
17	Open Balsam Poplar (Black Cottonwood) Forest	leaf litter	TL2	8	M2
18	Woodland Paper Birch-Balsam Poplar	lichen or grass & leaf litter	GR1	1	O1A
19	Spruce-Paper Birch-Balsam Poplar	leaf litter	TL6	8	M2
20	White Spruce - Paper Birch - Balsam Poplar - Spruce	leaf litter & herbaceous plants	TU1	8	M2
21	Dwarf Tree Mountain Hemlock Scrub	sparse moss & shrub	SH1	10	M2
22	Dwarf Tree Black Spruce Scrub	feather moss & shrub	TU4	9	C2

Guidebook Group Number	Description	Primary Carrier of Fire	40 Fuel Model	13 Fuel Model	CFFDRS Fuel Model
23	Closed Tall Alder Willow Shrub	leaf litter & woody debris	TU1	6	M2
24	Closed Tall Birch Shrub	shrubs	SH3	6	M1
25	Tall Shrub Swamp	herbaceous, shrub & leaf litter	SH1	1	O1A
26	Open Tall Willow Alder Shrub	grass & shrub litter	TU1	5	M2
27	Open Tall Birch/Birch-Willow Shrub	shrubs	SH3	5	M1
28	Closed Low Birch/Birch-Willow/Ericaceous Shrub	shrub	SH2	5	M1
29	Closed Low Willow/Alder-Willow Shrub	grasses	TU1	6	M2
30	Open Low Mixed Shrub-Sedge Tussock Tundra/Bog	tussocks	GR2	1	O1
31	Open Low Birch-Ericaceous Shrub/Bog	grass & dwarf birch	GR3	1	O1
32	Open Low Birch-Willow/Ericaceous Shrub/Bog	grass & shrub	GR2	1	O1
33	Open Low Willow/Sweetgale	herbaceous	GR1	1	O1A
34	Open Low Alder/Alder-Willow Shrub	grass & low shrubs	GS1	1	O1
35	Sagebrush-Juniper	juniper	SH2	8	O1A
36	Sagebrush-Grass	grass & shrub	GS1	2	O1
37	Dwarf Shrub Tundra	herbaceous & low shrub	GR1	1	O1A
38	Elymus	grass	SH4	8	O1A
39	Grass-Shrub	short grass	GR2	1	O1
40	Grass-Herb	short grass & herbaceous	GR1	1	O1A
41	Bluejoint Meadow	grass	GR4	3	O1
42	Bluejoint Shrub Herb	grass	GR2	1	O1
43	Tussock Tundra	tussocks	GR3	3	O1
44	Mesic Sedge-Grass-Herb Meadow Tundra	grass & herb	GR2	1	O1
45	Sedge Willow Dryas Tundra	herbaceous	GR1	1	O1A
46	Sedge-Birch Tundra	herbaceous & shrub	GR2	1	O1
47	Wet Meadow Tundra	herbaceous	GR1	1	O1A
48	Wet Sedge-Grass Meadow-Marsh	grass	GR1	1	O1A

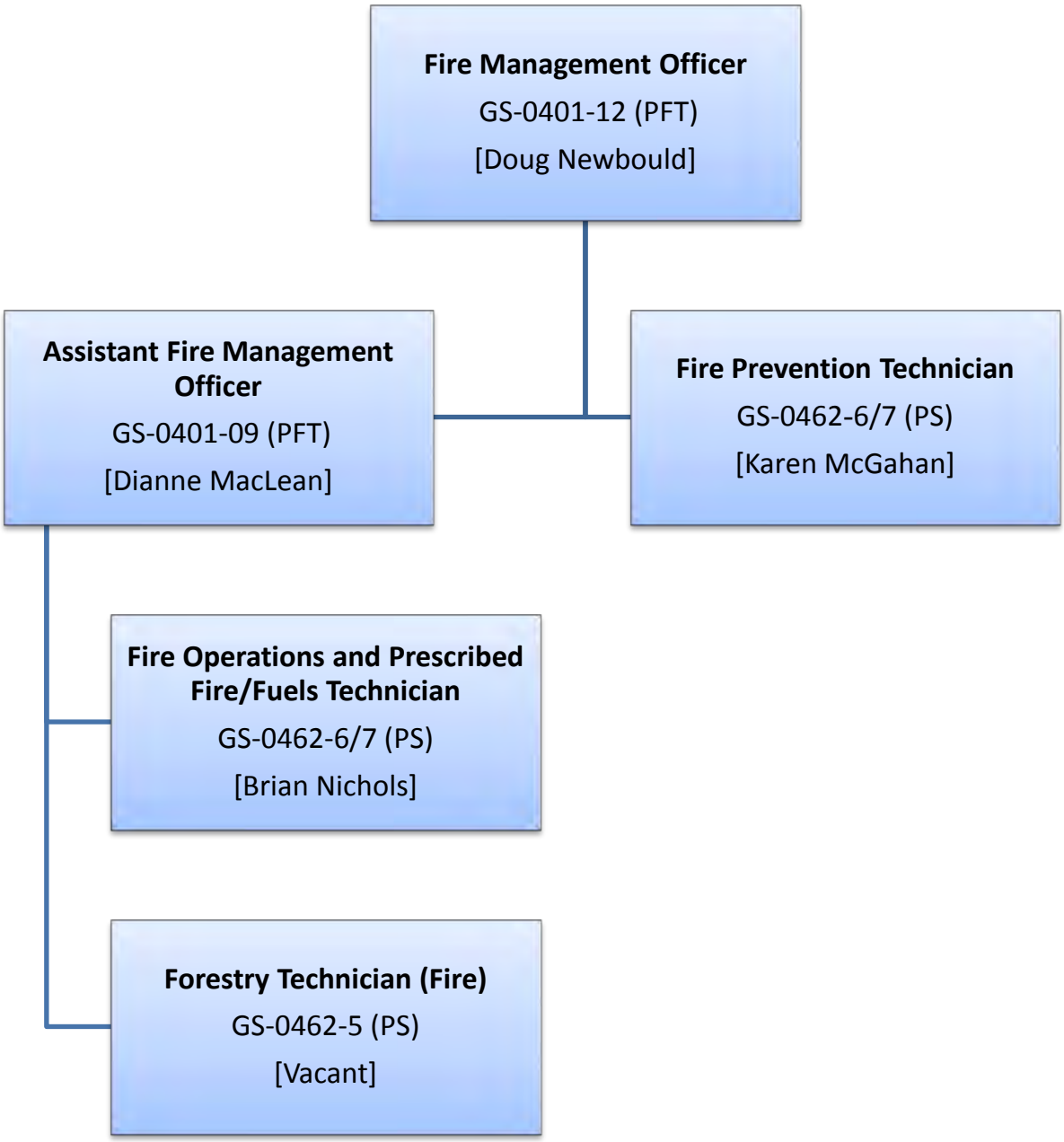
Guidebook Group Number	**Description**	**Primary Carrier of Fire**	**40 Fuel Model**	**13 Fuel Model**	**CFFDRS Fuel Model**
49	Wet Sedge Meadow-Bog-Shrub	herbaceous	GR1	1	O1A
50	Dry Species - Non Burnable		NB7	99	
51	Wet Species - Non Burnable		NB6	99	
52	Mesic Forb Herbaceous		GR1	1	O1A
53	Foliose and Fruticose Lichen		GR1	1	O1A
54	Crustose Lichen		NB9	99	
55	Aquatic Herbaceous		NB8	99	
56	Downed Beetle-killed spruce	downed woody fuel	SB1	11	M4

* The NB7 fuel model is a custom model for drier vegetated areas that typically do not burn.
** The NB6 fuel model is a custom model for wet vegetated areas that typically do not burn.

Appendix H

Kenai NWR Fire Management Organization Chart

January 13, 2012



Appendix I

2013 Kenai National Wildlife Refuge (AK-KNR) Dispatch Plan

I. Introduction

Refuge fire managers and firefighters will actively participate in wildland fire preparedness, prevention, mitigation, suppression and monitoring activities on Refuge lands and will cooperate with the Alaska Division of Forestry Kenai-Kodiak Area Office (KKAO) in the accomplishment of Refuge, Service and Departmental objectives for all wildland fire management activities implemented on Refuge lands. Refuge fire managers and firefighters will be available to respond to local, regional and national wildland and prescribed fire assignments as qualified and available, to maintain current NWCG qualifications and to gain experience and training for additional qualifications.

The Kenai National Wildlife Refuge Fire Dispatch Plan is prepared annually to meet the requirements of the Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement (2010) between United States Department of the Interior [Bureau of Indian Affairs (BIA), BLM, Fish and Wildlife Service (FWS), National Park Service (NPS)], United States Department of Agriculture Forest Service Alaska Region (USFS), and the State of Alaska Department of Natural Resources (ADNR).

II. Fire /Smoke Reporting Procedures

A. When a fire is reported to Refuge personnel, record as much information from the caller as possible, including:

- Location of caller
- Name and telephone number of caller
- Location of smoke or fire and best access route
- Color of smoke
- Size of fire
- Types of fuels involved and in the vicinity (spruce forest, grass, brush, etc.)
- Fire behavior (running, smoldering, torching, etc.)
- Is anyone fighting the fire?
- Was any person or vehicle seen in the vicinity or leaving the area? Is there any other information about the origin?
- Current weather conditions at the fire (wind speed, direction, clouds, etc.)
- Contact: KKAO by phone at 260-3473 and relay the information.

B. When Refuge personnel report a fire:

- Contact KKAO by radio or phone (260-3473).
- Size-up the fire; include items listed above
- Check maps (if available) for location of fire and report: Township, Range & Section or Global Positioning System (GPS) coordinates;
- If the fire is on or adjacent to the Kenai NWR, contact the following Refuge personnel:

  1. Fire Management Officer (FMO) – Doug Newbould [(w) 262-7021 or 260-2844, (cell) 252-9845]
  2. Assistant Fire Management Officer (AFMO) – Dianne MacLean [(w) 262-7021 or 260-2845, (cell) 252-9841]
  3. Deputy Refuge Manager – Steve Miller [(w) 262-7021, (cell) 394-9010]
  4. **Refuge Manager** – Andy Loranger [(w) 262-7021, (cell) 252-8129]

- Maintain a log of all radio and telephone communications.

C. Adjacent Landowners:

It is the responsibility of the Protecting Agency (KKAO/ADOF) to notify and maintain contact with adjacent landowners, when wildfires threaten or are expected to impact adjacent lands. The Refuge Manager or delegated responsible official (Acting Refuge Manager, Deputy Refuge Manager or FMO) will work with the KKAO to ensure that adjacent landowners are notified when a wildland fire on the Refuge has potential to impact those landowners.

The Refuge will work with the KKAO to develop press releases and other public information that includes agency messaging and Service policy related information. When press releases include specific incident related information, the Refuge will coordinate with the KKAO and Incident Management Teams to ensure consistency.

Key phone numbers for the adjacent public landowners are as follows:

- Alaska Division of Forestry / Kenai–Kodiak Area Office [262-4124 or 260-4200]
- USDA Forest Service, Chugach National Forest, Seward Ranger District [224-3374 or 288-3679]
- Alaska Division of Parks [262-5581]
- Kenai Peninsula Borough [262-4441], Office of Emergency Management [262-4910]

III. <u>2013 Refuge Fire Management Staff [262-7021 Fax: 260-4735] with NWCG qualifications:</u>

Fire Management Officer (FMO), Doug Newbould [Office: 260-2844, Cell: 252-9845]
(Permanent/Full-Time GS-0401-12) [RXB2, ENGB, ICT4, SOPL, ICT3 (t), DIVS (t), TFLD (t), STEN (t), FELB (t), FIRB (t)]

Assistant Fire Management Officer (AFMO), Dianne MacLean [Office: 260-2845, Cell: 252-9841]
(Permanent/Full-Time GS-0401-9) [RXB1, RXM2, HEB2, HMGB, FIRB, AOBS, ATVO, HEB1 (t)]

Fire Operations and Prescribed Fire/Fuels Technician (FOT), Brian Nichols [Office: 260-2842, Cell: 252-9857] (Permanent/Seasonal GS-0462-7) [ENGB, ICT4, FALB, ATVO, DZOP, BTOP, HECM, FFT1, DOZB (t), FELB (t), HGMB (t), FIRB (t), CRWB (t)]

Fire Prevention Technician (FPT), Karen McGahan [Office: 260-2841, Cell: 252-9844]
(Permanent/Seasonal GS-0462-7) [HMGB, HECM, FFT1, ICT5, PLDO, ATVO, ENGB (t)]

IV. Other Permanent (Collateral Duty) Refuge Staff [262-7021] in alphabetical order:

Leah Eskelin, Park Ranger Student Trainee [Home: 335-0017]
[PIOF (t)]

Todd Eskelin, Biologist (Subsistence) [Home: 335-0017]
[Boat Operator]

Debbie Perez, Refuge Clerk [Home: 262-7087]
[PIOF (t)]

Scott Slavik, Park Ranger [Home: 260-5470, Cell: 252-9850]
[FFT2, FALB, BTOP, HECM, HMGB (t), ATVO (t), FFT1 (t)]

Matt Bowser, Biologist (Entomologist) [Home: 260-6104]
[FFT2]

Elizabeth Bella, Ecologist [Cell: 398-9558]
[FFT2]

V. Other Temporary (Collateral Duty) Refuge Staff [262-7021] in alphabetical order:

Tom Honer
[FFT2, FALB]

Dillon Jensen
[FFT2, FALA]

Ciara Johnson
[FFT2, HECM (t)]

Scott Johnson
[FFT2, FALB, HECM (t)]

Christa Kennedy
[FFT2, FALA, HECM (t)]

VI. Refuge Wildland Fire Vehicles:

Engine 891 [Type 6]: 2008 Ford F-550 XL Super-Duty 4WD with 300-gallon Cascade slip-on pumper (mfg. 2010) [18-HP Vanguard 4-cycle pump (100 GPM @ 100 PSI)]

Engine 224 [Type 6]: 2001 Dodge Ram 3500 4WD with winch and 200-gallon Mallory slip-on pump w/12 gallon foam capacity [13-HP Mallory MM-11 pump]

Engine 848 [Type 4]: 2005 Ford F-750 with 1000 gallon tank, 20 gallon foam Cascade slip-on. [23-HP Briggs and Stratton pump]

Muskeg Bombardier ATV [Type 6]: 1990 tracked diesel carrier with winch and 270-gallon Cascade slip-on pumper (mfg. 2002) [18-HP Vanguard 4-cycle pump, 15-gallon Foam-Flo foam cell]

Crawler Dozer [Type1]: 1984 Terex T-9, model 82-20B with winch

Crawler Dozer [Type 3]: 1975 John Deere, model JD450CJ with hydraulic tilt blade and attachable fire plow

Hydro-Ax: 1989 Omark Industries 520 Hydro-Ax with winch and rotary-ax attachment

Polaris Ranger: 2010 UTV All wheel drive

Polaris Ranger: 2003 ATV 4WD

Polaris Ranger: 2003 ATV 6WD with rubber tracks, electric winch and dump bed

Pickup Truck 210: 2002 Chevy Crew Cab 4WD

Pickup Truck 211: 2002 Chevy Extended Cab 4WD with a lift gate

Pickup Truck 228: 2003 Ford F-250 4WD

Pickup Truck 818: 2004 Ford F-150 4WD

Note: Refuge Fire Engines (848, 221, and 224) are stocked to Normal Unit Strength (NUS) per the Interagency Standards for Fire and Fire Aviation Operations (Redbook).

VII. Refuge Fire Equipment:

- **Thompson Diesel trash (volume) pump trailers 400-gpm with 3" discharge** (2)
- **Homelite 500-gpm portable trash pump on wheeled cart with 4" discharge** (1)
- **Wajax-Pacific Mark III portable water pump** (4)
- **Wajax-Pacific Mark 26 portable water pump** (3)
- **Waterous Floto-Pump, portable water pump** (1)
- **Wick 375, portable water pump** (1)
- **Homelite waterbug portable water pump** (1)
- **Shindaiwa GP-40 portable water pump** (1)
- **Husqvarna 51 Chainsaws** (2)
- **Stihl 361 Chainsaws** (5)
- **Stihl 360 Pro Chainsaws** (4)
- **Stihl 460 Magnum Chainsaw** (1)
- **Husqvarna brush cutters** (3)
- **Portable water tanks** (10) [1200 gallon pumpkin (2), 1500 gallon (3), 2000 gallon Roll A Tank (1), 2100 gallon (3), 3000 gallon (1)]
- **Fire hose** [1½-inch (28,200 feet), 1-inch (13,100 feet), ¾-inch (3200 feet)
- **Fire shovels** (16)
- **Pulaski's** (38)
- **Rhino** (3)
- **Fedco Backpack pumps** (34)
- **Combies** (13)
- **McClouds** (1)
- **Flappers** (10)

I. Refuge Aircraft:

Interior 67: Fixed-wing Cessna 185, N56581 (on floats during fire season)

Interior 79: Fixed-wing Piper PA 18-150 Super Cub, N784 (on floats during fire season)

Appendix J

Refuge Fire Management Preparedness Plan
[Kenai-Kodiak Area Forestry: Fire Preparedness Staffing & Action Guide]

The Kenai National Wildlife Refuge adopts the Kenai-Kodiak Area Forestry's *Fire Preparedness Staffing & Action Guide* as its Fire Management Preparedness Plan. This plan is updated annually and will be incorporated by reference as Appendix J of the Refuge FMP.

2013

Fire Preparedness Staffing & Action Guide

Kenai-Kodiak Area Forestry

Approvals:

Robert Deleuze Date 4/30/13
State Operations Forester

Howard L. Kent Date 4/1/13
Area Fire Management Officer

Michael Cumm Date 4-15-13
Regional Forester

Hans Rinke Date 4-1-13
Area Forester

Staffing & Action Guide Development

2013

Fire Preparedness Staffing & Action Guide

Kenai-Kodiak Area Forestry

Approvals:

_____ Date _____
State Operations Forester

_____ Date _____
Area Fire Management Officer

_____ Date _____
Regional Forester

_____ Date _____
Area Forester

Staffing & Action Guide Development

The Division of Forestry adopted the Canadian Forest Fire Danger Rating System (CFFDRS) in 1992. Within the CFFDRS are the Fire Weather Index (FWI) and the Fire Behavior Prediction (FBP) systems. Both the FWI and FBP indices are used to determine a starting point from which to base daily decisions for **initial attack readiness** levels. Desired readiness levels for initial attack incorporate projected rates of wildfire perimeter growth, desired arrival times of initial attack resources, values at risk and containment size. Use of this guide should allow for the dynamic seasonal changes that occur through the fire season. Knowledge of local conditions, influences, and the modifying forces of topography, fuel, and fire weather also affect the overall preparedness scheme. Consideration must be given to the location and number of weather stations. Move up and down preparedness level to best fit the day to day fire danger, as weather variables or human risk change. This guide only addresses initial attack readiness and does not include other fire support activities. The terms readiness and preparedness will be used interchangeably. This guide provides **minimum** staffing levels for each preparedness level. Public events, fire activity in adjacent Areas or other conditions will be considered when determining the actual daily staffing level.

GRAPHS: Each preparedness level is described by fire intensity rank, display color, and public awareness code. These descriptors reference the intensity rank and color on the graphs; the public awareness code is how the public is alerted to fire danger.

Canadian Forest Fire Danger Rating System (CFFDRS) Indices

The Fire Weather Index (FWI) tabulates fuel moisture levels throughout the fire season and in turn gives a relative value of anticipated fuel dryness (fire behavior). Fine Fuel Moisture Content (FFMC), Duff Moisture Code (DMC), and Initial Spread Index (ISI) ranges are at the top of the Preparedness Level descriptor sheets. Any or all, of these indices can drive this preparedness guide, depending on the time of year, and their respective levels. Use the FBP system to calculate fire intensity for specific fuel types. FFMC levels indicate whether fine fuels are dry enough for combustion. If the FFMC level is low, surface fire spread will be very limited. ISI indicates relative fire spread and DMC indicates dryness of the upper duff. Deep duff burning and smoldering conditions will persist if DC levels are around 300. As the Drought Code (DC) climbs (greater than 300) then concern must be noted when resistance to control is high and intense mop-up is required. Conversely, if Build-Up Index (BUI) or DMC levels are low but FFMC indices are greater than 90, a fire will still spread, especially in high wind conditions. When using the CFFDRS indices, do not get locked into one index or one range. Look at the fuel moisture codes as well as the fire behavior indexes. Consider time of year, fuel curing, human/lightning risks, and weather forecasts.

Fuel Type- Standing Grass O-1b (Graph I)

This graph is based on standing grass and best represents the fuels on the southern Kenai Peninsula from snow free to the early stages of green up and the fall season prior to snowfall. This graph incorporates Initial Spread Index (ISI) and Degree of Curing. Appropriate readiness levels can be based upon this matrix.

Fuel Type-Dead Balsam Fir/Mixedwood Leafless 100% dead M-3

This fuel type is based on mixed stands of 100% dead balsam fire and boreal mixed wood species in the leafless stage. Pre-green up staffing levels will be based on this model in conjunction with the Grass model.

Fuel Type-Dead Balsam Fir/Mixedwood Leafless 60% dead M-3

This fuel type is based on mixed stands of 60% dead balsam fire and boreal mixed wood species in the leafless stage. Post-green up staffing will be based on this model in conjunction with the Grass model.

Fuel Type-Black Spruce C-2 (Graph II)

This graph, as well as the fire behavior descriptions is based primarily on the C-2, Boreal Spruce Model. The C-1, Spruce-Lichen Woodland fuel model, with verification, may also work with this graph.

Fuel Type-Black Spruce C-2 (Graph III)

This graph was produced by Alexander and Cole (1995) and should reflect black spruce burning conditions later in the summer. Use this chart after mid-June. Plot actual fire conditions throughout the summer to validate. Experience through time finds this chart to over predict fire danger rating in early season. This graph is more representative in mid to late June as vegetation cures and moisture wicking approaches equilibrium.

Additional Fuel Types

Hard woods D-1, Slash S-2 and M1-M4 fuel models may be appropriate in Alaska. These fire intensities may be calculated using the Fire Behavior Prediction (FBP) program. Again, these fuel models need to be verified to insure that they actually represent Alaska burning conditions.

Risk Assessment and Staffing Levels

The degree of risk of fire ignitions must be entered into readiness planning which is area specific. Each area should develop a type of risk matrix. Identify what the normal risk of human and lightning caused fires are for the area. Historical fire records compared to the CFFDRS indices will help identify norms. If the risk is MODERATE, maintain the current readiness level; if risk is LOW, consider

moving down a readiness level and if the risk is HIGH, consider moving up a readiness level.

Policy and Procedure
Refer to Department Order 17 for determining acceptable expenditures for High Fire Danger.

Current policy is to contain 90% of fires in critical, full and modified at 10 acres or less.
Area managers have authority to move up or down 1 readiness level, depending on Area fire danger and associated risk.
Standby of resources should be identified under Action Guides and Considerations.

**Fire preparedness for FIRE WEATHER WATCH'S or RED FLAG WARNING advisories (wind and relative humidity) should be addressed in the Staffing and Action guide.

Canadian Forest Fire Danger Rating System (CFFDRS) Indices

Modified for Kenai Peninsula / Kodiak Island based on local fuels, weather & fire history

	FFMC	DMC	DC	ISI	BUI	FWI
Low	0 - 80	< 20	< 150	0 - 2	< 26	0 - 3
Moderate	81 - 86	20 - 40	150 - 350	2 - 3	25 - 35	4 - 13
High	87 - 90	40 - 60	350 - 400	3 - 4	36 - 55	14 - 23
Very High	90 +	60 +	400 - 500	5 - 10	56 - 80	24 - 28
Extreme	91 +	60 +	500 +	10 +	81 +	29 +

FFMC	Fine Fuel Moisture Code
DMC	Duff Moisture Code
DC	Drought Code
ISI	Initial Spread Index
BUI	Build-Up Index
FWI	Fire Weather Index

PREPAREDNESS LEVEL 1

Fire Intensity Rank	**1**
Display Code	**GREEN**
Public Awareness Code	**LOW**

FIRE WEATHER INDEX
Pre green-up: FFMC <81, ISI <2
Post green-up: FFMC <81, ISI <2, BUI 25

HUMAN FACTORS
Localized small-scale public events do not impact acceptable initial attack responses

FIRE BEHAVIOR DESCRIPTION

New fire starts are unlikely to sustain themselves due to overall moist fuel conditions. New ignitions may take place from large or prolonged heat sources such as campfires or burn piles but the resulting fires rarely spread beyond the point of origin and if they do, control is very easily achieved. Mop-up or complete extinguishment of fires that are already burning may be required if there is sufficient fuel to support smoldering combustion. Flame is generally non-existent without significant preheating.

ACTION GUIDE

1. Five days per week Dispatch coverage with staggered schedule, 0800-1800.
2. Normal staffing for all sections with regularly scheduled days off.
3. Aircraft and flight crew on normal availability, or may be on ½, 1 or 2-hour call back, or pilot days off may be approved.
4. Off station work projects acceptable.
5. Sixty-minute response time for IA acceptable.

Canadian Forest Fire Danger Rating System (CFFDRS) Indices

Modified for Kenai Peninsula / Kodiak Island based on local fuels, weather & fire history

	FFMC	DMC	DC	ISI	BUI	FWI
Low	0 - 80	< 20	< 150	0 - 2	< 26	0 - 3

PREPAREDNESS LEVEL 1 (continued)

STAFFING	AMOUNT	REGULAR DUTY	EXTENDED DUTY
DISPATCH	2	0800-1800	Duty Officer Discretion for all resources on extended duty for this Preparedness Level
IA PERSONNEL (Total)	6	1000-1800	
Suppression Foreman	1	0800-1800	
Engines	2	1000-1800	
Crewmembers	2 ea	1000-1800	
Helicopter	0	1000-1800	
Helitack Crewmembers	0		
Prevention	1	1000-1800	

CONSIDERATIONS

1. Standby for minimum response capabilities.
2. Seven days per week Dispatch coverage when fire season starts.
3. Personnel available for Out of Area assignments.
4. Contact adjoining Areas regarding helicopter delayed response.
5. Staff Kenai Tanker Base depending on statewide needs.

PUBLIC EVENTS CONSIDERATIONS

Should large-scale public events occur on the Kenai Peninsula that would affect normal IA and support staffing and acceptable response times, consider moving to the next higher Preparedness Level.

PREPAREDNESS LEVEL 2

Fire Intensity Rank	**2**
Display Code	**BLUE**
Public Awareness	**MODERATE**

FIRE WEATHER INDEX
Pre green-up: FFMC 81-86, ISI 2-3
Post green-up: FFMC 81-86, ISI 2-3, BUI 25-35

HUMAN FACTORS
Localized small-scale public events begin to impact acceptable initial attack responses

FIRE BEHAVIOR DESCRIPTION

From the standpoint of moisture content, fine surface fuels represented by FFMC are considered sufficiently dry to sustain ignition and combustion from flaming or glowing firebrands. Fire activity is limited to creeping or gentle surface burning with maximum flame heights of less than two feet. Control of fires is normally fairly easy but can become troublesome under adverse weather or topographical conditions. Direct manual attack by "hot-spotting" around the entire fire perimeter by firefighters with only hand tools and water from backpack pumps is possible. Helicopter(s) bucket work is also very effective. Fireline constructed with hand tools should hold.

ACTION GUIDE

1. Normal IA and support staffing and duty periods.
2. Duty extensions to cover peak occurrence period if IA fires occur. Attention must be paid to potential for fire behavior transitioning to next level with approach of front or wind event (based on KKAF Area historic data).
3. Aircraft on normal availability or extended with IA activity.
4. Thirty-minute response time for all IA forces acceptable.
5. Standby after hours for minimum response.
6. Off station work projects evaluated on case-by-case basis.
7. Fire Weather Watch will augment engine, helitack, prevention, cache, and dispatch staffing until 2000 hours.

Canadian Forest Fire Danger Rating System (CFFDRS) Indices

Modified for Kenai Peninsula / Kodiak Island based on local fuels, weather & fire history

	FFMC	DMC	DC	ISI	BUI	FWI
Moderate	81 - 86	20 - 40	150 - 350	2 - 3	25 - 35	4 - 13

PREPAREDNESS LEVEL 2 (continued)

STAFFING	AMOUNT	REGULAR DUTY	EXTENDED DUTY
DISPATCH	2	0800-1800	Duty Officer Discretion for all resources on extended duty for this Preparedness Level
IA PERSONNEL (Total)	13	1000-1800	
Suppression Foreman	1	0800-1800	
Engines	4	1000-1800	
Crewmembers	2 ea	1000-1800	
Helicopter	1	1000-1800	
Helitack Crewmembers	2	1000-1800	
Prevention	2	1000-1800	

CONSIDERATIONS

1. All tactical considerations for Preparedness Level 1.
2. Consider seasonal adjustments, spring green-up, fall brown-up and human caused risk factors present.
3. May adjust one level up if multiple fires occur.
4. Staffing engine resources in both Homer and Soldotna.
5. Staffing the Kenai Tanker Base.
6. Seven days per week Dispatch coverage with staggered schedule, 0800-1800.
7. Resource order one EFF to assist dispatch and KKAF Admin with EFF hiring and associated work.

PUBLIC EVENTS CONSIDERATIONS

Should large-scale public events occur on the Kenai Peninsula that would affect normal IA and support staffing and acceptable response times, consider moving to the next higher Preparedness Level.

PREPAREDNESS LEVEL 3

Fire Intensity Rank	**3**
Display Code	**YELLOW**
Public Awareness	**HIGH**

FIRE WEATHER INDEX
Pre green-up: FFMC 87-90, ISI 3-4
Post green-up: FFMC 87-90, ISI 3-4, BUI 36-55

HUMAN FACTORS
Localized large-scale public events impact optimal initial attack responses

FIRE BEHAVIOR DESCRIPTION

Moderate to highly vigorous surface fires with flame lengths of 2 - 4 feet are possible. Torching and candling will occur. Fires can be moderately difficult to control. Hand-constructed fire guards are likely to be challenged and the opportunity to "hotspot" the perimeter gradually diminishes. Water under pressure (e.g. fire pumps with hose lays) and heavy machinery (e.g. dozer) with helicopter bucket support are generally required for effective action at the fire's head. Fine fuels are noticeably dry and "crunchy" underfoot. Poor RH recovery due to extended daylight hours and shorten nights leads to early morning fire activity from holdovers.

ACTION GUIDE

1. IA, dispatch, & cache personnel coverage seven days per week.
2. Aircraft and flight crews on normal or extended availability.
3. Response times required for responding IA forces.
4. Engine crew's response time - 10 minutes or less.
5. Helitack crew response time - Rotors turning in 7 minutes or less.
6. Red flag warnings or predicted lightning will augment engines, helitack, prevention, cache, and dispatch staffing until 2100 hours.
7. Burn permit advisories or suspensions based on CFFDRS graphs and current and predicted fire behavior.
8. Tactical considerations for evening posted and/or broadcast on IA frequencies by 1600 hours.
9. Engines and/or helitack on standby after hours.

Canadian Forest Fire Danger Rating System (CFFDRS) Indices

Modified for Kenai Peninsula / Kodiak Island based on local fuels, weather & fire history

	FFMC	DMC	DC	ISI	BUI	FWI
High	87 - 90	40 - 60	350 - 400	3 - 4	36 - 55	14 - 23

PREPAREDNESS LEVEL 3 (continued)

STAFFING	AMOUNT	REGULAR DUTY	EXTENDED DUTY
DISPATCH	3	0800-1800	1800-2030
IA PERSONNEL (Total)	16-28	1000-1800	1800-2000
Suppression Foreman	1	0800-1800	1800-2000
Engines	5	1000-1800	1800-2000
Crewmembers	2-4 ea	1000-1800	1800-2000
Helicopter	1	1000-1800	1800-2000
Helitack Crewmembers	3-5	1000-1800	1800-2000
Prevention	2	0800-1800	1800-2000
AIRTANKER BASE	2	1000-1800	1800-2000

CONSIDERATIONS (FMO or Duty Officer Discretion)

1. All tactical considerations for Preparedness Levels 1 and 2.
2. Prepositioning considerations for Homer, Ninilchik and/or Cooper Landing with additional engine where needed.
3. Extended staffing may be necessary during pre green-up or when multiple IA fires occur.
4. Consider staffing IA personnel to cover increased morning initial attack fire activity.
5. Preposition EFF firefighters for an IA Squad.
6. Spot weather readings taken in critical areas.
7. May need to preposition IA forces to Kodiak.
8. Consider prepositioning a load of smokejumpers south of the Alaska Range (Palmer or Kenai).
9. Detection flights late afternoon.
10. Consider prepositioning one air tanker and lead plane, or ASM, to the Kenai Tanker Base.
11. Retardant on Yellow Alert, request in Region with Lead or ASM.
12. Consider ordering Logistical Coordinator for Kenai Tanker Base if aircraft are being prepositioned.
13. Resource order additional Prevention personnel.
14. Resource order additional Support Dispatcher.
15. Resource order additional Admin / Clerical personnel as needed.
16. Resource order a Public Information Officer.
17. Resource order one EFF to manage cache for fire preparedness.
18. Resource order one Equipment Manager.
19. Resource order two Fire Investigators.
20. Consider ordering support vehicles and drivers as needed.
21. Consider ordering GSUL due to shortage of qualified resources in area.
22. Consider prepositioning a Type 2IA handcrew to the Area.
23. Consider hiring a contract helicopter – check local availability.
24. Consider prepositioning a Helicopter Manager.
25. Staff admin 7 days a week.
26. Out of Area assignments on a case by case basis.

PUBLIC EVENTS CONSIDERATIONS

Should large-scale public events occur on the Kenai Peninsula that would affect initial attack and support staffing and response times, consider moving to the next higher Preparedness Level.

PREPAREDNESS LEVEL 4

Fire Intensity Rank	**4**
Display Code	**ORANGE**
Public Awareness	**VERY HIGH**

FIRE WEATHER INDEX
Pre green-up FFMC 90+, ISI 5-10
Post green-up FFMC 90+, ISI 5-10, BUI 56-80

HUMAN FACTORS
Area-wide large-scale public events begin to impact area-wide initial attack responses

FIRE BEHAVIOR DESCRIPTION

Vigorous surface fire with flame lengths of 4 feet or more promotes intermittent crowning and short-range spotting. Wildfire control is very difficult. Direct attack on the head of a fire by responding forces may succeed in the first few minutes after ignition. Uncontrolled fires exhibit high resistance to control within minutes. Attempts to attack the fire's head should include air resources, preferably dropping long-term chemical fire retardants. In the event rapid initial attack is unsuccessful, Kenai-Kodiak IA staff will consider indirect attack and/ or structure protection options until the fire weather abates and additional resources respond. Fire growth is rapid with expansion to 10+ acres in 1 hour. Fire mop-up will be prolonged. Poor RH recovery due to extended daylight hours and shorten nights leads to early morning fire activity from holdovers.

ACTION GUIDE

1. Preposition one additional Suppression Foreman and other resources, as necessary, to the Area.
2. Request one or more air tankers and one load of smokejumpers south of the Alaska Range (PAQ or ENA).
3. Notify cooperators of very high to extreme burning conditions.
4. Suspend burn permits; activate media PSAs.
5. Multiple engine response to all reported fires.
6. Response times required for responding IA forces.
7. Engine crew's response time – Immediate.
8. Helitack crew response time - Rotors turning in 7 minutes or less.
9. Current weather observations and tactical considerations posted and/or broadcast on IA frequencies by 1600 hours.
10. Red flag warnings will augment engines, helitack, prevention, cache and dispatch staffing as needed.
11. IA, dispatch, cache and administrative support personnel staffing for seven days per week coverage.
8. Activate hand crews and preposition as needed.
9. Request attendance (in person or by phone) of KPB fire departments to 1145 briefing.
10. Preposition a Type 2IA crew here.

Canadian Forest Fire Danger Rating System (CFFDRS) Indices

Modified for Kenai Peninsula / Kodiak Island based on local fuels, weather & fire history

	FFMC	DMC	DC	ISI	BUI	FWI
Very High	90 +	60 +	400 - 500	5 - 10	56 - 80	24 - 28

PREPAREDNESS LEVEL 4 (continued)

STAFFING	AMOUNT	REGULAR DUTY	EXTENDED DUTY
DISPATCH	2 2	0800-1800 1200-2200	1800-2200
IA PERSONNEL (Total)	31-34	1000-1800	1800-2200
Suppression Foreman	2	0800-1800	1800-2200
Engines	5	1000-1800	1800-2200
Crewmembers	4 ea	1000-1800	1800-2200
Helicopter	1	1000-1800	1800-2200
Helitack Crewmembers	5-8	1000-1800	1800-2200
Prevention	4	0800-1800	1800-2200
AIRTANKER BASE	3	1000-1800	1800-2200

CONSIDERATIONS (FMO or Duty Officer Discretion)

1. All tactical considerations for Preparedness Levels 1, 2 and 3.
2. Spot weather forecasts obtained.
3. Two engine crews on Standby with engines, along with helitack and support staff.
4. Consider staffing IA personnel to cover increased morning initial attack fire activity.
5. Add additional telephone and computer support, port-a-potties, weather port tent and/or other facility needs.
6. Consider prepositioning a dozer with transport at Soldotna, Anchor Point, Homer or other location.
7. Duty officer on standby with a vehicle.
8. Resource one additional Type 6 engine with 3 crewmembers.
9. Resource order an HEB2 for Soldotna helibase.
10. Resource order one additional retardant worker for Kenai Tanker Base.
11. Resource order one Ramp worker for retardant site.
12. Resource order Logistical Coordinator for the Kenai Tanker Base.
13. Resource order additional maintenance person for KKAF.
14. Resource order additional Admin personnel as needed.
15. Resource order one GSUL.
16. Resource order one additional RCDM to manage supply distribution if fire activity picks up.
17. Resource order Fire Prevention Team
18. Resource order Fire Investigator
19. Hold all Out of Area assignments.
20. Request one load of SMJ to Kenai Tanker Base.
21. Initiate fuel truck availability and hire on. Staff 1000-2100.
22. Consider 24 hour dispatch staffing.
23. Consider identifying available local and regional Type 3 Incident Management Team members.
24. Consider ordering additional LEOs and/or Security personnel.

PUBLIC EVENTS CONSIDERATIONS

Should large-scale public events occur on the Kenai Peninsula that would affect initial attack and support staffing and response times, consider moving to the next higher Preparedness Level.

PREPAREDNESS LEVEL 5

Fire Intensity Rank	**5**
Display Code	**RED**
Public Awareness	**EXTREME**

FIRE WEATHER INDEX

FIRE WEATHER INDEX
Pre green-up FFMC 91+, ISI 10+
Post green-up FFMC 91+, ISI 10+, BUI 81+

HUMAN FACTORS
Area-wide large-scale public events significantly impact area-wide initial attack

FIRE BEHAVIOR DESCRIPTION

Intermittent crown fires are prevalent and sustained run continuous crown fires occur under certain weather, forest type and topographic situations. Control is extremely difficult and all efforts at direct control are likely to fail unless aggressive initial attack immediately contains fire. **Direct attack should only be attempted with the utmost caution**. Suppression action may limit fire growth if directed to the flanks and tail of the fire. Indirect attack with aerial ignition (i.e. helitorch and / or A.I.D. dispenser), if available, may be effective depending on the fire's forward rate of advance. Flame lengths > 8 feet. In the event that rapid initial attack is unsuccessful, IA staff will consider indirect attack, structure protection, and evacuation options until the fire weather abates and resources can safely work on the fireline. Fire growth is rapid with extreme fire behavior a possibility. Fire mop-up will be prolonged. Poor RH recovery due to extended daylight hours and shorten nights leads to early morning fire activity from holdovers.

ACTION GUIDE

1. Preposition one additional Suppression Foreman and other resources, as necessary, to the Area.
2. Request one or more air tankers and one or more loads of smokejumpers prepositioned south of the Alaska Range.
3. Multiple engine response to all reported fires.
4. Response times required for responding IA forces
5. Engine crew's response time – Immediate.
6. Helitack crew response time - Rotors turning in 7 minutes or less.
7. Include additional fire behavior and safety briefings for all engine and helitack staff.
8. Notify cooperators of extreme burning conditions.
9. Burn Suspension or Burn Ban in effect.
10. Current weather observations and tactical considerations posted and/or broadcast on IA frequencies by 1600 hours.
11. Red flag warnings will augment engines, helitack, prevention, warehouse and dispatch staffing commensurate to warning.
12. Preposition a Type 2IA crew here.
13. Resource order additional support dispatcher.
14. Hire restricted use helicopter
15. Resource order helicopter manager.
16. Notify Cooperators possible need of a tender for support

Canadian Forest Fire Danger Rating System (CFFDRS) Indices

Modified for Kenai Peninsula / Kodiak Island based on local fuels, weather & fire history

	FFMC	DMC	DC	ISI	BUI	FWI
Extreme	91 +	60 +	500 +	10 +	81 +	29 +

PREPAREDNESS LEVEL 5 (continued)

STAFFING	AMOUNT	REGULAR DUTY	EXTENDED DUTY
DISPATCH	3 2	0800-1800 1200-2200	1800-2230
IA PERSONNEL (Total)	31-34	1000-1800	1800-2200
Suppression Foreman	2	0800-1800	1800-2200
Engines	5	1000-1800	1800-2200
Crewmembers	4 ea	1000-1800	1800-2200
Helicopters	1	1000-1800	
Helitack Crewmembers	4-8	1000-1800	1800-2200
Prevention	4	0800-1800	1800-2200
AIRTANKER BASE	3	1000-1800	1800-2200

CONSIDERATIONS (FMO or Duty Officer Discretion)

1. All tactical considerations for Preparedness Levels 1, 2, 3 and 4.
2. Preposition additional resources to the Area, including one or more Type 2 crews, medium helicopter and/or engines.
3. Consider staffing IA personnel to cover increased morning initial attack fire activity.
4. Possible double crew needed for helicopter operations.
5. Spot weather readings will be taken bi-hourly during the heat of the day in critical areas, and spot weather forecasts obtained.
6. May need to preposition IA forces to Kodiak. Three engine crews on Standby with engines, along with helitack and support staff (1 HOM, 2 SXQ, and Prevention).
7. Add additional telephone and computer support, port-a-potties, weather port tent and/or other facility needs.
8. Request one retardant tanker and lead plane/ASM on Red at Kenai Tanker Base.
9. Resource order two additional retardant workers at Kenai Tanker Base.
10. Resource order one additional maintenance worker to KKAF.
11. Resource order one additional fire investigator.
12. Consider staffing KIDC Expanded Dispatch.
13. Consider ordering Type 3 Incident Management Team.
14. Consider ordering additional LEOs / Security personnel.

PUBLIC EVENTS CONSIDERATIONS

Should large-scale public events occur on the Kenai Peninsula that would affect initial attack and support staffing and response times, consider staffing at the highest Preparedness Level.

FIRE RANK

A Fire Description

RANK 1	RANK 2	RANK 3	RANK 4	RANK 5	RANK 6
NO OPEN FLAME WHITE SMOKE SMOULDERING GROUND FIRE	VISIBLE OPEN FLAME SURFACE FIRE ONLY UNORGANIZED FLAME FRONT LITTLE OR NO SPREAD	ORGANIZED SURFACE FLAME FRONT MODERATE RATE OF SPREAD VIGOROUS SURFACE FIRE	ORGANIZED SURFACE FLAME FRONT MODERATE TO FAST ROS ON THE GROUND SHORT AERIAL BURSTS GREY TO BLACK SMOKE	ORGANIZED CROWN FIRE FRONT MODERATE TO LONG RANGE SPOTTING INDEPENDANT SPOT FIRE GROWTH BLACK TO COPPER SMOKE	ORGANIZED CROWN FIRE FRONT MODERATE TO LONG RANGE SPOTTING INDEPENDANT SPOT FIRE GROWTH PRESENCE OF FIRE BALLS AND WHIRLS

DEFINITIONS:

Ground Fire - A fire that burns in the ground fuel layer.

Surface Fire - A fire that burns in the surface fuel layer, excluding the crown of trees.

Crown Fire - A fire that advances throughout the crown fuel layer.

Head - The portion of the fire having the greatest rate of spread and frontal intensity.

Flanks - Those portions of the fire that are between the head and the base.

Base - That portion of the fire perimeter opposite the head; the slowest spreading part of the fire.

Rate of Spread - The speed at which a fire extends its horizontal dimensions, expressed in terms of distance per unit time.

Candling - A single tree or a small clump of trees is said to candle when its foliage ignites and flares up, usually from bottom to top.

Spotting - A fire producing firebrands carried by the surface wind.
A fire whirl and/or convection column that falls beyond the main fire perimeter, and results in spot fires.

Flame Front - The strip of primarily flaming combustion along the fire perimeter; a particularly active fire edge.

Organized Front - A flame front exhibiting all the same characteristics, ROS (Rate of Spread), flame height and length.

Appendix K

Delegation of Authority for Refuge Fire Management Officer

_____FMO Name_____, Fire Management Officer for the Kenai and Kodiak National Wildlife Refuge(s), and in his/her absence, the Assistant Fire Management Officer, _____AFMO Name_____, are delegated authority to act on my behalf for the following duties, actions and expectations:

1. Represent the US Fish and Wildlife Service in the local area Multiagency Coordinating Group in setting priorities and working to assist the Protecting Agency in fire emergencies.

2. Provide direction, supervision and leadership to the Kenai and Kodiak Refuges Fire Management Program as outlined in the Kenai NWR Fire Management Plan and the Kodiak NWR Fire Management Plan, and provide a liaison to the Protecting Agency for all wildfire activities on the Refuges.

3. Coordinate with and provide timely and accurate reports to the Refuge Managers, Deputy Refuge Managers or Acting Refuge Managers, and Regional Fire Management Coordinator on all wildland fire management activities on the Refuges.

4. Coordinate the preparation and maintenance of all Refuge Fire Management Plans, Fuels Hazard Mitigation Plans and Prescribed Fire Plans per bureau/agency guidelines and to meet Refuge Comprehensive Conservation Plan objectives.

5. Responsible for Refuge Fire Management Budget coordination and oversight to assure adherence to agency fiscal guidelines.

6. Coordinate prescribed fire and hazardous fuels management activities for the Refuges including requests and oversight of funding for Hazardous Fuel and WUI projects.

7. Request and oversee distribution of Severity and Emergency Preparedness Funding for Refuge fire activities.

8. Ensure all Refuge wildfire incidents are managed in a safe and cost-effective manner in collaboration with Protecting Agency FMO's.

9. Provide for the management of inventories and property records for supplies and equipment purchased with fire program funds.

10. Oversee the recruitment and hiring of Refuge fire personnel as required.

11. Ensure Refuge personnel participating in prescribed fire and wildfire operations are fully qualified for assigned positions.

12. Responsible for representing the Refuges and/or the Region in assigned interagency wildland

fire management program activities and collaborative efforts such as AWFCG sub-committees and working teams.

13. Coordinate Refuge wildfire prevention and mitigation activities and provide appropriate program direction and guidance.
14. Hire emergency firefighters as necessary to meet Refuge Fire Management Plan objectives, in accordance with the *Department of Interior Pay Plan for Emergency Workers*.

15. Manage the Incident Qualification Certification System (IQCS) and certify Incident Qualification Cards within the Refuges. Coordinate incident management resources status (ROSS) with dispatch center(s).

16. Initiate and Certify NWCG Position Task Books for Refuge personnel per NWCG and agency guidelines. Participate in the FWS Alaska Region Red Card Committee.

17. After initial implementation of the Wildland Fire Decision Support System (WFDSS) by the Protecting Agency, continue the WFDSS documentation through completion.

18. In the rare event the Refuge Manager and the Deputy Refuge Manager **are absent,** the FMO can approve the WFDSS, and the Periodic Fire Assessment.

19. This delegation will be reviewed and signed annually prior to fire season.

_____	_____
Refuge Manager, Kenai NWR	Date
_____	_____
Refuge Manager, Kodiak NWR	Date

Appendix L

Kenai NWR Staffing/Availability Report

Operational Period: Date: On: Off:

Permanent Fire Staff		Cell #
FMO	Doug Newbould	252-9845
AFMO	Dianne MacLean	252-9841
Prevention Tech	Karen McGahan	252-9844
Ops & RX Fire Tech	Brian Nichols	252-9857

Duty Officer:
Fire Office Phone#

Engine 224 (T6)

Location: Soldotna

Status:
ENGB:
FFT1:
FFT2:

Engine 891 (T6)

Location: Soldotna

Status:
ENGB:
FFT1:
FFT2:

Engine 848 (T4)

Location: Soldotna

Status:
ENGB:
FFT1:
FFT2:

Bombardier (T6)

Location: Soldotna

Status:
ENGB:
FFT1:
FFT2:

Fire Staff	**Status**	**Location**
FMO	Unassigned	Local
AFMO	Unassigned	Local
Prevention Tech	Unassigned	Local
Ops & RX Fire Tech	Unassigned	Local

Appendix M

MIST Guidelines for the Kenai NWR

Kenai National Wildlife Refuge Minimum Impact Suppression Tactics

FIRELINE CONSTRUCTION

1. Use natural barriers wherever possible.
2. Use wetline where it will be effective.
3. Construct sawline to minimum necessary width (trim ladder fuels near line for added effectiveness).
4. Reduce total line length whenever possible by bridging fingers and burning out.
5. Avoid using retardant or foam where run-off into water source is likely.
6. Avoid flooding ash pits on steep slopes or within 100 feet of stream banks and lakeshores.
7. Avoid trenching fireline wherever possible, especially in permafrost areas. If trenching is necessary do not exceed one foot trench width.
8. ATVs will only be used with prior Refuge approval.
9. Dozers, Fire Line Explosives will only be used if absolutely necessary, and then only with prior Refuge approval.
10. Consider using sprinkler systems and fire resistant wrap to protect cabins.
11. Cultural resources will be stabilized and protected from further degradation if determined to be appropriate by agency archaeologists.

HELISPOT CONSTRUCTION

1. Consider long-line use in lieu of helispot for gear delivery/retrieval.
2. Choose impact resistant sites whenever possible.
3. Construct helispot with irregular outlines whenever possible.
4. Construct helispots to meet safety and utility requirements with the least environmental impact possible.
    - TYPE II: 90’ safety zone
    - TYPE III: 75’ safety zone

CAMP CONSTRUCTION

1. Choose impact resistant sites whenever possible.
2. Construct latrine(s) for any camp to be used for multiple days.
3. Construct latrines 200’ minimum from water sources.
4. Cut and roll back moss and duff from fire pits. Keep layer intact for replacement.
5. Minimize clearing.
6. Avoid trenching campsites.

FIRELINE REHABILITATION

1. Rehabilitation efforts will be directed at mitigating suppression impacts.
2. Burned area rehabilitation may be considered, but must be approved by the Refuge Manager.
3. Flush cut stumps.

4. Scatter brush along fireline. Avoid large piles inside or outside the line.
5. Return moss to trenches.
6. Construct water bars on steep slopes where moss layer has been removed.
7. Remove all flagging, trash.

HELISPOT REHABILITATION

1. Flush cut and cover stumps with brush outside of pad area.
2. Scatter brush and disperse any large brush piles.
3. Remove all flagging and trash.

CAMP REHABILITATION

1. Restore campsites to as natural a condition as possible.
2. Extinguish campfires. Only replace moss mat if campfire is dead out and cold.
3. Scatter rocks, poles and firewood.
4. Fill latrines and replace moss.
5. Remove all equipment and gear.
6. Burn all trash or haul it out. **Do not** bury trash.
7. Police camp area and **check it** before crew departure.

Appendix N

Sample Delegation of Authority to Incident Commander:

DELEGATION OF AUTHORITY

I authorize delegation of authority and transition of responsibility for the management of the Shanta Creek Fire (# 903348) at 1600 on 7/9/09 from the current Type 3 Incident Commander (IC) Brad Reed to Type 1 IC Steve Gage.

My management concerns and priorities are:

1) Highest priority and maximum effort shall be on firefighter and public safety. Ensure the 10 Standard Fire Orders are followed, and the 18 Watch Out Situations are mitigated.

2) Hold the fire within Limited suppression areas.

3) Increase efforts appropriately should the fire approach Full suppression areas; use all appropriate means, consistent with these management concerns and priorities, to contain fire within the Kenai National Wildlife Refuge boundaries.

4) Consistent with the above objectives, allow the fire to play its natural role in fire-dependent ecosystems. Fuels reduction of beetle-killed spruce and mature black spruce forest in Limited suppression areas is desired, consistent with Priorities 1 – 3 above.

5) Manage the fire consistent with values at risk with due consideration to cost containment.

6) Integrate Minimum Impact Suppression Tactics (MIST) as practicable to address the Refuge's primary management objectives to include resource conservation, wildlife-oriented recreation, and wilderness values. Minimize ground disturbance and use of mechanized equipment in designated wilderness areas as practicable while addressing primary objectives. All use of dozers or tracked vehicles on the Refuge requires prior approval by the Refuge Manager or designee.

7) Coordinate with State of Alaska representatives as appropriate and honor State management responsibilities (see below).

8) Establish an information process that provides timely public information and notification and provides a productive relationship with the public, political officials, and the media.

9) Avoid retardant drops on lakes, streams, and wetlands, as practical, to protect fisheries.

10) We will be using the Wildland Fire Decision Support System (WFDSS) to document decisions related to this fire. Daily updates of applicable information will be required for this process as long as the fire remains active. In addition to updating intelligence gathering and

assessments, cost analysis for implementation strategies and advice on adapting incident objectives based on current and predicted fire behavior will be expected.

11) Facilitate any necessary restoration or rehabilitation efforts.

12) I encourage use of training positions to be used in a cost-effective manner wherever reasonable opportunities may exist.

Doug Staller, Deputy Refuge Manager, is being assigned to the team as my Agency Representative. He is authorized to speak for me in the event that an administrative decision is needed. Doug Newbould, the Refuge Fire Management Officer, is assigned as a Resource Advisor.

_____ _____

Refuge Manager Date

STATE Of ALASKA MANAGEMENT CONCERNS AND DELEGATION

I concur with the Refuge management concerns and priorities listed above. Additionally, consistent with Numbers 1, 3 and 7 above, the delegation for full suppression actions to protect State and private lands or structures threatened by the Shanta Creek Fire is authorized. State managed resources may also be made available to address any of the listed State or Refuge concerns and priorities, following current protocols (the State approves the use of Federal credit cards for procurement).

The Division of Forestry's Agency Administrator Representative for this fire is Hans Rinke, Kenai-Kodiak Area Forester.

_____ _____

Coastal Region Forester Date
Alaska Department of Natural Resources
Division of Forestry

Appendix O

Burned Area Rehabilitation (BAR) Contacts

- **Regional Fire Management Coordinator (RFMC) –** Doug Alexander (907) 786-3497
- **Regional Fire Ecologist** – Lisa Saperstein (907) 786-3422
- **Refuge Manager –** Andy Loranger (907) 262-7021
- **Refuge Supervisory Biologist** – John Morton (907) 262-7021
- **Refuge GIS Specialist** – Dawn Magness (907) 262-7021
- **Refuge FMO** – Doug Newbould (907) 260-2844

Appendix P

Kenai NWR Five-Year Hazardous Fuels Treatment Plan

Refuge and Regional Fire Management Staff, through collaboration with interagency land and fire management partners and the Communities of the Kenai Peninsula, annually develop and update the Refuge Five-Year Hazardous Fuels Treatment Plan. Planned and approved hazardous fuels projects and treatments are input in the National Fire Plan Operating and Reporting System (NFPORS) database, and are hereby incorporated by reference in Appendix P of the Refuge FMP. Project and treatment implementation is coordinated among the interagency and community partners through the All Lands All Hands Committee on a semi-annual basis. Project and treatment accomplishment is by necessity, a very fluid process. Project funding, weather, fuels conditions and implementation resource availability are all factors that contribute to, or limit accomplishment in any given year.

Appendix Q

Kenai Refuge Wildfire Prevention and Outreach Plan

This plan will be developed through interagency collaboration for inclusion in the 2013 Fire Management Plan for the Kenai National Wildlife Refuge.

Appendix R

Refuge Wildfire and Hazard Fuels Mitigation Monitoring Plan

This plan will be developed through consultation with the Regional Fire Ecologist and the Refuge Ecologist for inclusion in the 2013 Fire Management Plan for the Kenai National Wildlife Refuge.

Appendix S

Fire Ecology and Fire Regime Shift due to Climate Change

Historic Fire Regime

The historic fire regime has been well studied on the Kenai Peninsula (Berg and Anderson 2006, Anderson et al. 2006). Prior to this past century, major fires of unknown origin took place in 1871, 1883, 1891, and 1910 (Lutz 1960), burning much of the Tustumena Benchlands. In 1947 and 1969, two large human-caused fires burned 310,000 acres and 86,000 acres, respectively, in the Kenai Lowlands, converting much of the mostly mature black spruce forest to birch and aspen. Since the 1990s, ~ 140,000 acres of mature and beetle-killed white and Lutz spruce have burned in several fires around Skilak Lake and south of Tustumena Lake.

Historically, two distinct fire cycles occur in spruce on the Kenai landscapes. Black spruce forests, primarily in the Kenai Lowlands, increase in flammability with age (DeVolder 1999). A revised estimate of the mean fire return interval over the entire study area for the past 300 years is 89 ± 43 years (1 SD) years (range 25-185 years) based on 1,022 basal cross-sections and 771 increment cores of lowland black spruce (Berg, pers. comm.). Twelve fires were dated as occurring in 1708, 1762, 1801, 1828, 1883, 1834, 1849, 1867, 1874, 1884, 1888, and 1898.

In contrast, white, Lutz and Sitka spruce forests on uplands 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 for the past 2,500 years was estimated to be 515 ± 355 (1 SD) years (range 105–1642 years); the mean time-since-fire was estimated at 605 ± 413 years (median 444 years, range 90–1518 years). These estimates are based on a sample size of 112 radiocarbon dates of soil charcoal at 22 sites from Anchor Point to Nikiski (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 ~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 north of Kachemak Bay, there are no spruce forests more than 200 years old, even though some of those forests have not burned for at least 1,500 years. It appears that spruce bark beetle outbreaks recycle these forests much more frequently than does fire (Sherriff et al. 2011). It is rare to find spruce trees more than 300 years old, although these species typically live to be 500 - 600 years in other parts of their range.

In mixed white and black spruce and hardwoods forests, the mean fire return interval for the Paradox Lake area ~10 km north of Sterling was estimated at 130 ± 66 years (1 SD) years with 35 fires separated by intervals of 40 to 270 years occurring during the last 4,600 years since the arrival of black spruce on the landscape. This estimate is based on sedimentary charcoal in a 9m core taken from Paradox Lake (informal name) at a depth of 15.8 m, supplemented with a 70-cm short core of near-surface sediments. The total charcoal fire history record spanned ~13,000 calendar years; mean fire return intervals were longest during the shrub-herb tundra phase (138 ± 65 yr), decreased after expansion of *Betula kenaica*, *Salix* and *Populus* (77 ± 49 yr) and *Picea glauca* (81 ± 41 yr), and increased again with the arrival of *P. mariana* (130 ± 66 yr)(Anderson et al. 2006).

The presence of almost 1 million 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. On average, 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).

Wildland-Urban Interface

The western and southern boundary of Kenai National Wildlife Refuge is quickly becoming 175 miles of WUI, stretching from the subdivision at Point Possession, past the communities of Nikiski, Kenai-Soldotna, Sterling, Funny River, Kasilof-Clam Gulch, Ninilchik and Anchor Point-Happy Valley, to the cabins in Caribou Hills near the headwaters of Kachemak Bay. Portions of this developing WUI have shared boundaries that both delineate refuge administrative boundaries and Congressionally-designated Wilderness. These areas, in particular, will become increasingly more problematic because of the juxtaposition of lands managed under critical and full fire management options with those that are limited. Additionally, the three wilderness units nested within the administrative boundary of the refuge makes for a strange geometric artifact: there is actually more wilderness boundary (760 km) than refuge administrative boundary (660 km)!

The ecological effects of managing the WUI will almost certainly become more pronounced as lands outside the refuge become developed. Indeed, Dibari and Morton (2006) examined the fire history along the refuge boundary during 1937-2005 and found that a greater area of black spruce and white/Lutz/Sitka spruce burned in the portion of the 2 km buffer inside the refuge than the portion of the 2 km buffer outside the refuge. Additionally, a greater percentage white/Lutz/Sitka spruce burned inside the refuge than would be expected given the percentage of land in that land-cover type, suggesting that increasing parcelization and associated fire suppression outside the refuge may already be creating a discontinuity in vegetation composition on either side of the administrative boundary.

In general, the 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 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; and
- impacts to animal and plant populations due to increased legal and illegal harvest, increased brown bear mortality in defense of life or property (DLP), and increased moose-vehicle collisions.

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 risks 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 2005 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, we 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 (Morton et al. 2006).

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.

Naturalness and BIDEH

Wildfire is a natural landscape process. In forests of the Kenai Peninsula, historical fire return intervals 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. Human-caused ignitions have 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 (Morton et al. 2006):

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); and
4) to mimic (long-term) or restore (short-term) a significantly altered natural fire regime.

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 which conflicts with the primary purposes of Wilderness. Locally, reduced air quality from prescribed fires continues to concern the Alaska Department of Environmental Conservation, the fire management community, 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.

On the other hand, only 28,000 acres have been treated either mechanically or with prescribed fire since the 1960s. This relative lack of success is due in part to lack of access and to the fact that when fire conditions are good for prescribed burns, they are also good for wildfires (and so fire management resources are unavailable). Consequently, we will move away from attempting to use prescribed fire in a landscape context (e.g., enhancing moose habitat), and consider using it for more local-scale issues like reducing WUI in a strategic manner (to create more decision space to allow wildland fire to run), creating vegetative corridors to move wildlife towards highway mitigation structures, or for treating invasive plants (see discussion below).

Invasive Exotic Plants and Fire

Over 110 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 still relatively pristine, Kenai Refuge is one of only two refuges in Alaska on the highway system and hosts more than 300,000 annual visitors. The Peninsula has been the site of commercial oil and gas activities since the early 1960s. With 56 square miles of anthropogenic footprint (the area removed from habitat or ecological productivity by human activities), exotic flora are well established in certain areas of the Refuge. Most locations of the 70+ exotic species that have been documented on the Refuge are associated with roads, trails, seismic lines, utility rights-of-way, oil and gas infrastructure, campgrounds, and cabins. Several of these species are relatively invasive, including scotchbroom (*Cytisus scoparius*), white sweetclover (*Melilotus alba*), bird's vetch (*Viccia cracca*), and reed canary grass (*Phalaris arundinacea*).

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). The concern is that there is a positive feedback between invasive plants and fire: invasive plants can increase and change fire risk, and fire operations can increase the risk of invasive spread, and both are likely to increase along the WUI.

Fire has been demonstrated to contribute to invasive plant population increases in Alaska (Villano and Mulder 2008). Burned areas provide competition-free establishment areas as well as corridors for spread through undisturbed ecosystems (Conn et al. 2003). Increases in air temperature with a warming climate may lengthen the fire season and increase fire probability in Alaska (Randerson et al. 2006). Climate change is also known to increase invasion risk (Bradley et al 2010). Although fire management activities may contribute to spread of invasive populations by creating human and equipment movement vectors, prescribed burning may have positive effects on invasions as a control tool.

Prescribed burning can be used as a tool to control known populations of certain invasive plant species. Invasive control burns must take into account timing, fuel type, fire type, pre-treatments (such as herbicide application, mastication or thinning), and particular plants targeted (DiTomaso & Johnson 2006). Post-fire native vegetation success in Alaska depends on a variety of conditions, including climate and weather conditions, burn severity, pre-burn vegetation composition, fuel load, and burn season (Boucher 2003).

Late winter and early spring prescribed burns have been most effective in reducing non-native plant populations (Potts & Stephens 2009, Meekins & McCarthy 2001). Species that responded best to prescribed control are those with highest above and belowground mortality, including herbaceous forb species such as garlic mustard (*Alliaria petiolata*). However, most control efforts required post-burn monitoring and may require additional treatments such as herbicide application (DiTomaso & Johnson 2006, Meekins & McCarthy 2001, Nuzzo 1991).

<u>Fire operations as introduction and spread vectors</u>

Invasive plant species populations on the Refuge may increase through fire management activities. Although only four percent of the Refuge contained invasive species in the LTEMP systematic inventory , a focused anthropologically disturbed area invasive inventory revealed that major invasions were located in developed areas (access points, buildings, campgrounds, oil-gas wells, roads, seismic lines, trails, and a transfer station) (Barnett & Simonson 2007). Fire management activities frequently utilize these developed areas to conduct and stage activities and personnel.

Specific Refuge incidences with invasive plant introduction and spread include the 2004 Kings Court Fire. Numerous field crews and aircraft were based in and near the existing campground and parking lots of the upper boat launch on Skilak Lake, as well as in a gravel pit further east along Skilak Lake Road. Following fire operations, new populations of oxeye daisy (*Leucanthemum vulgare*), quackgrass (*Elymus repens*), and tansy ragwort (*Senecio jacobaea*) (previously

unrecorded in this region) were observed immediately within the operations area and the gravel pit. Subsequent tracking post-fire revealed a substantial increase in both oxeye daisy and quackgrass along the side access road to the boat launch and along the main road. Another incidence includes the Shanta Creek fire in 2009, on the northern shore of Tustumena Lake. Following fire operations, a half-acre population of orange hawkweed (*Hieracium aurantiacum*) was discovered along a dozer line, though it seemed apparent the infestation existed prior to the fire.

Fires or back fires may create new colonization habitat adjacent to developed sites, including private inholdings, historical cabins, and recreational cabins. While most inventoried non-native species at these sites have a low invasion risk value (Carlson et al. 2008), populations of wind-dispersed species may be undesirable in proximity to sensitive ecological areas such as glacial outwash plains.

Many graminoid species are well adapted to fire (USFS 2012). Species of specific potential concern in post-fire Refuge landscapes include:

- meadow foxtail *(Alopecurus pratensis*) - resprouts from rhizomes in low to moderate intensity fires, rapid colonization post-fire
- orchardgrass (*Dactylis glomerata*) - resprouts from rhizomes in low to moderate intensity fires, increases or remains stable post-fire
- quackgrass (*Elymus repens*) – resprouts from rhizomes in low to moderate intensity fires, can spread quickly by rhizomes in early spring seasonal fires. Late spring fires can reduce populations.
- foxtail barley (Hordeum jubatum) – rapid sprouting and dominant colonization post-fire
- perennial ryegrass (*Lolium perenne*) - resprouts from rhizomes in low to moderate intensity fires, increases post-fire
- timothy (*Phleum pretense*) – resprouts from rhizomes in low to moderate intensity fires, rapid colonization post-fire
- reed canarygrass (*Phalaris arundinacea*) - resprouts from rhizomes in low to moderate intensity fires, fire-tolerant seed bank, will rapidly germinate and dominant colonization post-fire
- Kentucky bluegrass (*Poa pratensis*) – fire intolerant, prescribed burns may be used for control in early spring. Other *Poa* species respond similarly.

Forb species of potential concern include:

- garlic mustard (*Alliaria petiolata*) – fire may kill all above and belowground material; potential to control by prescribed burning.
- spotted knapweed (*Centaurea stoebe* spp. *micranthos*) – taproot can survive fire, fire tolerant seeds, colonization post-fire with seed source.
- orange hawkweed (*Hieracium aurantiacum*), meadow hawkweed (*H. caespitosum*), tall hawkweed (*H. piloselloides*), and narrowleaf hawkweed (*H. umbellatum*) – rhizomes may survive, rapid colonization with seed source (wind dispersal).
- Oxeye daisy (*Leucanthemum vulgare*) – rhizomes survive post-fire, can resprout post-fire, neutral colonization ability post-fire.
- toadflax, butter-n-eggs (*Linaria vulgaris*) – deep root system survives fire, ready dispersal and colonization post-burn with seed source.
- white sweetclover (yellow sweetclover) (*Melilotus alba* or *M. officinalis*) – second-year plants may survive fire, heat tolerant seeds, germination stimulated by fire. increased colonization post-fire with seed source.
- tansy ragwort (*Senecio jacobaea*) – fire kills plants and seeds; prescribed fire may be a control tool.
- perennial sowthistle (*Sonchus arvensis*) – cans survive and persist in burned areas, establishment and colonization post-fire with seed source, wind-dispersed seeds.
- common tansy (*Tanacetum vulgare*) – rhizomes survive post-fire, resprouting post-fire, seedling colonization with seed source.

Some operational changes that we will consider to reduce the likelihood of spreading invasive plants include:

- Prepare and maintain weed-free helicopter staging areas strategically located around the refuge.
- Spray down heavy equipment in advance of a fire; consider purchasing portable washers (http://s-k-enviro.com/index.htm) for deployment at helo/staging areas.
- Prepare HACCP plans for general fire operations (Hazard Analysis & Critical Control Point Planning).
- BAER funding for post-fire restoration.

Climate Change

Mean annual temperatures on the Kenai Peninsula have warmed several degrees since 1977. Much of this increase is due to warmer winters, with December and January having warmed by an average 9° and 7° F, respectively. Summers began to warm most noticeably with the drought of 1968–69, 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), an almost 60% decline. The following changes on the Kenai landscape appear to be related to an increasingly warmer and dryer climate:

- The Kenai Peninsula was the epicenter of a spruce bark beetle outbreak that lasted over a decade through much of the 1990s and caused high mortality of Sitka, Lutz, and white spruce on four million acres in southcentral Alaska (including 1 million acres on the Kenai Peninsula). 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.

- With warmer summers, more water is transpired from vegetation and evaporated from the soil and water bodies; 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). 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 (Berg et al. 2009). The drying of wetlands and fens 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. 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. 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 (Anderson et al. 2006).

- Many Kenai Peninsula glaciers began retreating in the 1850s, but their retreat has greatly accelerated in recent years. The rapid retreat of the Skilak and Grewingk glaciers, and of the nearby Portage glacier, in the last 20–30 years is especially striking. The Harding Icefield lost an average of 21m in thickness (Adageirsdottir et al. 1998) and 5% in surface area (Rice 1987) in the latter half of the 20th century. Areas exposed by receding glaciers will not be vegetated for many decades. However, the hydrology of glacially-fed streams will likely change as glacial input in the warming summer increases in the near term.

- During the past five decades, tree line in the Kenai Mountains has risen an average of 1m per year (Dial et al. 2007), approximating a 300,000 acre loss of alpine tundra. For example, mountain hemlock normally 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 a ground-hugging *krummholz* to a more normal upright stance, indicating a general moderation of the climate at higher elevations. Increased fire at higher elevations is one likely outcome of this afforestation of alpine tundra.

- Over 1,000 lightning strikes in 2005 on the Kenai Peninsula, an area of Alaska in which lightning ignitions were once considered unusual, suggest that local meteorological conditions may be changing (Morton et al. 2006).

The effects of climate change on vegetation composition have been modeled for the Kenai Peninsula using two different approaches. Rupp and Mann (2002) simulated fire-induced vegetation change using ALFRESCO and refuge biologists have used a climatic envelope approach with RandomForest™. Although very different assumptions underlie these two approaches, both models suggest the following salient outcomes:

1) conversion of softwood to hardwood presumably due to more frequent and hotter fires;
2) rising treeline (primarily mountain hemlock) with concomitant loss of alpine tundra;
3) increasing herbaceous cover (grasslands) particularly south of Caribou Hills (note: parcelization and the resulting deforestation will also increase grasslands along the WUI); and
4) loss of old growth softwood forests (note: Berg suggests consecutive above-average summer temperatures will keep spruce bark beetles sustained metabolically and thereby Sitka, white and Lutz spruce from maturing in the foreseeable future).

In addition, Global Climate Change (CGM) model projections of future boreal forest climates suggest that fire burn area will increase as fire regimes change (Podur & Wotton 2010, Amiro et al. 2006). Altered fire regimes may cause a synergistic increase in invasion potential. Greater fire frequency may create more habitat for invasions, and invasions in turn can contribute to more frequent fires. Although the interaction of climate, fire regime, and invasions is not well understood in Alaska, there are well-documented examples of established invasive plants increasing fire frequency. Cheatgrass (*Bromus tectorum*) invasions in the western US has resulted in native vegetation loss, less predictable livestock and wildlife forage crops, and higher fire control costs (Epanchin-Neill et al. 2009). Before cheatgrass invasion, shrub-regenerating fire occurred every 60 to 110 years; major fires now occur every three to five years (ELI 2002). Buffelgrass (*Pennisetum ciliare*) causes higher intensity, lower interval fires that decrease native plant richness (McDonald & McPherson 2011).

Although there is no empirical evidence yet to suggest that the historic mean fire return interval in spruce is changing in response to rapid climate change, it is apparent that the fire regime may be altering in unexpected ways. In the aftermath of spruce bark beetle-induced deforestation, grassland (*Calamagrostis canadensis*) fires have burned in April on the southern part of the Peninsula in recent years. Lightning caused the 2005 Irish Channel fire that burned 1,100 acres of mountain hemlock (Morton et al. 2006), an event so rare in this forest type that charcoal evidence of a historic fire regime has not been detected.

Fire Monitoring

Long-term monitoring of fire activity and its effects on vegetation and fuel loads are supported by both plot-based and remote-sensed approaches.

Plot-based monitoring

Kenai NWR has three long-term plot-based data sets for monitoring the effects of wildfire: NPS Fire Monitoring Handbook (FMH) plots, Hakala plots, and the Forest Inventory & Analysis (FIA) plots. The FMH plots were established in areas where prescribed fires were planned and in areas recently burned by wildfires using established National Park Service FMH protocols (USDI National Park Service, 1992) to quantify the effects of fire on vegetation and fuel loading within the study areas. A report (Bowser & Berg, 2005) and protocol (Bowser, 2010) are available for the Kenai NWR FMH plots.

Most of the 68 FMH plots are located within five study areas: Mystery Creek (42 plots), Lily Lake (4 plots), Windy Point Fire (4 plots), Pothole Lake Fire (6 plots), and Hidden Creek Fire (4 plots). The remaining plots were located at East Road (2 plots) and in the vicinity of moose exclosures (6 plots).

Temporal Distribution

The majority of the plots were installed and simultaneously surveyed between 1994 and 1998 (Figure 3). The Mystery Creek plots burned in 2002 and were resurveyed in 2004. After the Windy Point Fire, the Windy Point plots were sampled in 1997, 1999, and 2004.

Fuel loadings and vegetation data collected as listed below:

- mass per unit area (tons/acre) of woody fuels 0 - ¼ in. diameter (1 hr. fuels)
- mass per unit area (tons/acre) of woody fuels ¼ in. - 1 in. diameter (10 hr. fuels)
- mass per unit area (tons/acre) of woody fuels 1 in. - 3 in. diameter (100 hr. fuels)
- mass per unit area (tons/acre) of live woody fuels > 3 in. diameter (1000 hr. fuels)
- mass per unit area (tons/acre) of dead woody fuels > 3 in. diameter (1000 hr. fuels)
- mass per unit area (tons/acre) of litter
- mass per unit area (tons/acre) of duff
- brush density (individuals/m^2) for each shrub species
- herbaceous density (% cover) for each herbaceous species
- herbaceous density (point-intercept density) for each herbaceous species
- seedling tree density (individuals/m^2) for each tree species
- seedling tree heights (categorical) for each tree species
- pole-size tree density (individuals/m^2) for each tree species
- pole-size tree heights (categorical) for each tree species
- pole-size tree diameter at breast height (DBH) (cm) for each tree species
- burn severity of vegetation (categorical)
- burn severity of litter and duff (categorical)

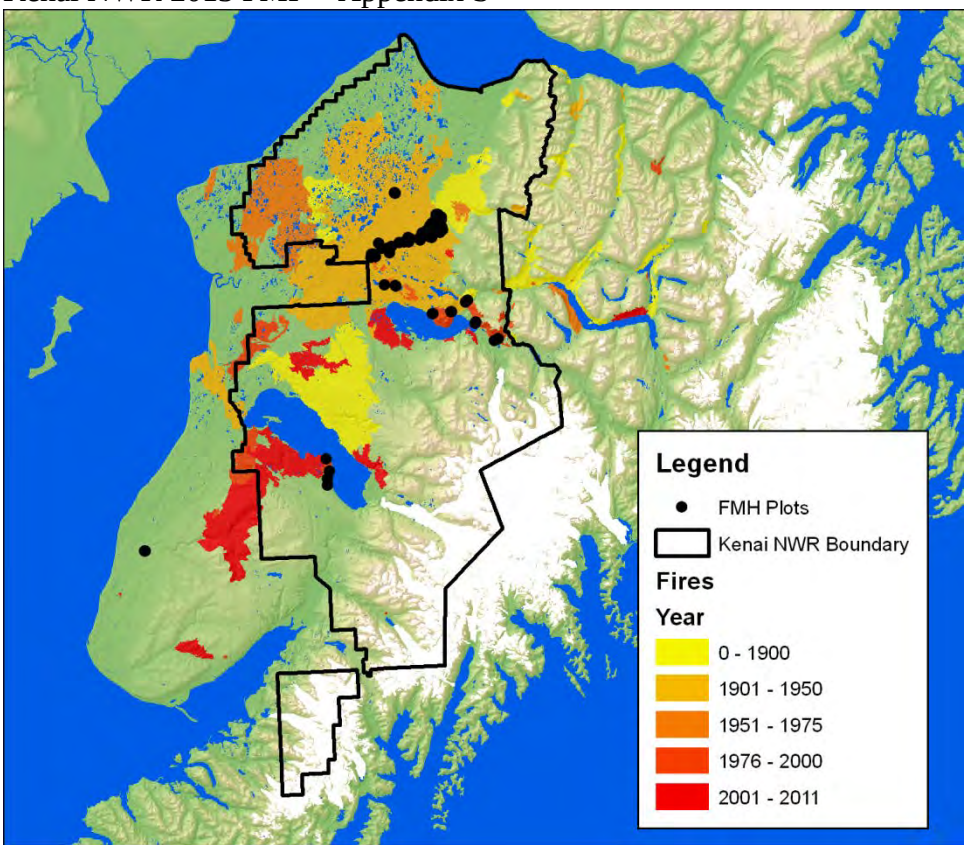


Figure 1. Kenai NWR FMH plot locations.

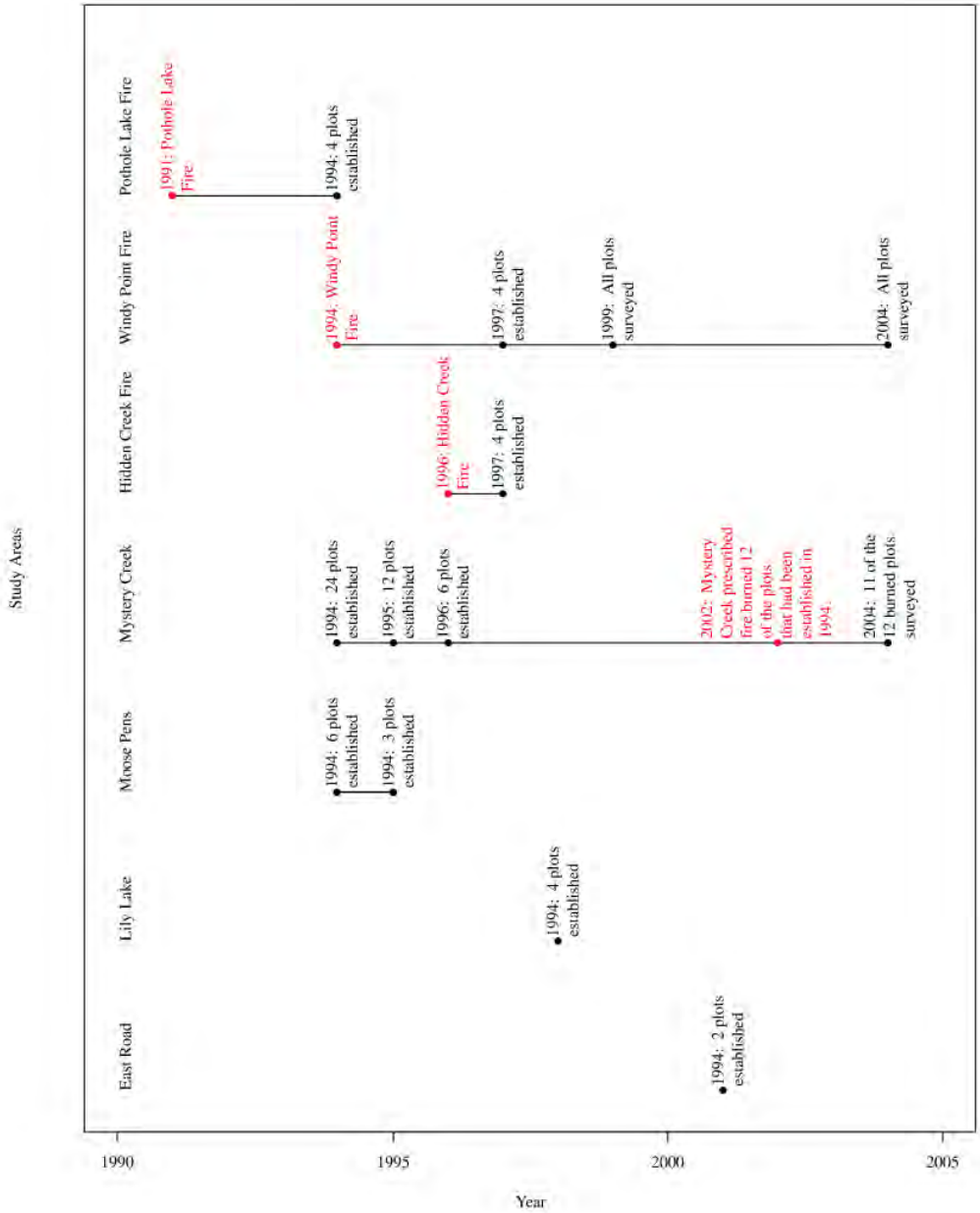


Figure 2. Timeline of establishment and sampling of KNWR FMH plots from Bowser (2010). The Lily Lake plots were established in 1998.

The Hakala plots were established in 1950 within the 1947 burn to monitor the succession of vegetation post-fire. The nine Hakala plots are spread along Skilak Lake Road from its western end to the vicinity of Bear Mountain. The plots were established and surveyed in 1950. They were resurveyed in 1955, 1961, 1965, 1995, 2000, 2005, and 2010. Data collected include the following:

- Basal area of all tree species and larger shrubs (ft^2/acre)
- DBH of trees and tall shrubs (cm)
- Heights of trees and tall shrubs (cm)
- Stem (stems/acre) densities of herbaceous plants and small woody plants (stems/unit area)
- Frequencies of occurrence of all non-tree species
- Cover estimates of ground cover classes (% cover)
- Burn severity (categorical)

(a) Spatial Distribution

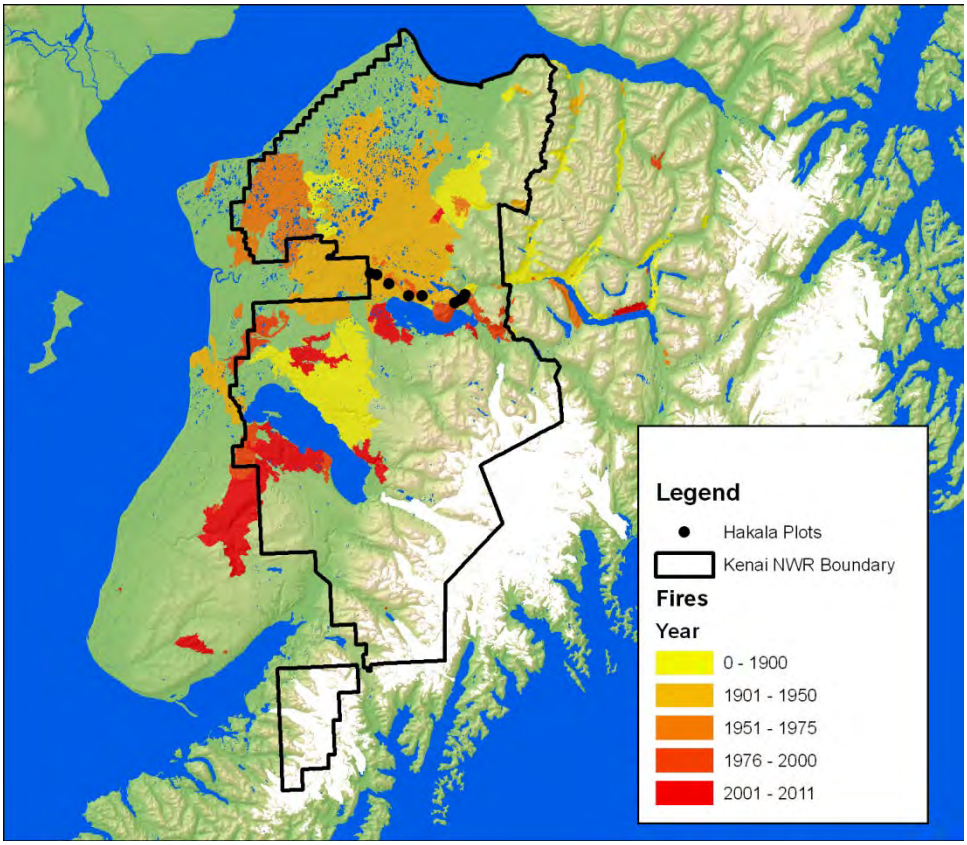


Figure 3. Hakala Plot locations.

The FIA plots are monitored by the US Forest Service and are considered part of the Refuge's Long Term Ecological Monitoring Program (LTEMP). Plots were initially established during 1999-2002 and include 215 P2 plots and 21 P3 plots on the refuge; 20% of these plots are resampled on even years every decade. Data collected at the P2 and P3 levels include the following:

P2 plots

Plot/stand level metrics

- Condition class (categorical, related to basal area & stem density)
- Stand age (years)

Seedling stocking, regeneration, and biomass information for all tree species

- Seedling condition (categorical)
- Seedling density (seedlings/acre)

Tree and sapling data for all tree species

- Tree condition (categorical)
- Tree status (categorical)
- Standing dead tree (categorical)
- Tree diameter at breast height (DBH) (in.)
- 10 year growth rate, from core (in.)
- Tree heights (ft.)

P3 plots

Down woody material

(b) Spatial Distribution

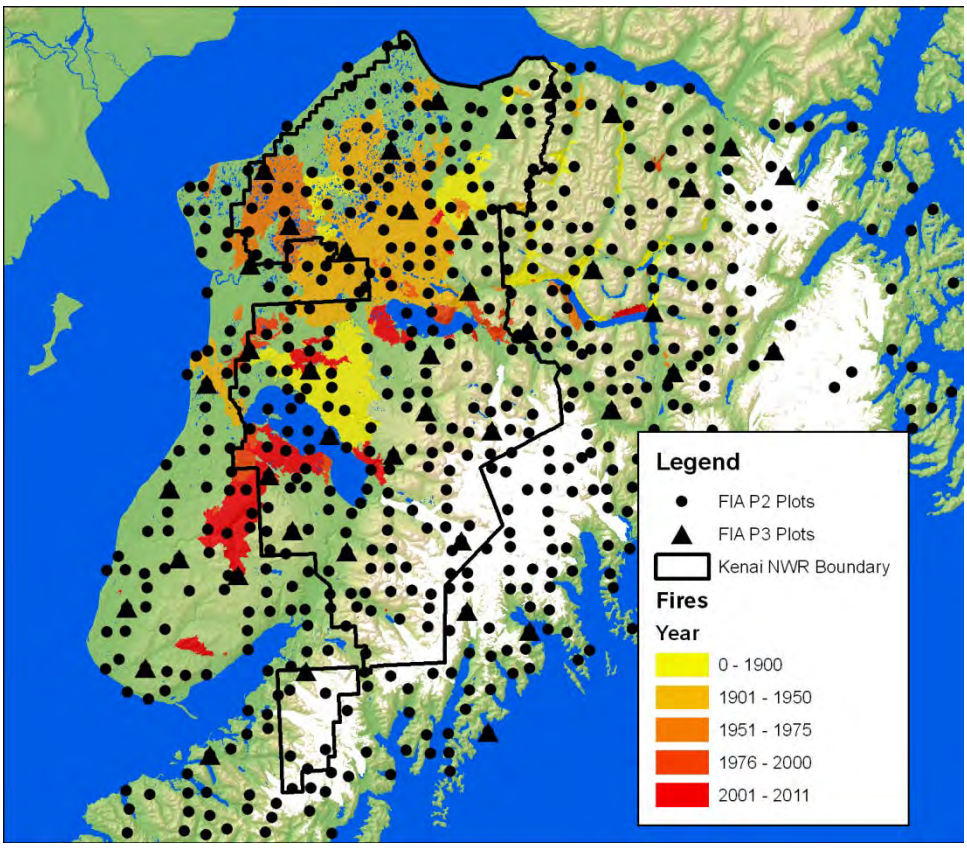


Figure 4. Kenai Peninsula FIA plot locations. These are the "fuzzed" coordinates.

Remote sensed

Historic fire perimeters have been reconstructed using natural features (lakes, wetlands, and rivers) and dendrochronology (fire scars, stand-age) from 1708 (De Volder 1999). In Alaska, systematic fire reporting began in the 1940s after the Alaska Fire Control Service was organized (Gabriel and Tande 1983). Fires over 1000 acres from 1940-1987 and fires over 100 acres after 1987 are included in a spatial database hosted by the Alaska Interagency Coordination Center. In 1999, the Moderate Resolution Imaging Spectroradiometer (MODIS) was launched to collect remotely sensed data. MODIS provides daily images used to detect and map the spread of active fires (Justice et al. 2002). Fire perimeters are also documented at field sites using GPS and uploaded into a database at the Alaska Interagency Coordination Center (www.fire.ak.gov). Therefore, the occurrence and extent of future fires on the KENWR will be accurately recorded. The KENWR also maintains a fire history geodatabase for the Kenai Peninsula.

In addition, refuge staff monitor landscape vegetation and land-use with change-detection analysis of classified LANDSAT imagery. The first landcover classification has been completed using 2002 LANDSAT images. Twenty-six land cover classes were identified and mapped across the Kenai Peninsula (O'Brien 2006). Classification and change detection analyses will occur in 10 year intervals as Forest Inventory and Analysis (FIA) data become available for training.

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