U.S. FISH AND WILDLIFE SERVICE

Kanuti National Wildlife Refuge

Fire Management Plan

March 2007

FIRE MANAGEMENT PLAN
KANUTI NATIONAL WILDLIFE REFUGE

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF EXHIBITS IN APPENDIX

Appendix

I. INTRODUCTION

A. PURPOSE OF THE FIRE MANAGEMENT PLAN

The purpose of the Kanuti Fire Management Plan (FMP) is to describe the fire management activities that will occur on the Kanuti National Wildlife Refuge (Refuge). The FMP provides the framework for all Refuge fire management decision-making and specifies the uses of fire which are consistent with Refuge goals and objectives. Once the FMP is approved, it becomes the basis for the expenditure of fire funds. U.S. Fish and Wildlife Service (Service) policy (621 FW 1) requires all refuges with vegetation capable of sustaining fire to develop a fire management plan. The FMP describes the relationship to land management goals and fire policy, wildland fire management strategies and components, organization and budget, and monitoring and evaluation. An approved FMP is also a prerequisite to conducting prescribed burning and wildland fire use.

B. ACHIEVING LAND AND RESOURCE MANAGEMENT OBJECTIVES

This FMP will help achieve land and resource management goals and objectives as defined in the Kanuti National Wildlife Refuge Comprehensive Conservation Plan, Environmental Impact Statement, and Wilderness Review – Final, May 1987 (CCP/EIS/WR). The FMP, recognizing fire as a natural and necessary ecological process, will guide fire-based decisions involving both wildland fires and prescribed fires to meet overall landscape objectives. The FMP will guide in protection against wildland fire whenever it threatens natural and cultural resources along with threats to the refuge boundary. The FMP also provides direction to the Alaska Interagency Wildland Fire Management Plan (AIWFMP).

C. COMPLIANCE

As required by the National Environmental Protection Act (NEPA), the Service must assess environmental effects of Service actions. Generally fire management activities are categorically excluded (516 DM 6, updated 1997). Two avenues for categorical exclusion are available, either through the Fish and Wildlife Service or the US Department of Interior. For each action a NEPA Compliance Checklist and an Environmental Action Statement shall be completed, along with supporting documentation. Based on this initial assessment the action will either meet the criteria for a categorical exclusion, require an Environmental Assessment (EA) or, if necessary, an Environmental Impact Statement (EIS). For actions not categorically excluded, the EA or EIS is prepared before taking any fire management action.

Fire management activities were analyzed in the Kanuti CCP/EIS/WR and the FMP is tiered to that document. Operational plans developed and implemented are usually categorically excluded from further NEPA analysis when there is an approved CCP, the CCP has been through the NEPA process and burning is done for habitat improvement or prevention purposes. Fire management activities will comply with all applicable regulations including but not limited to Section 106 of the National Historic Preservation Action of 1966, Section 7 of the Endangered Species Act (as amended in 1973), Section 810 of the Alaska National Interest Lands Conservation Act of 1980 (ANILCA), and Section 118 of the Clean Air Act (as amended in 1990).

D. COLLABORATIVE PROCESS

The FMP was prepared in cooperation with refuge neighbors and interested parties. Personal contact and correspondence, mail-outs, radio announcements and e-mail were among the methods used to contact interested parties. Village elders and two village councils (Allakaket, Bettles/Evansville) contributed to the development of the plan. The Alaska Department of Fish and Game, Bureau of Land Management Alaska Fire Service (AFS), Tanana Chiefs Conference, Bureau of Indian Affairs (BIA) and Doyon Limited provided information and exchange of ideas in the formulation of the FMP. The plan was also developed in association with Fish and Wildlife Service (Service) biologists, managers, and fire management officers.

Local residents, the Regional Native Corporation, and BIA were all concerned about private parcel protection. Repeated visits were made to two local villages (Allakaket and Bettles/Evansville) and the information gathered was used in writing this plan. The two village councils expressed concern for landscape-scale prescribed burning for resource purposes in areas close to their villages (given recent active local wildland fire history), but strongly supported hazard fuels reduction burns as part of village WUI projects. Kanuti Refuge staff was concerned about: (1) maintaining fire's natural role on the refuge, considering that 70% of the refuge has burned since 1950, (2) how to fund the monitoring of past and future fire, (3) protecting critical wildlife habitat, such as the remaining unburned lowland lichen range for wintering caribou. The Regional Archeologist expressed concern identifying and protecting prehistoric, historic, and cultural sites.

E. DESCRIPTION OF KANUTI NATIONAL WILDLIFE REFUGE

The Kanuti National Wildlife Refuge (NWR) lies totally within the Service's Interior Alaska Ecosystem Unit and contains a diverse mosaic of plant communities representative of all major habitat types occurring in Interior Alaska. Much of the following information comes from and is provided in more detail in other sources such as the refuge's Comprehensive Conservation Plan (CCP) (USFWS 1987), annual narrative reports (USFWS 1996a), and the Land Protection Plan (USFWS 2002).

1. Physical Description

The refuge is located in central Alaska, north of the Yukon River and south of the Brooks Range (Fig. 1). The southern boundary of the refuge is about 130 air miles north of Fairbanks. The Arctic Circle bisects the refuge. Three dominant physical features of the refuge are the Kanuti Flats, and the Koyukuk and Kanuti Rivers, which flow through the Flats. The refuge is roughly rectangular in shape, extends 50 miles east–west and 60 miles north–south, and is larger in size than the state of Delaware. As of 2002, there are 1.2 million acres under actual federal management, of 1.6 million acres within the refuge administrative boundary (USFWS 2002).

2. Adjacent Ownership

The refuge is surrounded by state selected and conveyed lands to the north and south; and private selected lands to the southeast and northeast. The Dalton Highway and the trans-Alaska pipeline corridor extend north–south a few miles east of the refuge boundary. Within the refuge there are approximately 346,000 acres of land selected or conveyed to Native corporations and 13,400 acres of Private Parcels. Corporation selections range in size from small lots to entire townships. Native allotments are considered trust lands and may be up to 160 acres. There are 37 private parcels scattered throughout the refuge. The land status of private parcels may be selected, interim conveyed, or conveyed. Selected and interim conveyed lands remain under the management of the FWS.

3. Village Population and Access

The entire Kanuti area is sparsely populated. No all-season roads pass through the refuge. The Village of Bettles, north of the refuge, is accessible by a winter road from the Dalton Highway, which borders the northeast corner of the refuge (Fig. 1). Travel in and around the refuge is by air throughout the year, mainly by boat in summer, and by snow machine and dogsled in winter. Four villages (Allakaket, Alatna, Bettles, and Evansville) are adjacent to the refuge boundaries. The total population of these four villages is currently 291 people (Alaska Interagency Communities at Risk Assessment 2001). There are no commercial or community developments within the refuge. Archaeological and historic sites are found throughout the refuge.

F. CLIMATE, WEATHER PATTERNS, AND LIGHTNING ACTIVITY

The refuge has a subarctic continental climate, characterized by extreme seasonal variations in temperature and day length. Climate information is taken from USFWS (1996a), Selkregg (1976) and USDA (2002). Summers are short but moderately warm and can be rainy, with average July temperatures usually 65 to 70°F (Table 1). Because of its northern location, the sun stays up nearly all day for much of the summer, leaving little time for cooling during the short "night." Even when the sun does set during the summer, lighting conditions still exceed "civil twilight" continuously from May 13 to August 4. The sun does not set from June 2 to July 9 on the refuge areas north of the Arctic Circle. Temperature extremes range from +90°F in summer to -70°F in winter.

For an understanding of fire activity, it is important to note that the Kanuti area's temperatures and topography are quite conducive to extraordinary summer lightning activity (Trigg 1971). These patterns dictate the lightning strikes that provide the primary ignition sources for wildland fires. The prevailing (“wet”) winds are southwesterly or westerly during summer (Jun–Aug) and average about 9 miles per hour. During the rest of the year, prevailing northeasterly (“dry”) winds average 5–10 miles per hour.

The geography of the Kanuti area resembles a large basin with an opening that faces southwest, along the Koyukuk drainage (see section G. Topography). The surrounding mountains, foothills and uplands cause uplifting of the moisture-laden summer air masses arriving from the southwest. These air masses have moved in from the Bering Sea along the entirely open Yukon and Koyukuk River valleys. The vertical movement of these summer air masses over the Kanuti Refuge leads to the development of towering cumulus clouds. A result of these towering cumulus clouds is a pattern of lightning storms, leading to wildfire ignitions (Fig. 2, 6).

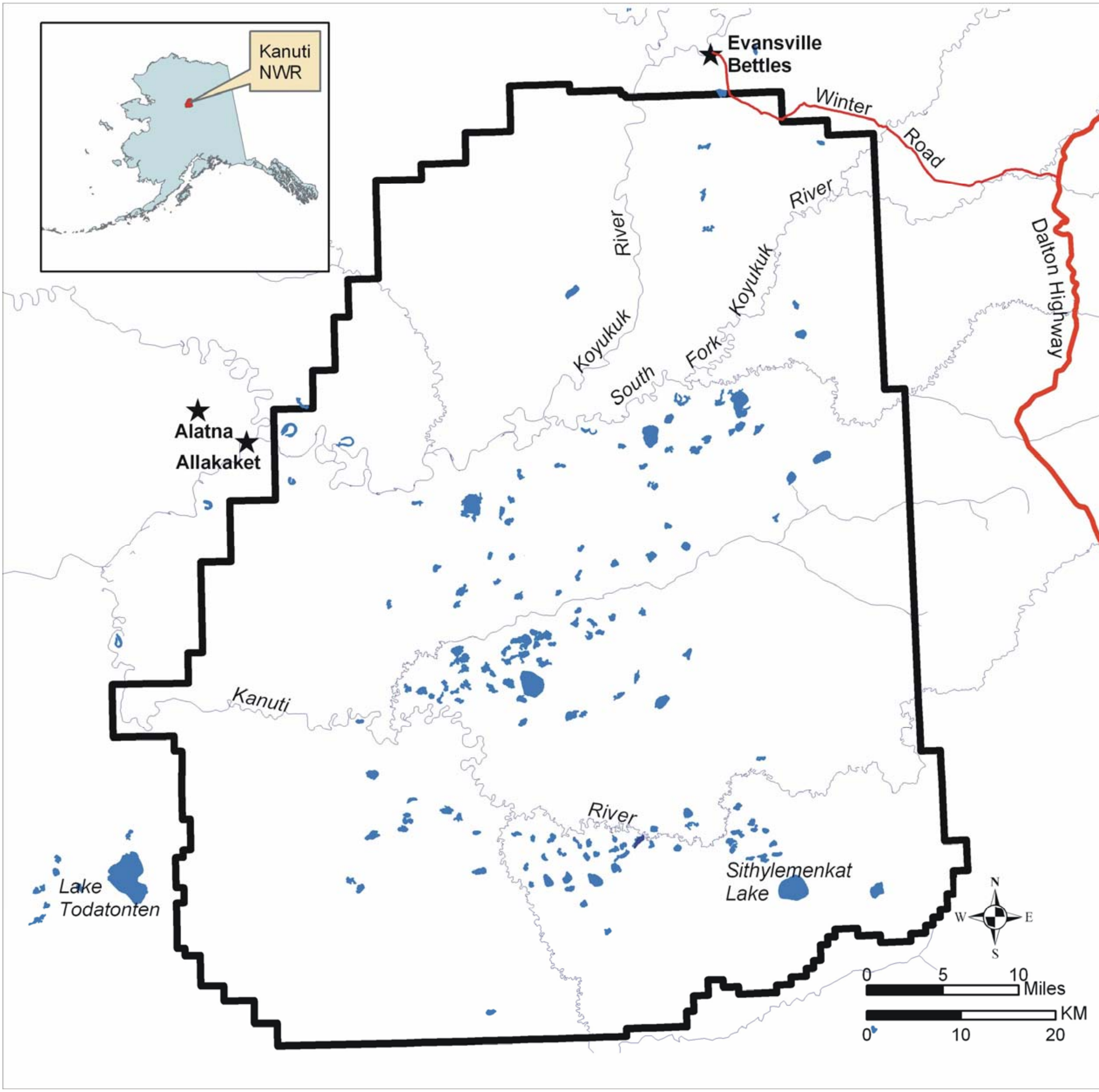

FIGURE 1. Kanuti National Wildlife Refuge with major rivers, lakes, adjacent villages, Dalton Highway and Bettles Winter Road identified.

As these winds are forced upward, the wind pattern on the northern slopes of the Ray Mountains can be particularly turbulent (Maxwell USFWS, pers. comm.). Some thunderstorms may also move counter to prevailing wind patterns (Dissing and Verbyla 1998). Some of these lightning storms are "wet", since the uplifting of the moisture-laden air also causes precipitation to fall. However, some lightning storms are "dry", with little precipitation. Most wildland fire ignitions result from the "dry" thunderstorms.

TABLE 1. Mean temperature and precipitation by month at Allakaket, Alaska, 1949–1998. From the Western Region Climate Center, Period of Record Monthly Climate Summary http://www.wrcc.sage.dri.edu/

	Mean temperature (°F)		Precipitation
Month	Maximum	Minimum	(inches)
Jan	-11.0	-28.4	0.40
Feb	-4.6	-24.8	0.36
March	13.6	-11.8	0.27
Apr	34.3	8.5	0.19
May	55.7	31.8	0.30
Jun	70.2	47.7	0.69
Jul	72.1	50.7	0.94
Aug	65.6	44.5	1.22
Sep	50.5	32.0	0.83
Oct	27.8	13.2	0.58
Nov	3.1	-12.3	0.41
Dec	-11.9	-27.9	0.39
Annual	30.4	10.3	12.50

Precipitation averages 12.5 inches annually at Allakaket (Table 1). During the period, from June through mid-September, the average rainfall is 8 inches at Allakaket. This is over half the average yearly rainfall in just three and a half months. Precipitation at Allakaket and Bettles in summer occurs mainly as rain showers and thunderstorms. Large differences in precipitation in the Kanuti area may be recorded within relatively short distances. Snow covers the ground in the Kanuti area from October to May. The average snowfall is 72 inches at Allakaket and 83 inches at Bettles. Because of the presence of snow for over half the year and the presence of permanently frozen subsoil, this amount of precipitation is relatively effective for plant growth, and in some places creates saturated soils. The growing season is short in the Kanuti area; green-up begins in late May, and leaves begin to drop in mid-August.

The average freeze-up date for the Koyukuk River is mid-October, although open water may be found until November. The river's average date of breakup at Allakaket is early to mid-May. Most ponds and lakes freeze up a week or two before the Koyukuk River, and the ponds usually thaw in early June. Flooding sometimes accompanies breakup in the spring, as ice blocks the river channel and water spreads over the broad lowlands between the Koyukuk and Kanuti Rivers. Many ponds and lakes in the floodplains depend on the flooding to be recharged because of otherwise relatively low precipitation. The summer thundershowers often cause floods along creeks and rivers that drain the Brooks Range and other mountainous areas to the east and south of the refuge.

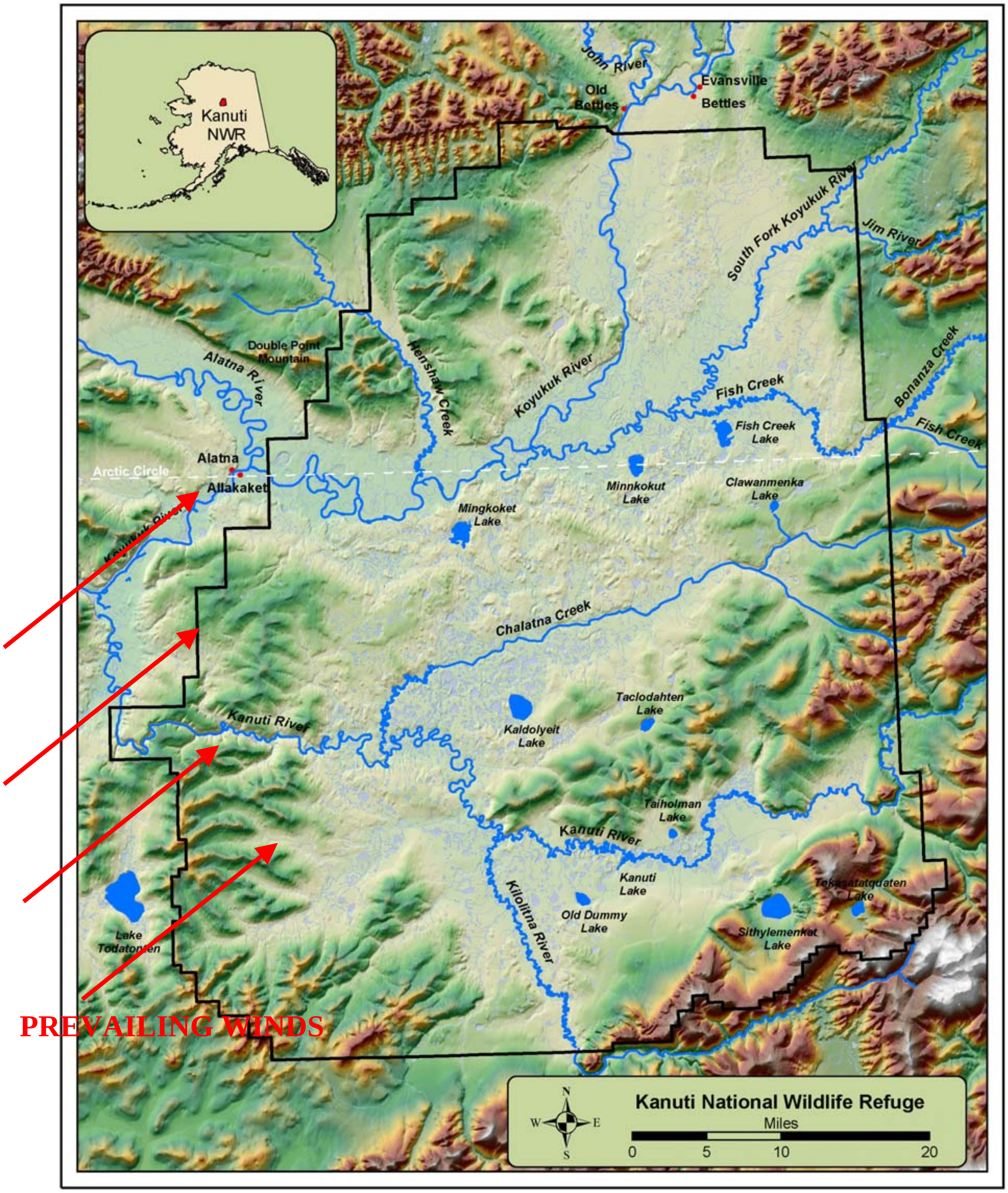

Figure 2. Uplifting of prevailing southwesterly summer winds leads to development of towering cumulus with resulting lightning strikes and wildfire ignitions.

G. TOPOGRAPHY

The Koyukuk River originates in the Brooks Range and flows through the northcentral portion of the Kanuti Refuge. The Kanuti River drains the Ray Mountains and flows through the southcentral portion of the refuge. The Kanuti and Koyukuk Rivers join west of the refuge forming a wide valley opening to the southwest. The Koyukuk River eventually flows into the Yukon River near Galena. The Koyukuk and Kanuti Rivers, before they join, flow through a large interior lowland basin known as the Kanuti Flats. The refuge also includes portions of the surrounding highlands and mountain areas to the south and east. Four physiographic regions are identified on the refuge: Kanuti Flats, Indian River Uplands, Hodzana Highlands, and the Ray Mountains (Selkregg (1976)). Wildland fire patterns are influenced by the landforms, geology and vegetation of these regions.

1. Kanuti Flats

The lowland basin forming the Kanuti Flats is the central feature of the refuge. It lies in the middle of and covers over half the refuge. The basin consists of marshy, lake-dotted flats between the two main rivers (the Kanuti and the Koyukuk). This feature was formed about 50,000 years ago from a 200 square mile, ice-dammed lake. The flats average about 600 feet in elevation but extend from 400 feet above sea level on the west to 1,000 feet on the east, before rising with the glacial deposits of the surrounding hills. The flats are open to the southwest along the Koyukuk River drainage.

2. Indian River Uplands

The Indian River Uplands covers much of the southwestern portion of the refuge. The topography consists of relatively low, gentle ridges and mountains with rounded or flat summits 1,300–2,800 feet high. The Kilolitna River, a tributary of the Kanuti, flows through the center of this region and drains the rolling to steep southern uplands of the refuge as well as the northern flank of the Ray Mountains, before joining the Kanuti. The Kanuti River in turn flows through a canyon in the Indian River Uplands before joining the Koyukuk River in a wide valley west of the refuge.

3. Hodzana Highlands

Rising to the southeast of the Kanuti Flats are the Hodzana Highlands. The highlands are rolling, silt and gravel-covered terraces of glacial origin that slope gradually upwards to the surrounding uplands and mountains along the eastern portion of the refuge. The Hodzana Highlands exhibit rounded ridges, 1,000–2,600 feet high, as well as some rugged mountains to 3,000 feet. Peaks in the Hodzana region form the highest points on the refuge. Some drainages in the Hodzana Highlands are steep and dissected.

4. Ray Mountains

The northern flank of the Ray Mountains region lies along the southeastern boundary of the refuge. The Ray Mountains are an overlapping series of compact, east–west trending ranges, characterized by rounded ridges and small mountains, with peaks reaching 5,500 feet just outside the refuge. The metamorphic bedrock is usually covered with rubble and soils are generally shallow and rocky (USDA 2002). The area is drained by the Kanuti and Kilolitna Rivers.

H. GEOLOGY AND SOILS

At least three glaciations have descended from the Brooks Range to the refuge. As a result, the surficial geology of the Kanuti Refuge is largely composed of Quaternary and Pleistocene glacial deposits. Much of the Kanuti Flats region, especially along the major rivers, is covered by deep, poorly drained wind and water-deposited soils (histic pergelic cryaquepts) covered with a thick layer of peat. Also present are deep, well-drained silts (typic cryorthents) and deep, well-drained loess and silty or sandy, well-drained loams (typic cryorthents). Intermediate elevations and higher alluvial fans have well-drained, deep silt loams and fine sandy loams (typic fluvic cryofluvents) and deep, well-drained silts (typic cryochrepts). Rolling hills in the area also have shallow, poorly drained soils with a thick peaty organic layer (histic pergelic cryaquepts); deep, well-drained silty soils (typic cryochrepts); and rock outcropping of volcanic or sedimentary origin (SCS 1979, USFWS 1987).

Permafrost is continuous under large parts of the refuge and discontinuous elsewhere (Fig. 3). Subsoils may be permanently frozen to depths exceeding 300 feet. Over the permafrost is the active surface layer of soil, duff, and peat, which thaws each summer. This layer may be from a few inches to several feet thick, depending on aspect, distance to a river, soil type, time since last wildland fire, vegetation type, and characteristics of the moss and litter layer. Soil drainage is poor in many places because of permafrost and lack of relief (USFWS 1987).

I. AIR QUALITY

Air quality is generally good. Wind occasionally stirs up silt off river bars, and air pollution from Europe and Asia is present as "Arctic haze" which can be especially visible in late winter and early spring (USFWS 1987). Smoke from summer fires can be significant and linger for extended periods. See Section VII for smoke management procedures.

J. WATER RESOURCES

Abundant and diverse wetlands (including marshes, wet meadows, muskeg, lakes, ponds, rivers, and streams) are dominant features of the refuge. The lowland Kanuti Flats region contains over 3,000 lakes and ponds, most of them smaller than 10 acres in size, and more than 1,800 miles of streams and rivers. See the Kanuti Fishery Management Plan (USFWS 1993) for descriptions of the types of water bodies on the refuge. Sediment loads range from 10 to 100 parts per million in major streams in the flats and up to 500 parts per million in steep uplands. Dissolved solids average less than 200 milligrams per liter. Mean annual runoff for the region is very low, about 0.5 cubic feet per second per square mile. Exceptions are the Middle Fork and the South Fork of the Koyukuk River, and some of their tributaries, which have been actively mined for gold north of the refuge border, in the Wiseman and Coldfoot areas (USFWS 1993).

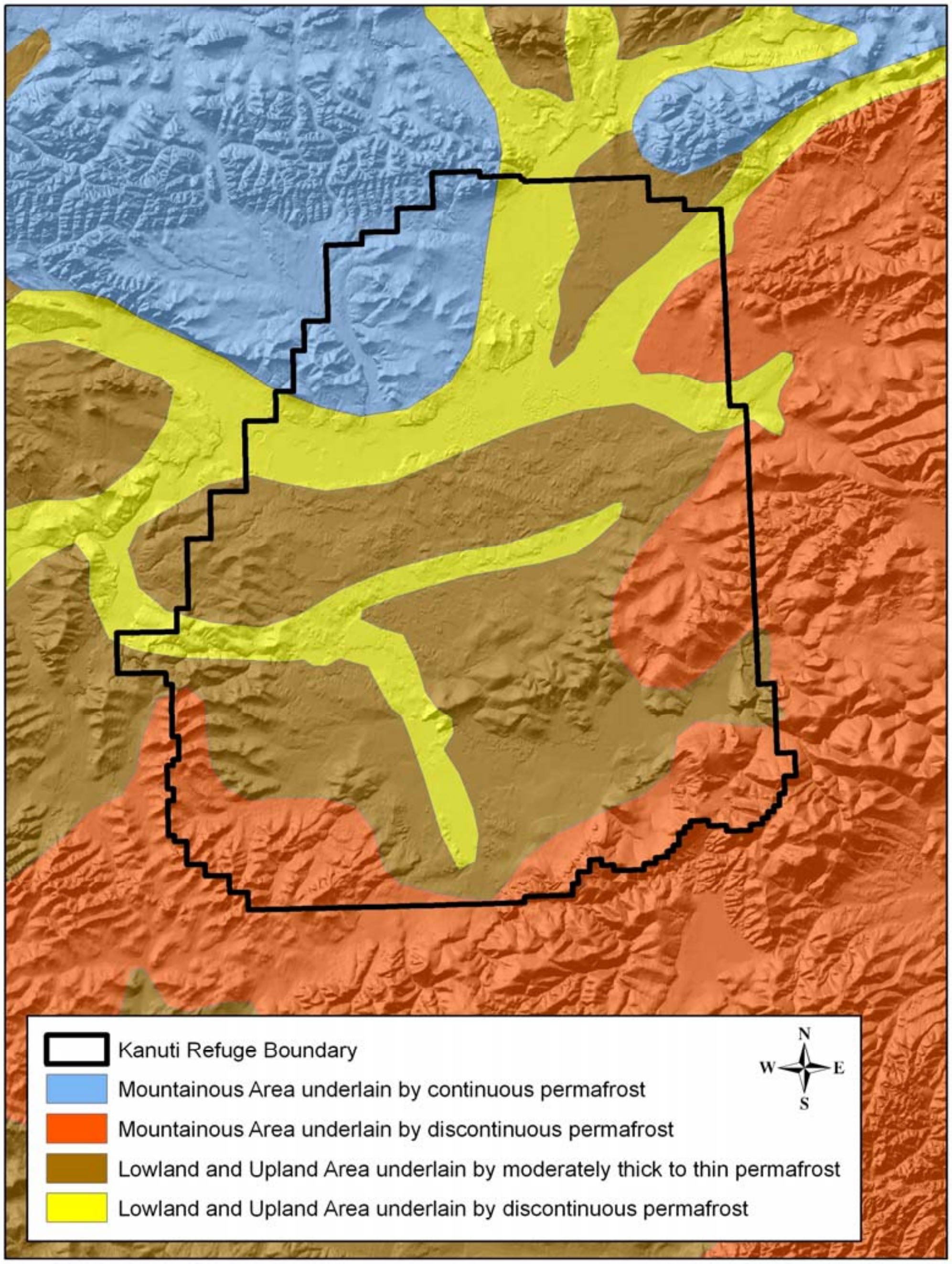

Figure 3. Distribution of permafrost in Kanuti National Wildlife Refuge and vicinity.

K. VEGETATION

The vegetation of the Kanuti Refuge forms part of the circumpolar boreal forest. About 58% of the refuge is covered by forest and about 15% is dominated by successional stages of herbaceous plants, shrubs, and seedlings as a result of wildland fires (USDI and Ducks Unlimited 2001). The burned areas include peat lands and tundra, as well as forest types. Other shrubby types, meadows, and alpine tundra cover about 27% of the refuge (Table 2; Figure 4). Land cover classification derived from 1999 imagery at a 30 meter square resolution (USDI and Ducks Unlimited 2001).

The most conspicuous characteristic of vegetation on the refuge is the complex mosaic of different vegetation types, especially forest cover types, caused by differences in soils, drainage, erosion, permafrost, flooding, and fire history (Figure 4). The succession changes resulting from these natural disturbances cause forest cover types to vary considerably in acreage, over time. The boreal forest regime of the Kanuti Refuge is thus highly dynamic, diverse and forms part of a naturally disturbance-driven ecosystem (Payette 1992, USDI 2002).

The major tree and shrub cover types on the refuge are coniferous forest, consisting predominately of extensive stands of black spruce, and broadleaf forest, which consists of more limited stands of mixed deciduous species (Figure 4). Black spruce (*Picea mariana*) dominates poorly drained and north-facing sites, while broadleaf forest occurs as a successional stage on better drained and south-facing sites. Smaller stands of discontinuous open white spruce (*Picea glauca*) are found on well-drained lowland sites along the major rivers. Deciduous tree species on the refuge include quaking aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*), balsam poplar (*Populus balsamifera*), and tamarack (*Larix laricina*) (Figure 4). Woody species in wetter scrub habitats also include two alder species (*Alnus* spp.*)*, bog birch (*Betula nana*), and many species of willow (*Salix* spp.). Upland sites are characterized by open scrubby forests of black spruce as well as successional aspen stands interspersed with tall shrublands, depending upon aspect and recent fire history (USDA 2002). These deciduous and coniferous species thus make up the seral stages in the fire-driven ecosystem. See also USDI and Ducks Unlimited (2001); and Foote and others (1989, 1995) for descriptions of vegetation on the refuge and also Viereck and others (1992). See Heglund (1992) for a discussion of wetland vegetation types.

Chemical composition and vegetation structure make many tree and shrub species in the boreal forest quite flammable. Black spruce is an example of a fire-adapted species (its cones open after fire or prolonged hot and dry periods). Crowberry (*Empetrum nigrum*) and Labrador tea (*Ledum palustre*) burn with great intensity due to the oils in the plant (Johnson 1992). A more thorough discussion of vegetation types and fuel models for wildland fire is found in Section IV.D.

1. Threatened and Endangered Plants

No threatened or endangered plant species are known to occur on the Kanuti Refuge. However, the yukon aster (*Aster yukonensis*), a candidate for threatened or endangered species listing, has been found on the Koyukuk River south of Bettles, just north of the refuge boundary. (See Refuge Map, Figure 1).

2. Sensitive Biological Communities

The Kanuti Canyon, located in the extreme southwestern portion of the refuge, supports rare plant communities. The north-facing slope of the canyon is covered with a wet taiga community, whereas the south-facing slope maintains a steppe-bluff community. Steppe-bluff communities in this part of Alaska are generally restricted to steep, south-facing bluffs near larger rivers and are quite unique in comparison to surrounding boreal forest communities (USFWS 2002). These steppe-bluff communities in the Kanuti Canyon contain sagebrush and grasses and drought-tolerant forbs. The cliffs of the Kanuti Canyon also provide unique nesting habitats for birds of prey and support higher concentrations than the surrounding boreal forest areas. The steppe-bluff community is mapped on interagency fire maps.

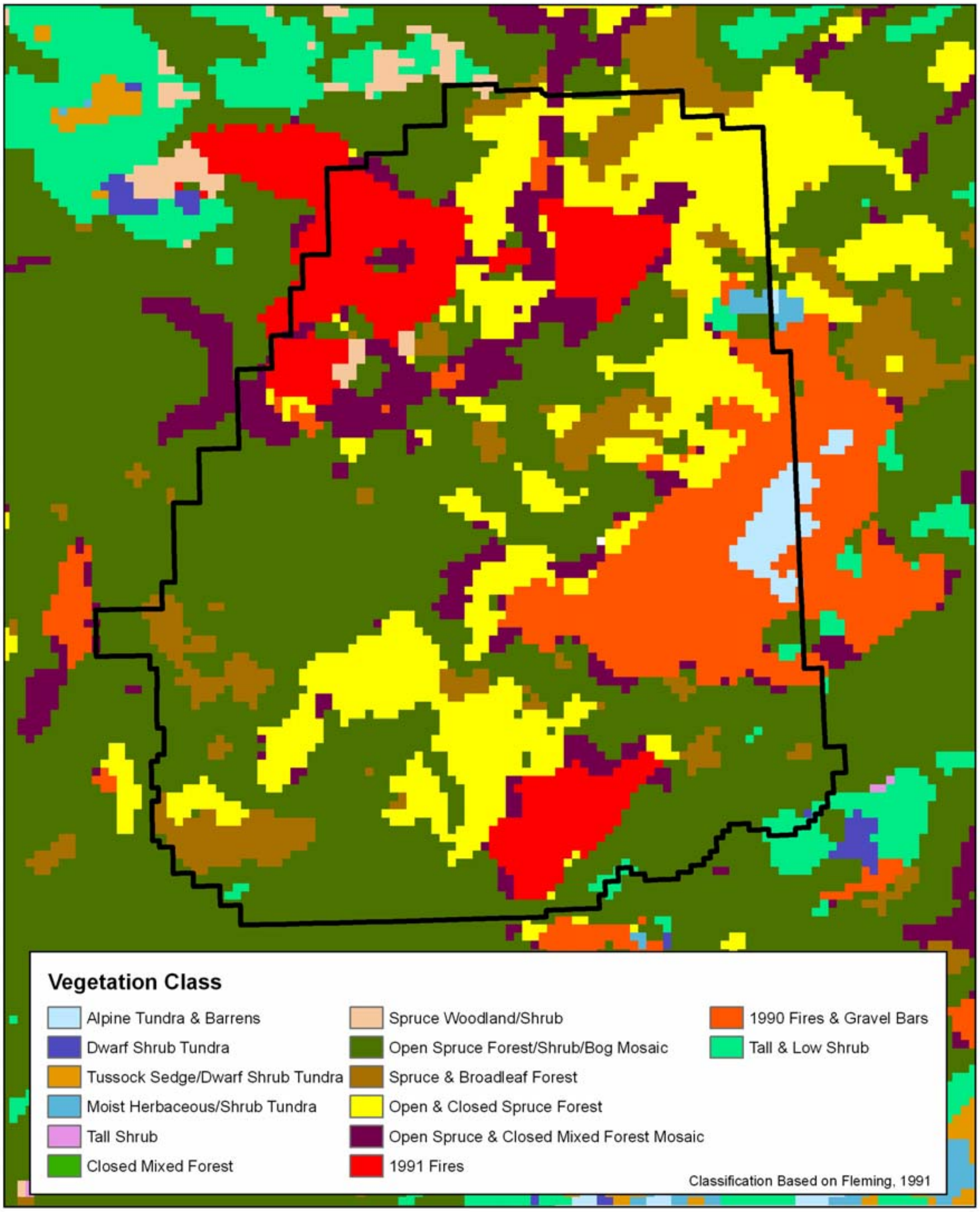

Figure 4. Vegetation/fuels map for Kanuti National Wildlife Refuge and vicinity

TABLE 2. Earth cover acreages for Kanuti NWR lands[a]

Earth cover class	Acres	Percent cover
Closed Needleleaf	1,798	0.11%
Open Needleleaf	347,725	21.24%
Open Needleleaf-Lichen	28,587	1.75%
Woodland Needleleaf	135,343	8.27%
Woodland Ndl.-Lichen	58,110	3.55%
Woodland Ndl.-Moss	1,294	0.08%
Subtotal coniferous	572, 857	35%
Closed Deciduous	109,627	6.70%
Open Deciduous	14,861	0.91%
Subtotal hardwood	124, 488	7.61%
Closed Mixed Ndl./Decid.	67,618	4.13%
Open Mixed Ndl./Decid.	110,116	6.72%
Subtotal mixed conf./hard	177,734	10.85%
Tall Shrub	60,519	3.70%
Low Shrub	68,401	4.18%
Low Shrub-Tussock Tundra	76,261	4.66%
Dwarf Shrub	8,200	0.50%
Subtotal shrub	213,381	13.04%
Wet Graminoid	14,500	0.89%
Lichen	1,994	0.12%
Moss	2,490	0.15%
Mesic/Dry Graminoid	518	0.03%
Tussock Tundra	4,295	0.26%
Tussock Tundra Lichen	1,856	0.11%
Subtotal herb/moss/lich	25,653	1.56 %
Aquatic Bed	13,444	0.82%
Emergent	1,988	0.12%
Clear Water	48,513	2.96 %
Turbid Water	6,183	0.38%
Subtotal aquatic/water	70,128	4.28 %
Snow/Ice	8	0.00%
Sparse Vegetation	5,871	0.36%
Rock/Gravel	8,801	0.54%
Subtotal sparse/non-veg.	14,680	0.9 %
Terrain Shadow	248	0.02%
Smoke	9	0.00%
Subtotal obscured	257	0.02%
Fire Scar	116,331	7.10%
Fire Scar-Regeneration[b]	321,921	19.67%
Subtotal recent fire scar	438,252	26.77%
Total	1,637,430	100.03%

[a] The area within the Kanuti NWR boundary includes some in-holdings of Native Patented and Native Selected lands, which are included in the acreage figures, above. Data above is from the Kanuti/Ray Mountains /Hogatza River Earth Classification Report, 2001.

[b] Fire scar regeneration classes further detailed in Table 3.

TABLE 3. Fire scar regeneration class acreages for Kanuti NWR lands

Fire scar regeneration class name	Acres
Open Needleleaf	37,768
Woodland Needleleaf	8,327
Tall Shrub	80,051
Low Shrub	54,186
Low Shrub Tussock Tundra	129,135
Tussock Tundra	12,454
Total	321,921

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L. SPECIAL VALUE AREA

The Hulgothen Bluffs, thought to be a rich repository of Pleistocene fossils, have been identified as a "special value" area of the refuge. The Bluffs are located on Fish Creek in the northeast corner of the refuge. Fossilized remains of Pleistocene megafauna, buried in riverine or glacial lake sediments, have been recovered here (Smith 1984). Many of these fossils represent steppe-grassland species. The Bluffs may be an ideal site for excavation and study, although they have yet to be fully investigated.

M. WILDLIFE

The quality of habitat within the refuge is reflected in its diversity and abundance of wildlife. Nearly 160 bird species (including 64 kinds of waterfowl and shorebirds), 36 mammal species, 16 fish species, and 1 amphibian species have been found on the refuge (USFWS 1987).

The refuge provides breeding habitat for more than 100 species of birds and serves as a migration corridor for birds breeding farther north and west. The Kanuti Flats was identified as a major breeding ground for white-fronted geese (*Anser albifrons*) in the early 1950s. This was an important factor leading to its designation as a national wildlife refuge (USFWS 1987). Canada geese (*Anser canadensis*) also nest on the refuge. The white-fronts winter in Louisiana, Texas and Mexico, while the Canada geese migrate to Washington and Oregon. Ducks banded on the refuge migrate along all four North American flyways.

Thirty-nine species of mammals, representing 7 orders and 17 families, have been recorded on the refuge. Some of the more noteworthy species include moose (*Alces alces*), caribou (*Rangifer tarandus*), black bear (*Ursus americanus*), brown (grizzly) bear (*Ursus arctos*), gray wolf (*Canis lupus*), marten (*Martes americana*), wolverine (*Gulo gulo*), lynx (*Lynx canadensis*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethica*), and snowshoe hare (*Lepus americanus*).

Sixteen species of fish have been found on the refuge. Important species include chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), and chum salmon (*Oncorhynchus keta*).

These salmon travel 1,000 miles up the Yukon River to spawn in the Koyukuk River system, which runs through the heart of the refuge. Other important species include northern pike (*Esox lucius*) and whitefish (*Coregonus* spp. and *Prosopium* spp.), which are found in many streams and stream-connected lakes, and burbot (*Lota lota*) and sheefish (*Stenodus leucichthys*), which are found in the major rivers (USFWS 1993). No threatened or endangered fish or wildlife species are known to occur on the refuge. The American peregrine falcon (*Falco peregrinus anatum*) (delisted in 1999) has been observed in small numbers on the refuge, and is known to nest on cliffs in the Kanuti Canyon and on the Jim River. The potential exists for this species to nest on other cliffs below 2,500 feet and in proximity to water.

Three species termed by the federal government as Species of Concern (formerly Category 2 Species) are found on the refuge; such a designation means that there is significant concern about a species but insufficient data exists for listing. The olive-sided flycatcher (*Contopus cooperi*) occurs on the refuge mainly in mature spruce forest associated with edges, especially streams and rivers. The northern goshawk (*Accipiter gentilis*) is fairly common in forested areas. The harlequin duck (*Histrionicus histrionicus*) nests in rapid, rocky, or boulder-strewn streams. Harlequin ducks are found along the Kanuti and Jim Rivers and in some numbers in the southern portion of the refuge, especially in the Kilolitna drainage and in the eastern Hodzana Highlands. Harlequin broods have also been observed in southern and eastern locations on Kanuti Refuge (Whitehill, USFWS, pers. comm.).

In addition, five bird species listed by the state as being "Species of Special Concern" exist on the refuge: American peregrine falcon, Arctic peregrine falcon, olive-sided flycatcher, grey-cheeked thrush (*Catharus mitimus*), and blackpoll warbler (*Dendroica striata*). These species and subspecies are of concern because of a long-term decline in abundance or are vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance.

N. REFUGE FACILITIES AND PUBLIC USE

1. Facilities

Refuge lands have no developed recreational or interpretive sites. One interagency interpretive site has been completed at Finger Mountain on the Dalton Highway just east of the refuge. A visitor center is located at Coldfoot on the Dalton Highway. There are no other roads or public developments on the refuge. Refuge headquarters are in Fairbanks. A refuge-owned administrative cabin, storage shed, and fuel tank are located on Kanuti Lake near the center of the refuge. The refuge had, until recently, a bunkhouse/visitor center in Bettles, just north of the refuge boundary. This structure was completely burned in a structural fire in January 2004. The bunkhouse will be rebuilt on the same site. A shop, shed, hangar, and fuel tanks remain in Bettles. Real property (USFWS) located in or near the refuge is listed in Table 4. One permitted cabin (a roofless partial structure only) is located within the refuge. This site is used by a private individual for trapping through a special use permit.

TABLE 4. Real property on Kanuti National Wildlife Refuge

Property	Number	Value ($)
Kanuti Lake Administrative Cabin	1	86,000

Kanuti Lake Storage Shed	1	19,000
Kanuti Lake 300 gallon fuel tank	1	13,000
Bettles Bunkhouse/Visitor Center*	1	1,030,000
Bettles Bunkhouse 1,000 fuel tank	1	15,000
Bettles Shop	1	165,500
Property	Number	Value ($)
Bettles Shop 500 gallon fuel tank	1	21,000
Bettles Fuel Storage Shed	1	6, 000
Bettles Hangar	1	377,000
TOTAL	9	1,732,500

*destroyed in a structure fire 01/04. To be rebuilt on the same location.

2. Public Use

There are three primary categories of public use on the refuge: subsistence use, recreational use, and commercial use, such as by air taxi operators. Subsistence uses are provided for by Alaska National Interest Lands Conservation Act (ANILCA) and account for the vast majority of public use on the refuge. Subsistence users harvest more than 50 species of fish, mammals, birds, and plants (Marcotte and Haynes 1985, Sumida 1988). Priority recreational uses, dictated by the National Wildlife Refuge System Improvement Act of 1997, are "hunting, fishing, wildlife observation, and photography, or environmental education and interpretation." The main recreational activities are hunting, fishing, floating rivers, and incidental activities such as camping and wildlife observation (USFWS 1987). For a more detailed discussion of subsistence activities on the refuge, see the refuge CCP (USFWS 1987) and annual narrative reports (USFWS 1996a). Commercial air taxi operators primarily support travel to and from villages but also carry recreational users.

A winter road extends 39 miles from Bettles to the Dalton Highway near Pump Station #5. The initial 3.9 miles of this road near Bettles are located on Kanuti Refuge proper (Fig. 1). The Bettles winter road is used from January through March when there is sufficient snow cover to allow construction of a graded surface on frozen ground.

A winter snowmobile trail extends across the Refuge from Allakaket to Tanana. There are no other all-season trails or roads on Kanuti Refuge.

3. Cultural, Social, and Economic Considerations

The refuge provides an area in which local residents conduct subsistence activities, an area for them and others to ply commercial ventures, and a wild, remote area for recreationists. All recreation and subsistence uses depend on healthy habitat and wildlife populations.

The refuge is mandated by ANILCA to provide for subsistence uses by local residents, and those uses have precedence over other consumptive public use (USFWS 1987). Subsistence uses are important not only for providing food, clothing, tools, and housing, but are important culturally and socially as well (USFWS 1987). The residents of the four list villages adjacent to the refuge depend heavily on the refuge's resources (Marcotte and Haynes 1985). Exact usage is not documented, because users often do not differentiate between refuge land or Native corporation land, and many wildlife species move back and forth across these boundaries. Recent surveys have documented that 90–100% of households in the four area villages harvest wild resources, and that 450–680 pounds of wild resources are harvested for human consumption per person per year. Much larger amounts of fish are harvested for dog food (Sumida 1988, 1989; Sumida and Andersen 1990).

The refuge has social importance beyond its value for subsistence and recreational activities. Although the area's remoteness and isolation result in relatively low levels of public use, those characteristics are important to many people (USFWS 1987).

Fish and wildlife that spend part of their life on the refuge are also important to commercial, subsistence, and recreational users elsewhere. Salmon, waterfowl, migratory nongame birds, and caribou are important to people downstream on the Yukon, out on the Pacific, in Canada, in the Lower 48, and in Russia, Mexico, and Central and South America.

Cash-paying jobs are scarce in the refuge area. Unemployment averages 32% in area villages, and 38% of people live below the poverty level (DLWD 2000). Cash incomes assist subsistence activities by allowing the purchase of supplies such as gasoline, oil, firearms, ammunition, tools, and other materials. Economic exploitation of the refuge is limited by law and by the nature of the area. Tourism, trapping, and commercial fishing take place on the refuge.

Commercial harvesting of timber is not allowed on the refuge (USFWS 1987). Although no commercial logging currently occurs in the area, white spruce stands on adjacent private lands are used for harvesting house logs.

Firefighting is and has been an important source of income for many local residents. Allakaket has two organized village emergency firefighting (EFF) crews that are called upon regularly in the suppression of large fires in Alaska and the Lower 48. These crews are trained to national standards. Gross earnings of local residents from firefighting have totaled more than $1 million during the years 1985–1994 (latest figures available), although there is high annual variability because this income follows the boom-and-bust cycle of large fire years (Sylvester 1971).

The refuge emphasizes involving local crews on appropriate fire management projects. Village crews may work on hazard fuel reduction projects, prescribed burning and a variety of natural resource projects. This work may include other emergency activities throughout the United States. For example, the Allakaket fire crew participated in Texas in the search for debris from the space shuttle *Challenger* disaster.

Further information on cultural resource sites within Kanuti Refuge can be found in other sources (Alaska Geographic 1983; Allen 1985; Andrews 1977; Clark 1996; Tobuk 1980).

O. GENERAL REFUGE FIRE INFORMATION

The mosaic of habitats present on the refuge today is largely a result of repeated glaciations, flooding and erosion of rivers, and fire activity (Figure 4). Fire exerts a powerful influence on the entire ecosystem, including hydrologic, carbon, and nutrient cycles, landscape diversity, wildlife and plant species diversity, and species distributions and abundances (Kelsall and others 1977; Pyne 1982, 1984; Bryant and others 1994; Clark and Sampson 1995).

Agencies responsible for fire management in the North American boreal forest recognize that fire exclusion is not possible, and is also neither economically nor ecologically desirable (Pyne 1982, Stocks 1993). Vegetation patterns in the boreal forest can be dominated by a few intense, stand-replacing fires, especially in black spruce. These stand-replacement fires burn in extreme weather conditions and cover hundreds of thousands of acres (Johnson 1992). Recovery from these severe fires tends to provide even-aged stands on a landscape scale. More frequent, smaller, and less intense wildland fires provide better temporal and spatial heterogeneity to the natural fire recovery process. The small-scale patchy environment resulting from these more frequent, lower intensity fires produces a varied habitat with an abundant edge-effect. This is clearly of value to many wildlife species. The smaller scale patchy fires also break up contiguous fuel loading and make future landscape-level fires less intense.

1. Refuge Fire History

Relatively low precipitation, very long summer days with thermal uplifting, the presence of highly flammable fuel types, and frequent lightning strikes from mountain thunderstorms, all combine to make the forests in the Kanuti area one of the most prone to wildfire ignition in the state (Trigg 1971). Most lightning activity occurs from 4:00 to 6:00 p.m. during late June and early July. Lightning activity starts earlier in the day at higher elevations and later at lower elevations.

Before 1940 an average of 1.5 to 2.5 million acres burned uncontrolled each year in Interior Alaska (Lutz 1956). With the creation of the Alaska Fire Control Service in 1939, the annual average decreased to 900,000 acres (Lutz 1956). Until 1984, policy dictated that all wildland fires be suppressed (SKPT 1984). Aggressive suppression from the 1950s to 1984 succeeded in controlling all but a few fires in the Kanuti Refuge area, and an average of only about 4,000 acres burned each year in and around the refuge before 1984 (USFWS 1987). These suppression actions were successful most of the time, although some large fires did occur, such as in 1972 (Figure 5). Large fires during this time defied suppression efforts, and others were not suppressed because of greater priorities elsewhere.

Figure 5 displays the perimeters of all recorded fires 1950–2005 in the area of the Kanuti NWR. Since the creation of the refuge in 1980 and after the fire suppression policy changed in 1984, an average of more than 22,000 acres has burned per year in the Kanuti Refuge (Table 5). Lightning has accounted for nearly all fire starts on the refuge. Since 1981, lightning has started 92 fires burning 468,000 acres, or about a third of the refuge area. Large fires in 1990 and 1991 burned about 24.8% of the refuge, including large portions of the Hodzana Highlands and the foothills of the Ray Mountains. Some 25% of the Refuge burned in 2004-2005 in several very large and prolonged fires during these two consecutive severe fire seasons.

Since 1980, only two very small fires have been caused by humans on the refuge. These were abandoned or escaped campfires that burned a total of 1.1 acres. From 1988 through 2000, 49% of all fires on the refuge were attacked with the intent of extinguishment (85 of 172 fires).

Approximately 50% of the refuge is within the Limited Suppression Management option, where wildland fires are monitored but not suppressed (see Section III.C.). Suppression on naturally-caused fires occurs in the Modified Management Option areas in the central portion of the refuge before the annual conversion date (ca. 15 July) to Limited, and in the Full and Critical Management Option areas near the villages (Table 5; see also Table 8 for definition of Fire Management Option Terms and Section III. D, for policy/objective explanations of the fire management options). A glossary of wildland fire management terminology is included in Appendix F. For another glossary of wildland fire terminology, see also www.nwcg.gov/pms/pubs/ glossary/index.htm.

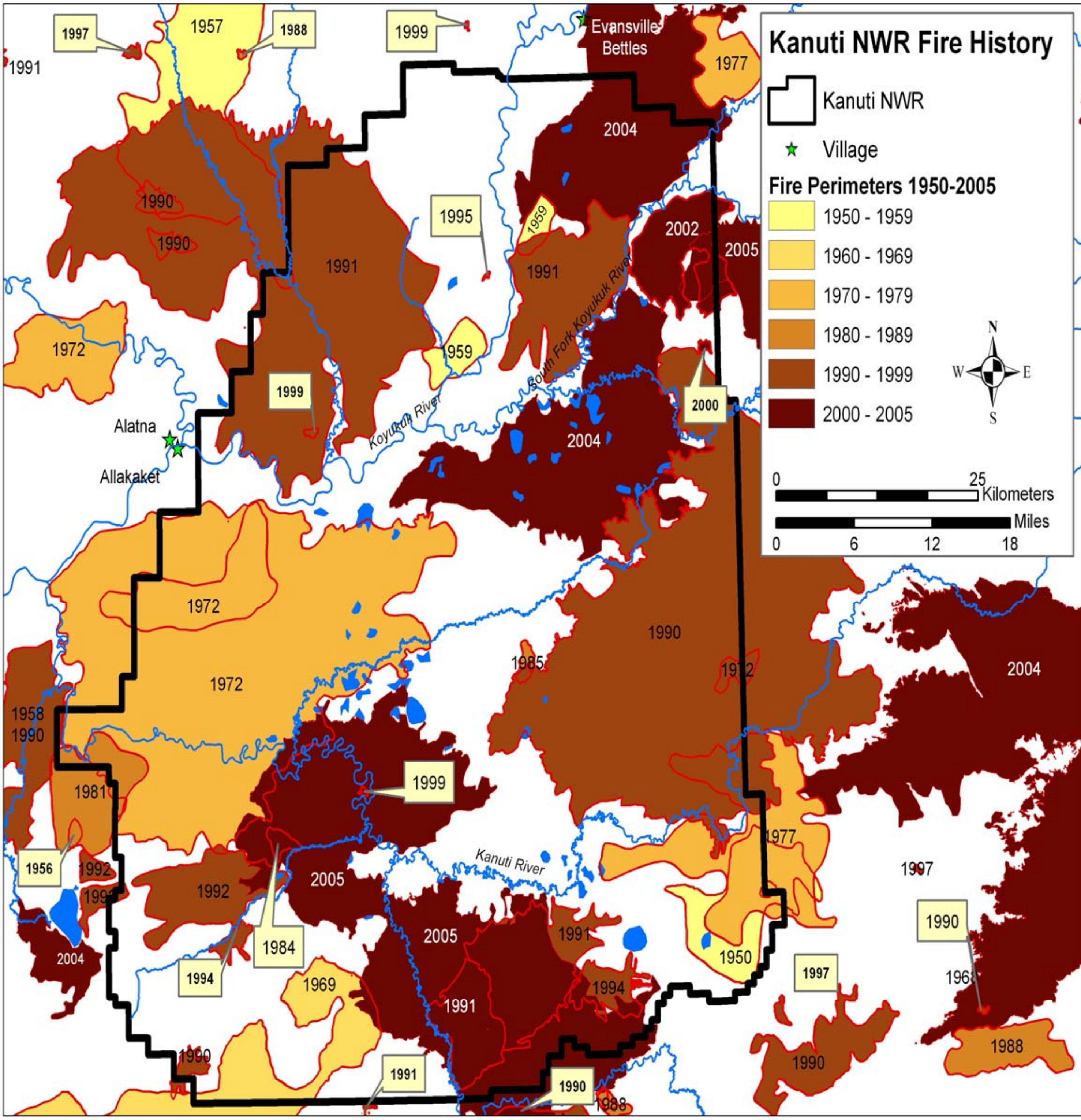

FIGURE 5. Fire perimeters and fire history on the Kanuti National Wildlife Refuge, 1950–2005. (For point source ignitions by month, see Figure 6.)

2. Fire Frequency

The refuge lies within the boreal forest, which is often characterized by a combination of high intensity crown fires and severe surface fires covering large areas. Weather, fuels, and topography can combine to create these extremely large fires (Viereck 1983). Large-scale weather patterns are responsible for creation of conditions that control fire activity over these large areas (Johnson 1992, Cahoon and others 1994). Much of the area that has burned in the Kanuti area is accounted for in periodic severe fire years, such as in 1972, 1990 and 2004 (Johnson 1992, Davis and Mutch 1994).

Over the last 400–500 years, the fire return interval in the boreal forest of Interior Alaska has been fairly stable at about 100 years (Mann and others 1995). That means, mathematically, that all parts of a large area (such as the Kanuti Refuge) would be expected to burn within 100 years. Some areas, however, would not burn at all during that time, and areas with high lightning frequency, few natural barriers, and flammable fuel types would burn more than once (Mann and Plug 1999).

Examination of Kanuti fire history maps shows that about 48% of the area within refuge boundaries burned between 1950 and 2002 (Fig. 5). This information supports a fire cycle of 105 years, typical of the boreal forest. About 33% of the area within refuge boundaries, however, burned between 1990 and 1992. This shorter cycle may suggest a fire return interval of approximately 30 years, but sufficient fuel loading may not occur within 30 years in the slowly growing boreal forest on the Arctic Circle (Mann and Plug 1999). Re-burns of dead and down timber in black spruce stands may carry the occasional wildland fire within 30 years, but the 100-year natural fire return interval is more likely. Yarie (1981) postulated a fire return cycle of less than 80 years in the Porcupine River valley, which lies in a drier subclimate well to the east of the refuge, near Fort Yukon. The recent large fires (1990–2005) on the Kanuti Refuge probably represent the combustion of fuels accumulated during the previous 50 years of dedicated fire suppression, in addition to those areas of unburned fuels built up in the more natural 100-year cycle.

Thus, in the absence of suppression since 1984, the fire-driven ecosystem of the Kanuti Refuge may be attempting to return to a more natural 100-year cycle. We expect, in theory, fewer large landscape-scale fires on the Kanuti Refuge in the short-term future as contiguous fuel loading is broken up by smaller, more frequent fires. Highly flammable areas such as continuous black spruce stands in the uplands, however, can and will burn more frequently than 100 years, especially during hot, dry summers. Upland areas of the Kanuti Refuge, particularly in the foothills of the Brooks Range, can become very dry, and are highly prone to lightning strikes (Trigg 1971). High ambient air temperatures during the month of June may be a key feature of the initiation of large-scale burns in this area. June air temperatures in Interior Alaska are correlated with the uplifting of air masses and the development of thunderstorms and lightning. Moist sites, by comparison, or other lowland sites protected by fuel breaks, such as riparian white spruce stands along the main rivers, would burn much less frequently (Mann and Plug 1999). These lowland riparian white-spruce sites are moister, have less flammable fuel types, and are less prone to lightning strikes (Mann and others 1995).

Closer examination of fire history maps shows the existence of different fire return intervals within the refuge boundaries (Fig. 5). Discontinuous white spruce stands on the banks of the Koyukuk and Kanuti Rivers are broken up by streams and wetlands. These lowland white spruce stands have a calculated fire cycle of about 450 years and would be expected to burn only under the most extreme drought conditions (Magoun and Dean 2000).

Rolling uplands and gravelly outwash plains with extensive contiguous stands of black spruce or stunted white spruce (e.g., on the Hodzana Highlands, on lower slopes of the Ray Mountains, and in the Indian River uplands) may have fire return cycles of 70–100 years. Steep, broken alpine tundra above the timberline, by comparison, such as the upper slopes of the Ray Mountains, has a fire cycle of about 560 years. (See Section I.O.3. for further discussion of fire frequency related to vegetation types and how susceptibility changes over time.)

The number and extent of fires on the Kanuti Refuge also varies widely between years and decades (Kelsall and others 1977). Within a 10- to 15-year period, there are generally some years with practically no fires or area burned (for example, on the refuge in 1989, 1998, 2003 and 2006), some years with a few fires reaching moderate size (such as 1985 and 2002), and one or two severe fire years with many large fires, some burning tens or hundreds of thousands of acres (such as 1990–1991 and 2004-2005). Over the last 12 years, area burned annually on the refuge has ranged from 5 acres to more than 355,000 acres (1990) (Table 5).

The definition of Fire Regime Condition Class (FRCC) includes a qualitative measure describing the degree of departure from a reference (or historical) fire regime (see www.frcc.gov). Severe departures, such as are evident in many areas of the contiguous United States as a result of 100 years of fire suppression, may result in alterations of key ecosystem components such as structural stage, stand age, canopy closure, and fuel loadings (BLM 2004). In Alaska, however, the relatively short period of fire suppression on Kanuti Refuge (from the 1950's to 1984) may have caused a departure from the natural fire regime, but historical data are otherwise lacking. The effects of this period of fire suppression on the Kanuti Refuge fire regime and the condition class are not well known, but it is believed that the vegetation attributes (i.e., the species composition and structure) remain intact on Kanuti Refuge, and are functioning within the natural range.

The boreal forest on Kanuti Refuge thus most likely remains within FRCC Condition Class 1, in which the fire regime lies within the natural range and the risk of losing key ecosystem components, is low. The Fire Regime description for the boreal forest on Kanuti Refuge best fits that of Group IV, with moderate frequency, stand replacement fires, characterized by a forty to 120 year fire return interval range (BLM 2004). Fire management on Kanuti Refuge is predicated on the assumption that the boreal forest is currently within the natural fire regime.

3. Fire Season

The fire season on Kanuti NWR extends from early May to mid-September (Fig. 6). The period of May through the middle of July is often dominated by high-pressure weather systems and sunny, dry weather. Cooler, rainy weather usually begins in mid-July with the advent of low-pressure weather systems. This weather pattern often continues through September until snowfall. The first frost typically occurs in early September. The first snow may occur at any time after the middle of September.

The vegetation can be dry on Kanuti Refuge during mid-to-late May, but lightning ignition is usually lacking because there are no thunderstorms (Fig. 6). Green-up occurs in late May. Air temperatures in June may provide the key to the entire fire season, with higher temperatures indicating greater risk of ignition and subsequent rapid rates of spread. Higher temperatures in June are associated with uplifting of air masses and resulting development of lightning storms (Fig. 6).

The peak time for such lightning ignitions on Kanuti Refuge, with about 60% of the fire starts on the refuge, is the 30-day period between June 10 and July 10 (Fig. 3). Wildfire ignitions by lightning tend to be clustered within Kanuti Refuge on mountain ridges exposed to uplifting southwesterly wind patterns (Fig. 6).

Mid-to-late June is a critical period for wildfire ignitions on Kanuti Refuge. Nearly 70% of ignitions have occurred by July 10, about 80% by July 20, and around 90% by August 1. Most of the total acreage burned is usually accounted for by the end of July, although "late" fire seasons can see active burning into August and September (Fig. 6).

TABLE 5. Fires and acreage burned by Management Option[a] on Kanuti NWR lands, illustrating fire frequency, 1981–2000

	Full protection*		Modified protection*		Limited protection*		Total	
Year	Fires	Acres	Fires	Acres	Fires	Acres	Fires	Acres
1981	9	4,184	0	0	0	0	9	4,184
1982	5	9	0	0	0	0	5	9
1983	24	1,622	0	0	0	0	24	1,622
1984	3	2	7	105	6	62	15	169
1985	6	3,847	4	18,282	4	144,442	12	166,573
1986	3	600	3	10,613	7	34,942	10	46,156
1987	0	0	4	83	5	18,001	9	18,084
1988	5	6,667	18	203,576	30	942,071	49	1,152,313
1989	1	1	2	4	1	4	4	9
1990	3	412	9	277,525	8	77,216	19	355,153
1991	3	42	12	64,580	8	227,450	22	292,072
1992	0	0	1	1	9	42,002	10	42,003
1993	2	22	4	29,101	9	63,467	13	92,590
1994	2	2	0	0	10	22,533	12	22,535
1995	4	1	0	0	2	420	6	421
1996	3	7,587	7	2,552	6	145,880	14	156,019
1997	2	1	2	10	4	30,750	8	30,761
1998	0	0	0	0	1	5	1	5
1999	0	0	0	0	7	151,531	7	151,531
2000	1	1	1	1	5	6,161	7	6,163
Total	76	25,000	74	606,433	122	1,906,937	256	2,538,372
Average	3.8	1,250	3.7	30,322	6.1	95,347	12.8	126,919

[a] Number of fires in each Management Option category may exceed total number of fires because some fires burned in more than one category.
*For definitions of Management Options, please see Table 8.

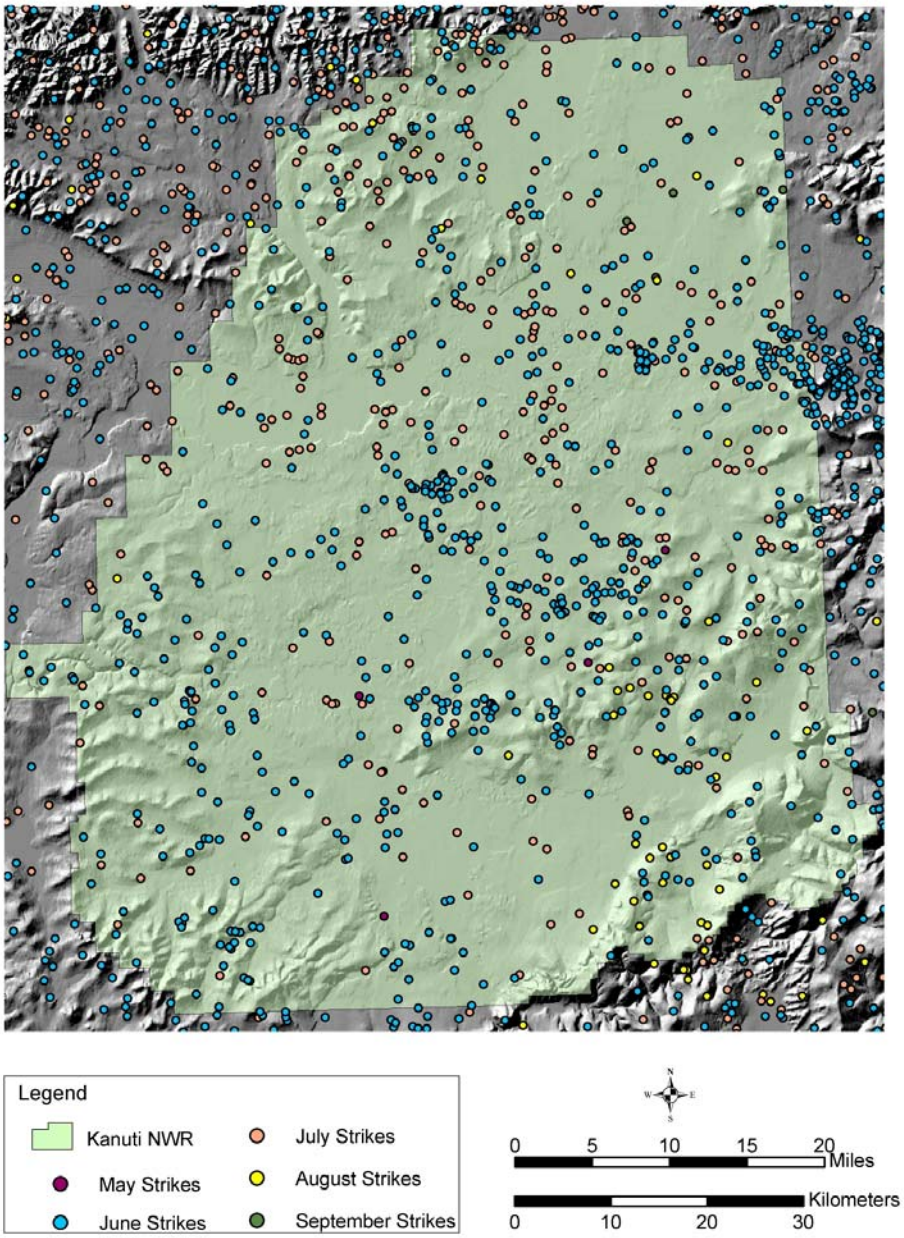

FIGURE 6. Wildfire ignitions by month for the period from 1950 to 2002, Kanuti NWR, Alaska. Note the clusters of June lightning strikes from uplifting of southwesterly winds along ridges in central and eastern Kanuti Refuge. (See also Figure 2).

4. Vegetation Types, Fuel Models and Fire Behavior

There are seven broad vegetation types on the Kanuti Refuge, as described by models from the Northern Forest Fire Laboratory (NFFL), National Fire Danger Rating System (NFDRS), and the Canadian system (CFFDRS) (Table 6). See also Section I.M.3.f. (Fire Season) and Figure 4. Fuels, topography and weather, are the components that are used when calculating the NFDRS and Canadian models. Fire behavior likely to be encountered in each fuel type is discussed below (from BLM 1995, USFWS 1996a). Fuel loadings are from sampling conducted on the refuge and described in Foote and others (1989, 1995).

Fire behavior is strongly tied to fuel moisture levels, especially in the duff and moss layer. Those fuels (coded as FFMC and DMC) are relatively quick to change in response to rain and humidity variations. Number of sequential days without rain significantly correlates with area burned (Flannigan and Harrington 1988). As time since precipitation increases, moisture is lost, increasing susceptibility to ignition and availability of fuel. Prolonged dry periods result in progressive deep drying into the duff layer (coded as DC), as well as drying of live fuels (Pyne 1984, Johnson 1992). Depth of burn is extremely important in determining resistance to fire control efforts and fire effects on vegetation (Schimmel and Granstrom 1996).

Van Wagner (1983) divides fuels into four types: subsurface organic layers, surface fuels, down dead trees and branches, and standing live and dead vegetation. For a more detailed description of these fuel types and general fire behavior on Kanuti Refuge, see Appendix E.

a. <u>Black Spruce (C-2 Boreal Spruce)</u>

Black spruce is the most fire-prone tree species in Alaska and is a fire-adapted species, dependent upon fire for regeneration. Black spruce stands are widespread in the Kanuti Refuge on the Hodzana Highlands and lower slopes of the Ray Mountains. Such black spruce woodlands usually occur on poorly-drained permafrost sites and on cold, north-facing upland slopes (USDA 2002)(Figure 4). White spruce stands on poor sites are often mistaken for black spruce stands. Ground cover in black spruce stands dries rapidly and the resulting fine fuels become quite flammable, and can produce large amounts of heat in a short period to time. Such flammable ground cover is mainly composed of feathermosses (*Hylocomium splendens*), lichens (*Cladonia* spp.), and low shrubs such as bog blueberry (*Vaccinium uliginosum*), Labrador tea (*Ledum palustre*), and lowbush cranberry (*Vaccinium vitis-idaea*).

Fires in black spruce (and stunted white spruce) are carried by these surface fuels, which generally burn with relatively high intensities and slower rates of spread. Ignition of the tree crowns (individuals or groups of torching trees) will occur just behind the flaming fire front if flame lengths are high enough (2 feet or more) to ignite the lower branches (i.e., ladder fuels). Because black spruce often grows on poor sites, the trees are commonly stunted (less than 20 feet). This, coupled with the fact that the surface fuels respond quickly to changes in relative humidity, causes this black spruce fuel type to be flammable through a longer part of the fire season than any other fuel.

Areas of black spruce where old fires have only partially consumed the surface fuels may be susceptible to reburns after several decades. Dead and down fuel loads in black spruce may be about 2 tons/acre. After 30–40 years, these re-burn sites may have accumulated sufficient amounts of continuous fuels (mosses and low shrubs) to be able to sustain larger fires again, although these are most likely to be ground fires. Spotting by aerial firebrands from torching mature trees is, however, a common feature in mature stands of this fuel type, which increases overall rate of fire spread. Instability of the atmosphere, surface winds, and moisture content of receptor fuels are critical factors influencing the amount and distance of spotting. Under the right drought conditions, rapid conflagrations can occur in black spruce stands.

Norum (1982) correlated fire behavior in black spruce fuels with NFFL fuel models. Rate of spread was generally 1.2 times that predicted by model 9 (hardwood litter). Flame length was approximated by model 5 (short brush). The Canadian system can predict not only rate of spread and flame length, but also likelihood of ignition, crown involvement, crown fire effect on rate of spread, fuel consumption, and fire shape and growth rate. The hauling chart produced by Alexander and Cole (1994) relates fire behavior outputs from the Canadian system to resistance to control.

b. <u>White Spruce (C-2 Boreal Spruce)</u>

White spruce stands usually occur on warm, well-drained lowland riparian sites such as on riverbanks in the Kanuti Flats. These lowland discontinuous white spruce stands may have a very long fire return cycle (200–450 years) because they tend to be isolated by adjoining watercourses and lowland marshes (Magoun and Dean 2000), and because lowland sites are not especially prone to lightning strikes. Paper birch and balsam poplar are often abundant in the riparian stands of white spruce (spruce and broadleaf forest; Figure 4). These deciduous species do not carry fire well.

Seral aspen may be present in other upland stands of white spruce with more recent fire histories and shorter return cycles (150 years) (Welbourn 1983). Such mixed white spruce forest occurs on warmer, south-facing slopes (USDA 2002). These drier elevated slopes, such as on ridges in central and eastern Kanuti Refuge, may be more prone to lightning-caused ignition than lowland white spruce sites. Smaller upland stands of white spruce may be open and park-like or have a dense shrub layer (often alder) depending upon aspect and soil conditions. Stunted upland white spruce stands in poor sites are often mistaken for black spruce stands. These upland white spruce sites burn much as black spruce when the ground fuels are similar.

Fires in stands of large white spruce, by comparison, are generally slow in spreading and burn with lower intensities than those in black spruce. Large white spruce trees along drainages often do not burn when fires burn surrounding vegetation, except under the most extreme drought conditions (e.g., 450-year cycle). Smoldering fires in white spruce root systems may result from less intense fires. Increased canopy cover and the shade provided by white spruce tempers the response of fine fuels to changes in relative humidity. Ladder fuels on white spruce are not as common as on black spruce and stem density of mature white spruce is much lower than in black spruce stands. As a result, crowning in white spruce occurs only under very dry conditions or near jackpots of dead fuels. Dead and down woody fuels in white spruce stands generally range from 4 to 8 tons/acre, but may be as much as three times higher.

c. Hardwoods and Mixed Spruce/Hardwoods (M-2 Hardwood Forest)

Young hardwood stands (birch, aspen) compose post-fire successional stages in the boreal forest, especially on better sites (well-drained and/or with south exposure)(Figure 4). Hardwood stands are often dense with little understory (20–50 years post-fire). In mixed spruce–hardwood forests, which are a later successional stage (+50 years), fire intensity generally increases in relation to the amount of regenerating spruce in the stand. Pure hardwood stands (without a spruce understory) can serve as natural fuel breaks under certain moisture conditions. Because surface fuel loading is light and composed primarily of leaf litter, fires in this fuel type are usually slow spreading and burn with relatively low intensities. Fuel and soil moistures are relatively high in this type because of closed canopy shading and a compacted leaf litter layer. Crown fires in spruce stands will normally drop to the forest floor when they encounter a hardwood stand, unless there is sufficient spruce regeneration in the understory to carry the fire. Even aspen stands will burn with a spruce understory under very dry and windy conditions. In addition, hardwoods may burn with fairly high intensity and carry a crown fire in the spring during green-up. Smoldering fires in the duff/litter layer and dead logs are common in hardwood stands. Dead and down fuel loads generally range from 5 to 14 tons/acre and increase with stand age.

d. Brush and Shrublands (M-2 Hardwood Forest)

Included in this type is the brushy successional stage resulting from recent burns (less than 10–15 years old) such as in the Henshaw Creek drainage (Figure 4). In wet brushy sites or where surface fuels are sparse, fires will not carry through this fuel type. Alternatively, the presence of seasonally dry grasses and sedges, shrubs with flammable chemicals (such as bog birch, crowberry, lowbush cranberry, and Labrador tea), and significant amounts of dead woody material on drier sites, make other shrublands much more flammable. Dead and down fuel loads are generally around 4 tons/acre, but are much less in small brush and may be up to 20 tons/acre in decadent stands of large willows (30–50 years old). Loadings may be more than twice that in brushy areas where large trees have been killed by older fires and eventually topple over. Such areas may occasionally re-ignite from lightning strikes or spot from adjacent fires, but the resulting combustions are surface fires and tend not to carry well. Indeed old burn sites covered with brushy deciduous regeneration may break up areas of contiguous fuel loading and hinder development of landscape-level fires (Figure 4).

e. Tundra and Marshes (O-1a Matted Grass or O-1b Standing Grass)

Substantial accumulations of fine, flashy fuels (especially cured grasses and sedges) can result in fires with high rates of spread and high intensities. Cured grasses and sedges are prevalent in lowland areas in spring on Kanuti Refuge, especially during dry, windy conditions after snowmelt, and before green-up (Figure 4). Natural ignition (lightning), however, is usually lacking during this May dry season. Where dry tussocks are present at other times of year, the taller tussocks occasionally correspond with higher fire intensities and rates of spread. On occasion, (e.g. 2004-2005) extreme fire behavior can be expected during midsummer even on the Kanuti lowlands, as the Duff Moisture Code approaches 90, as a result of prolonged dry conditions. Other types of low tundra and marshes burn only rarely because moist conditions and/or sparse fuels create slow rates of spread and low intensities. These types include low shrub, mesic graminoid herbaceous, wet sedge, lichens, and *Dryas* dwarf shrub and alpine tundra (names from Viereck and others 1992) (Figure 4).

TABLE 6. Fuel models for fire behavior prediction and fire danger rating for vegetation types of Kanuti NWR. From the Canadian Forest Fire Danger Rating System (Stocks and others 1989), the Northern Forest Fire Laboratory (NFFL--Anderson 1982), and National Fire Danger Rating System (NFDRS--Deeming and others 1978).(See also Figure 4).

Vegetation type	Canadian fire behavior/ danger model	NFFL fire behavior model	NFDRS fire danger prediction model	Estimated acreage on refuge[a]
Black spruce forest White spruce forest	C-2 C-2	custom black spruce[b] 8 or 10 (heavy downed fuel)	Q H	573,000
Mixed spruce/ Hardwood forest	M-2 (can set amount of spruce)	8 (few spruce) or 9 (moderate spruce)	R	1,416,000
Hardwood forest	M-2	8	R	1,324,000
Shrublands/Brush	M-2	2 (grass w/flammable shrubs) or 5 (dwarf flammable shrubs) or 6 (heavy dead woody load)	B	3,452,000
Marsh Grasses	O-1	3	N	185,400
Tundra	O-1	1 (tussocks <1 ft high) or 3 (tussocks >1 ft)	S	278,100

[a] Derived from Table 2.
[b] Also see discussion in Section M.3.a. (Below and Norum 1982).

5. Fire Effects

Fire is an important factor in the function of the boreal forest and has contributed to the development of the ecosystem as well as component plant and animal species. Fire influences nutrient cycling, hydrology, landscape diversity, standing biomass, plant succession and diversity, wildlife diversity, insect populations, and disease levels (Bendell 1974, Kelsall and others 1977, Pyne 1982, Bryant and others 1994, Davis and Mutch 1994, McCullough and others 1998, USDA 2002).

Habitat diversity is a key to long-term ecological stability and serves as a limiting factor to the occurrence of large-scale, catastrophic events, including fire. Animals found on the Kanuti Refuge are thriving in the diverse array of habitats that are available as a result of fire (Heinselman 1971). Maintaining the natural role of fire is important to fulfilling a primary purpose for which the refuge was set aside, to conserve fish and wildlife populations and habitat in their natural diversity. Fire affects soil, permafrost, vegetation, fish, wildlife, and water and air resources.

Fire suppression activities could result in impacts greater than the severity of the fire. Heavy equipment can cause soil erosion, stream siltation, subsidence, and gully formation. Use of fire retardants dropped from aircraft can affect aquatic resources. Use of heavy equipment and fire retardants are excluded from Kanuti Refuge, except in cases of defense of life and property, or with Refuge Manager's approval. Retardant use on adjacent lands in areas of mixed ownership is of concern. The Refuge staff will make efforts to collaborate with other agencies in these cases. Fire suppression activities may also destroy aboveground and subsurface cultural resources. Long-lasting impacts to visual resources result from straight-line construction of fire lines.

Fire exclusion and resulting changes in plant and animal communities are another effect. These changing plant and animal communities can in turn affect subsistence and recreational users (Natcher 1996), as particular populations of animal, may be displaced from an area and users may choose to subsistence hunt or recreate in different areas. Fire exclusion has altered natural processes on parts of the refuge, slowing nutrient cycling, reducing productivity, slowing tree growth, and altering wildlife habitat (USFWS 1987). Fire exclusion can also lead to unnatural levels of fuel loading, and eventual landscape-level fires.

Wildland fire management actions also have socio-economic impacts. Many villagers earn a portion of their annual income by firefighting. This income in turn facilitates subsistence activities such as moose and caribou hunting. Trappers will experience furbearer population and possible species change following a wildland fire. Fur markets, trapline location, fire size, and severity are several factors that may influence the success and associated income to a trapper.

II. Relationship to Land Management Planning/Fire Policy

A. AGENCY FIRE/RESOURCE MANAGEMENT POLICY

Service wildland fire management policy is based on Authorities (Appendix G), Department of the Interior, and Fish and Wildlife Service policies. The following is not a comprehensive list of Department of Interior or Service policy but a list of those areas that generally affect all aspects of the fire plan and its implementation. It is our policy that:

1. ***Firefighter safety and public safety is the first priority of the Fire Management Program.***
2. Only **trained and qualified people** will conduct fire management duties.
3. **Trained and certified employees** will participate in the wildland fire management program as the situation demands.
4. We will conduct fire management planning, preparedness, wildland and prescribed fire operations, monitoring, and research on an interagency basis with the **involvement of all partners** when appropriate.
5. An **approved Fire Management Plan** must be in place for all of our lands with burnable vegetation.
6. We will integrate **fire, as an ecological process,** into resource management plans and activities on a landscape scale, across bureau boundaries, based upon the best available science.
7. We will use **wildland fire** to meet identified resource management objectives when appropriate and the Fire Management Plan contains such direction.
8. We will employ **prescribed fire** whenever it is an appropriate tool for managing our resources and to protect against unwanted wildland fire whenever it threatens human life, property and natural/cultural resources.
9. Our Regions will provide **safe, cost-effective fire management programs** in support of land, natural, and cultural resource management plans through appropriate planning, staffing, training, and equipment.
10. Management actions we take on wildland fire will consider firefighter and public **safety,** be **cost effective,** consider **benefits** and protection **values,** and be consistent with **natural and cultural resource** objectives**.**
11. Refuge staffs must **work with local cooperators** and the public to prevent unauthorized ignition of wildland fires on our lands.

U.S. Fish and Wildlife Service Manual, 621 FW 1, Policy and Responsibilities for Fire Management states: "*The goal of wildland fire management is to plan and make decisions that help accomplish the mission of the National Wildlife Refuge System. That mission 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.*"

B. RELATIONSHIP TO ENABLING LEGISLATION

Authorities (See also Appendix G)

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

1. Guidance for Developing Objectives

a. Origin of Resource Management Objectives for Refuge

The Kanuti NWR Fire Management Plan provides guidance and direction for implementing Departmental, Service, Regional, and refuge policies, to achieve objectives. Refuge objectives were set by Alaska National Interest Lands Conservation Act (ANILCA) (1980) and the refuge CCP (USFWS 2007). ANILCA established the refuge and its primary purposes and the CCP provides broad policy guidance on the management of the refuge. Service and Departmental policy also guide fire management actions. Significant wildlife resources on Kanuti NWR have been identified in the CCP as White-fronted Geese, other waterfowl, moose, caribou and furbearers.

The mission of the National Wildlife Refuge System "is to preserve 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" (National Wildlife Refuge System Improvement Act of 1997, P.L. 105-57).

The Service has adopted an ecosystem approach to fish and wildlife conservation (National Policy Issuance #94-07, March 1994), which means "protecting or restoring the function, structure, and species composition of an ecosystem, recognizing that all components are interrelated." The fire management program will conform to the ecosystem approach and objectives as they evolve.

2. Guidance from Departmental and Service Manuals

The Department of Interior Fire Management policy (620 DM 1.4) also guides this plan. It emphasizes that firefighter and public safety is always the first priority. Protection priorities are human life and property and natural/cultural resources. This policy also recognizes that fire is a "critical natural process," and will be "integrated into land, natural, and cultural management plans and activities on a landscape scale, across bureau boundaries, and will be based upon best available science." In addition, it states that 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." It requires those management actions taken on wildland fires to be "cost-effective; consider firefighter and public safety, benefits, and values to be protected; and be consistent with natural and cultural resource objectives."

The Service Manual (620 FW 1.3) dictates that habitat management activities strive for "the attainment and maintenance of naturalness and, to the extent possible, natural diversity." The goal of fire management as stated in the Service Manual (621 FW 1.2) is "to protect or enhance habitat and ecosystems for the benefit of fish and wildlife." Service policy (621 FW 1.3) states that the Service will use prescribed fire whenever it is an appropriate tool for managing Service resources, and will protect against wildland fire whenever it threatens human health, private property, or Service resources.

3. Compliance with Other Legislative Mandates

This plan must also comply with Section 106 of the 1966 National Historic Preservation Act, Section 7 of the Endangered Species Act, Section 810 of the Alaska National Interest Land Conservation Act, and Section 118 of the Clean Air Act. Smoke management is detailed in Section VII. No known properties on the refuge are included in or eligible for inclusion in the National Register of Historic Places. There are also no designated historic landmarks.

The management direction and actions specified in this fire management plan have been evaluated in accordance with National Environmental Policy Act (NEPA) and Sections 304 and 810 of ANILCA. The fire management plan is considered a step-down plan from the refuge CCP. Public participation in the CCP planning process was used in the development of alternatives and in the selection of a preferred management alternative, and the direction and intent of this fire management plan is based on that document (see Section II). Copies of a draft of this plan were provided to each village government around the refuge. In addition, visits were made to the villages near the refuge (Allakaket, Bettles and Evansville), and information received was also used in writing this Fire Management Plan. The CCP has included general guidance for fire management. The Fire Management Plan is being done under the NEPA process used for the CCP.

C. PURPOSE OF THE REFUGE

The Kanuti Refuge was established in 1980 as a result of the Alaska National Interest Lands Conservation Act (ANILCA).

ANILCA. SEC 302 (3) KANUTI NATIONAL WILDLIFE REFUGE—(B) The purposes for which the Kanuti National Wildlife Refuge is established and shall be managed include:

- To conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to white-fronted geese and other waterfowl and migratory birds, moose, caribou (including participation in coordinated ecological studies and management of the Western Arctic caribou herds) and furbearers;
- Fulfill international treaty obligations with respect to fish and wildlife and their habitats;
- Provide, in a manner consistent with purposes set forth in subparagraphs (i) and (ii), the opportunity for continued subsistence uses by local residents; and
- Ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (i), water quality and necessary quantity within the refuge.

Special values to be protected include as listed in the CCP/EIS/WR (pp. 11-12):

1. Hulgothen Bluffs. The Hulgothen Bluffs on Fish Creek in the northeast corner of the refuge are a rich repository of Pleistocene fossils and also may be an important archeological site.
2. Kanuti Canyon. The canyon is tremendously scenic, with 400’ cliffs, unusual arid plant communities, and unique nesting habitat for birds of prey.
3. Sithylemenkat Lake. The area surrounding the lake has rocky outcrops, sandy beaches, nesting habitat for birds of prey, and high scenic values.
4. Subsistence activities. The refuge is an important area for trappers, hunters, fisherman and other subsistence users.
5. Cultural Resources. Pre-Athabaskan and Athabaskan sites and remnants of five turn of the last century mining camps are located on refuge lands.

Guidance from Comprehensive Conservation Plan, Environmental Impact Statement, and Wilderness Review:

The refuge CCP, which was adopted in 1987, provided further direction in habitat management objectives, specifically to "emphasize the maintenance of the refuge's natural diversity and key fish and wildlife populations and habitat," to "maintain the refuge in an undeveloped state," to "provide opportunities for continued subsistence use of refuge resources," and to "maintain opportunities for hunting, fishing, and other recreational activities" (USFWS 1987). At the time of writing the 2007 CCP was in final draft, the guidance for this FMP was taken from the 2007 CCP.

The refuge CCP (USFWS 2007) further states:

The primary objectives of fire management on Service lands are to conserve, protect or enhance habitat and to maintain ecosystems for the benefit of fish and wildlife. Fire management activities on the refuge include preparedness, wildland fire suppression, wildland fire use, prescribed fire, outreach, education and prevention, monitoring, emergency stabilization and rehabilitation, fuels management, smoke management, fire trespass and research. All activities will be conducted in accordance with refuge, Service, and Department of Interior policies and approved interagency and refuge-specific fire management plans. Fire management decisions by manager are based on values warranting protection, protection capabilities, firefighter safety and/or land and resource management needs.

The Refuge Fire Management Plan provides specific information on the application and management of fire on the refuge. Additionally, the Alaska Interagency Wildland Fire Management Plan1 provides a cooperative framework and operational guidelines for the suppression of wildland fires. The suppression of human-caused and unwanted wildland fires and the use of natural-caused wildland fires and prescribed fires as management tools are important management prerogatives on the refuge.

The refuge CCP also references area wide fire management planning (i.e., Alaska Interagency Wildland Fire Management Plan [AWFCG 1998] and Seward–Koyukuk Fire Management Plan [SKPT 1984]), which describes the use of suppression to help meet management objectives.

1 Developed be Bureau of Land Management, Alaska Fire Service

Whenever possible, refuge management, and specifically fire management decisions, should attempt to maintain the wild character of Kanuti Refuge, as stated in the most recent CCP (USFWS 2007). Kanuti Refuge has fire wilderness review units (Kanuti Flats, Kanuti Canyon, Koyukuk Flats, Alatna Hills and Ray Mountains.) Each of these units has special features that meet the definitions of wilderness as defined by the Wilderness Act, being undeveloped, untrammeled, highly natural and offering outstanding opportunities for solitude or a primitive and unconfined type of recreation, However, as a result of concerns expressed by the State of Alaska and subsequent analysis of those concerns by the Service, management alternatives that would have recommended Congress consider areas of the refuge for inclusion in the National Wilderness Preservation System were eliminated from detailed consideration in the 2007 CCP.

Guidance from other Plans:

The refuge Fishery Management Plan (USFWS 1993) describes the importance of aquatic resources on the refuge and calls for monitoring of fish species and water quality to conserve fish populations and habitat in their natural diversity and provide opportunity for continued subsistence use by local residents.

The North American Waterfowl Management Plan (USDI 1986) identifies the Kanuti Refuge as a waterfowl habitat area of major concern. The plan stresses the value of maintaining an adequate habitat base to ensure perpetuation of North American waterfowl populations.

The Western Arctic Caribou Herd Management Plan (BLM and others 1995) calls for allowing a natural fire regime to help maintain habitat quality. The refuge is partly within the herd's historic range.

The National Fire Plan was developed in August 2000 (www.fireplan.gov) with the intent of actively responding to severe wildland fires and their impacts to communities, including assuring necessary firefighting resources, emergency stabilization and rehabilitation, hazardous fuels reduction, and community assistance. The Kanuti Refuge fuels reduction WUI projects at the adjacent communities of Allakaket, Bettles and Evansville are in response to directions within the National Fire Plan.

The Koyukuk River Moose Management Plan (ADF&G 2001) indicates the need to evaluate, plan and implement prescribed burns to maintain and/or improve moose habitat in the Koyukuk River drainage.

III. WILDLAND FIRE MANAGEMENT STRATEGIES

A. GENERAL MANAGEMENT CONSIDERATIONS

The boreal forest of the Kanuti Refuge is recognized as a fire-dependent ecosystem. Fire exclusion will alter the ecosystem character, function, vigor, and diversity of the refuge. There are objects and resources within the refuge boundary that warrant special consideration regarding fire and/or protection from fire. They include Federal property on the refuge (e.g., the Kanuti administrative cabin, the Kanuti RAWS site, and radio repeater sites), private property within the refuge, sensitive plant and wildlife species (lowland caribou/lichen range), and sensitive biological communities (steppe-bluff communities).

Inherent in all fire management decisions is the fact that wildland fire is an integral and necessary part of the boreal forest ecosystem. Departmental policy states "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). Wildland fires are a natural part of the boreal forest, and the plants and animals in it are adapted to fire, which maintains ecosystem health (Payette 1992). Analysis of fire history suggests that the boreal forest area of the Kanuti Refuge naturally burns on an approximately 100-year cycle, typical of Interior Alaska (Mann and others 1995, Mann and Plug 1999).

The Appropriate Management Response (AMR) to wildland fires occurring on the Refuge will be one or a combination of the following: (1) suppression; (2) surveillance and monitoring; or (3) management for resource benefits. The refuge will assist in improving the capability of federal, State and local firefighting resources to respond to wildland fires and the readiness to protect communities from wildland fires where feasible. Efforts will be taken to reduce hazardous fuels where needed to protect human life and property and/or areas of special concern. Strategies will be developed under AMR to determine the benefits of allowing lightning-ignited wildland fires to burn while taking appropriate measures to protect human life, property and/or areas of special concern.

The Fish and Wildlife Service is responsible for fire management activities on refuge lands. Through agreement the Alaska Fire Service - Yukon Zone (AFS) provides fire suppression services for the refuge. Upon notification of a fire, the Refuge Fire Management Officer will consult with the Refuge Manager or Acting Refuge Manager regarding special concerns and specific direction to be taken. Together, AFS and the refuge will develop an appropriate management response.

When appropriate or needed, representatives from Native Corporations, the Bureau of Indian Affairs, DOF, and/or the local Alaska Department of Fish and Game (ADF&G) staff will be consulted for input/concerns regarding suppression or wildland fire use strategies.

Upon receiving the detection report from AFS or DOF, a decision criteria check list and a Stage I of the Wildland Fire Implementation Plan (WFIP) will be completed. See Appendix I. Wildland Fire Use Management or the Service Fire Management Handbook Chapter 3.3 for the instructions on how to complete Stage I of the WFIP.

1. Wildland fire suppression

All unplanned ignitions occurring in the critical, full, or modified (until the conversion date) management options and those ignitions occurring in the limited management option failing to meet predetermined conditions for wildland fire use will be suppressed through the selection and implementation of an appropriate suppression response [Predetermined conditions (Appendix S) which permit wildland fire use include: naturally caused fire, safety of individuals and/or property is not jeopardized; fire protection level for affected lands permits fire use; no private parcels and/or prehistoric/historic sites and/or special resources “to-be-protected” are involved; and ***resource benefit***.] See Appendix F Alaska Interagency Wildland Fire Management Plan pages 18-32 for a description of the management options. In selecting an appropriate suppression response, the Incident Commander and the Agency Administrators must consider firefighter and public safety, cost effectiveness, and impact of suppression activities as well as protection of resources and values to be protected. Appropriate suppression responses will range from aggressive initial attack, to surveillance/monitoring, to indirect containment, or any combination of the former. The level of suppression will depend upon the fire management option, available resources, time of year, fuel, terrain and other factors related to the management of a fire.

2. Wildland fire use

Natural ignitions may be managed as use fires for ***resource benefit*** (i.e.., to maintain fire's natural role, reduce hazardous fuel loads, provide a diversity of seral habitats, and/or maintain/ enhance wildlife habitat). Wildland fire use will be considered for all natural ignitions detected within the limited management and modified management options (after the conversion date) in all fire management units (FMU), unless the Refuge Manager or designee directs otherwise. (Appendix S prescription criteria). Wildland fire use comprises an *alternative* response in the FMUs modified (prior to the conversion date) and full management options and may be implemented within these units only if initial attack has not been initiated and/or suppression resources are not available.

A signed (by the Refuge Manager) Decision Criteria checklist (Appendix I) and a Wildland Fire Implementation Plan (WFIP) Stages I will be developed. A Periodic Planning Needs Assessment will be completed on each fire to determine the need to manage the fire under a Stage II or III WFIP. Wildland Fire use Management or the Fire Management Handbook Chapter 11) will be used. The WFIP is signed by the Refuge Manager or Acting Refuge Manager, and resources will be assigned to manage the fire. If the Decision Criteria Checklist indicates the fire cannot be managed for resource benefit, it will continue to be managed by AFS or DOF as a suppression fire.

Utilization of wildland fire use supports the 10-Year Comprehensive Strategy goals of reducing hazardous fuels and restoring fire-adapted ecosystems. The principles of the 10-Year Comprehensive Strategy will be followed by (1) protecting communities, (2) collaborating with the AFS, DOF, and ADF&G in setting priorities, (3) establishing meaningful performance measures, and (4) monitoring the fires before and immediately after they are declared out. **Protecting human life will be the number one priority**. Fire use priorities will be established immediately following the decision to manage a wildland fire as wildland fire use. AFS and/or DOF will be consulted during the development of wildland fire use priorities and performance measures. Monitoring and surveillance will be key components of a Stage I, II or III WFIP. Each fire will be monitored based on a pre-determined schedule (depending upon weather and the availability of surveillance personnel/aircraft) in order to validate the WFIP and to determine whether fire performance measures/objectives are being met. Responsibility for fire surveillance lies with the refuge but can be shared with AFS and/or DOF providing they have the available time, personnel, and aircraft. AFS and/or DOF will be briefed daily on the status of each fire. Wildland fire use will strive to be fiscally responsible.

The Incident Commander and the Agency Administrators must consider firefighter and public safety, cost effectiveness, and impact of suppression activities as well as protection of resources and values to be protected. Appropriate suppression responses will range from aggressive initial attack to surveillance/monitoring to indirect containment or any combination of the former. The level of suppression will depend upon the fire management option, available resources, time of year, fuel, and terrain and other factors related to the management of a fire.

The Alaska Interagency Wildland Fire Management Plan (AWFCG1998) was developed to provide a coordinated and cost effective approach to fire management on all lands in Alaska. Previous policy (before 1984) had required the immediate suppression of all wildfires in Alaska.

A 10-Year Comprehensive Strategy (2001) was developed as a subset of the National Fire Plan. This national strategy emphasized a collaborative approach for reducing wildland fire risk to communities and the environment. The goals of the strategy were to improve prevention and suppression, reduce hazardous fuels, restore fire-adapted ecosystems, and promote community assistance.

The Alaska Wildlife Fire Coordination Group (AWFCG) in which Department of Interior and State of Alaska land management agencies (FWS, NPS, BLM, USFS, ADF&G, and ADEC), Native Regional Corporations, and local tribal governments coordinate fire management actives in a collaborative process.

As an example of the local collaborative process, the neighboring communities to Kanuti Refuge (Allakaket, Bettles and Evansville) have been identified as being at risk for wildfires originating on Federal lands. Allakaket received a very high wildfire risk priority rating, as published in the Congressional Record. In accordance with this wildfire risk rating, a FWS-sponsored community hazardous fuels reduction project was initiated in 1997. Three separate non-fire treatments were completed by 2004 as part of this project at Allakaket in cooperation with the tribal government and the local Allakaket fire crew.

A similar collaborative community fuels project has been initiated by FWS at Bettles and Evansville in 2006 in cooperation with the tribal and city governments. The priority setting for this Bettles and Evansville fuels reduction project was based on the demonstrated wildfire risk to the community (as evidenced by the 2004 Evansville Fire) and was endorsed by the AWFCG Fall Fire Review (2005).

B. WILDLAND FIRE MANAGEMENT GOALS AND OBJECTIVES

From policy and from objectives outlined in ANILCA, the refuge CCP, the National Fire Plan, and the 10-Year Comprehensive Strategy, the refuge's fire management goals are:

a. Broad Fire Management Goals

- Improve Prevention and Suppression. Protect life, property, and identified resources from fire. Priorities in fire suppression are human life and property and natural/cultural resources. Strengthen interagency partnerships with Alaska Fire Service, which is the regional fire suppression organization.

- Restore Fire Adapted Ecosystems. Manage wildland fire and prescribed fire to protect or enhance habitat and ecosystems for the benefit of fish and wildlife.

- Promote Community Assistance. Communicate, coordinate, and cooperate with suppression organization staff, adjacent landowners, and the general public

b. Refuge Specific Fire Management Goals and Objectives

- **Goal.** Protect human life and settlements within and adjacent to Kanuti NWR from wildland fire. Reduce hazardous fuels as appropriate in local communities.

  Objectives:

  - By 2007, work with the community of Allakaket to implement a monitoring program for the 2003-2004 hazardous fuels treatment area to determine when treatment needs to be repeated. The program will include standardized methods for measuring fuels, establishment of photo plots, suggested monitoring intervals, and an outreach component to educate village residents and individual house lot owners about the values of FireWise activities and results.

  - Strengthen interagency partnerships with National Park Service in Bettles. By 2007, in collaboration with the National Park Service, distribute educational material about FireWise techniques to residents of Alatna, Bettles, and Evansville and provide information about funding opportunities/criteria for participation in the national FireWise program. Continue with other outreach efforts on an annual basis through newsletters, village visits, and classroom instruction.

  - Evaluate wildland fire pre-planned suppression options (AIWFMP) annually in collaboration with the Refuge staff and Alaska Fire Service and coordinate with the suppression agency and regional office.

  - By 2007, complete the Bettles and Evansville community hazardous fuels reduction project in collaboration with the local tribal and city governments.

- **Goal.** Protect sensitive biological communities, cultural and historic sites, private parcels, privately owned and legally registered cabins, and refuge administrative facilities on Kanuti NWR from wildland fires to the extent practicable.

  Objectives

  - Within two years of plan approval, ensure that accurate Global Positioning System (GPS) locations and photographs (aerial and ground) are available for all cabins within the refuge. Identify vegetation communities to the Viereck Level III class (Viereck et al. 1992) within a 0.5 mile radius around the cabin and provide specific fuels information for the area within a 0.25 mile radius around the cabin.

  - Within two years following approval of this plan, contact all cabin owners and provide Alaska FireWise information for reducing risk to cabins from fire.

  - By 2010, re-treat the Kanuti NWR administrative cabin on Kanuti Lake to meet FireWise recommendations for reduction of hazardous fuels. Monitor fuels buildup within treated area at 2-year intervals. Establish a fire safety plan for the cabin that can be followed by field personnel and ensure that field personnel are aware of proper procedures. Upon completion of fuels treatment, post an educational sign and provide leaflets describing FireWise measures implemented to inform visitors about proper fire prevention techniques.

- Together with the Regional Archaeologist or cultural resources specialist, identify and map which cultural and historic sites are at risk of unacceptable damage from wildland fire by 2008 so that suppression efforts can be prioritized appropriately.

- Within four years following approval of this plan, identify and map potentially sensitive biological communities, evaluate their uniqueness in interior Alaska, and determine if they are at significant risk of burning and require special protection from fire.

❖ **Goal.** Restore, perpetuate, and protect native wildlife and plant species on Kanuti NWR by maintaining a diversity of plant communities that would be expected under a natural regime of wildland fire.

Objectives:

- By 2010, establish fire history for the southern half of the refuge by tree ring analysis.

- By the end of 2008, explore the feasibility of obtaining fire history information using techniques such as peat and lake coring and carbon dating of charcoal in soil by conducting literature reviews and contacting scientists involved in such work.

- By 2010, compare the use of SPOT satellite imagery for mapping Fire regime Condition Class (FRCC) to methods using Landsat, aerial photos, or other remote sensing products.

- By 2007, Provide increased fire protection for lichen habitat used as range by wintering caribou within the area depicted in Figure 7 so that no more than 5% of this total area burns each year for the next 20 years. This area will be continually evaluated for additional protection level changes, in case additional wildland fires burn more of this lowland habitat.

- Provide first order fire effects data to determine if newly burned sites would be appropriate areas to monitor bird use of burned habitat over time. If appropriate, bird and habitat monitoring would begin the June following the fire and would continue on an annual basis for five years. After five years, the monitoring schedule will be reevaluated based on preliminary data analysis.

- Continue working with the National Park Service and USGS/University of Alaska Fairbanks to develop research proposals investigating the role of fire in northern Alaska moose ecology or other research needs as identified. Submit a study proposal to the Joint Fire Science Program by 2007.

- **Goal.** Maintain natural fire-related ecosystem processes on Kanuti NWR to the maximum extent feasible and initiate studies if the role of fire in these processes is poorly understood.

Objectives:

- Evaluate areas where recent (within 1 year) suppression activities has occurred in critical and full protection zones and determine if prescribed fire would be an appropriate tool to maintain the role of fire in the ecosystem where fire has been excluded.

- The summer following a wildland fire, map burn severities within the fire perimeter, when possible, using a combination of remote sensing and ground-based techniques. Ability to map severity will depend on availability of satellite imagery and access to ground plots.

- Beginning in 2007, lakes with pre-existing baseline data will be monitored if they fall within fire perimeters. The refuge plans to conduct a baseline inventory of lake attributes (water chemistry, bathymetry, aquatic plants, etc.), and these data can be used to assess short- and long-term effects of fire.

- Refuge staff will participate in interagency efforts to plan and implement fire-related monitoring and modeling activities such as those documented in the National Fire Plan or recommended by the Alaska Fire Effects Task Group.

- Continue coordination with Regional Office fire staff to determine what role Kanuti NWR can have in implementing national fire initiatives such as FPA, Farsite, LANDFIRE, FRCC and fuel types mapping. Activities may include accumulation of GIS layers required for LANDFIRE products or providing study sites, staff, and logistical support for LANDFIRE/ FRCC activities.

- **Goal.** Educate children and adults residing in or visiting northern Alaska to recognize the role of fire in the boreal forest and understand the long- and short-term ecological consequences of maintaining or restricting fire in the landscape.

Objectives:

- Continue educational activities about fire effects at the Arctic Interagency Visitor Center in Coldfoot, covering topics such as fire's role in maintaining habitat diversity and its effects on permafrost, wildlife, vegetation, and human activities.

- By 2008, or within a year of plan's approval, incorporate the Role of Fire curriculum into classroom visits at local schools and science camps.

- By 2007, develop a post-fire educational poster about the relationship between vegetation and small mammal populations for display in schools and at outreach events.

C. WILDLAND FIRE MANAGEMENT OPTIONS

1. Strategies to be Employed:

Wildland fires started by natural causes and where prescriptive criteria are met, may be managed for resource benefits (Wildland Fire Use) (see Section IV.D; Table 9). Suppression action will be taken on all wildland fires not managed for resource benefits and all human caused fires. (See Section IV). A full range of suppression actions are available, from surveillance to direct attack.

Prescribed fire will be used for hazard reduction and resource management objectives (see Section IV.E.). Prescribed burning may be permitted on a case-by case basis subject to provisions of NEPA, and an approved prescribed fire plan (USFWS 1987).

Fuels management and mechanical treatment projects may be undertaken refuge lands with local village and tribal governments. This is part of cooperative efforts to reduce hazard fuels and lessen wildfire risks spreading from Federal to adjacent Native lands.

Fire prevention and education programs (such as FireWise) should be expanded in order to reduce the risk of accidental ignitions and lessen wildland fire risk around structures (cabins) and/or village residences in the vicinity of Kanuti NWR.

2. General Constraints to All Strategies

Protection of human life is the highest priority at all times. The "light hand on the land" concept is encouraged on the refuge; any fire suppression activities on refuge lands will use methods that minimize environmental damage and disturbance to wildlife (minimal impact suppression techniques – MIST). ANILCA states that subsistence uses of the refuge have precedence over other consumptive uses. Effect of fire management activities, especially the use of prescribed fire on subsistence uses must be evaluated (see Section 810 of ANILCA). Fire management actions must be cost-effective and consider benefits and values to be protected. Fires in the boreal forest can produce large amounts of smoke, and fires must be managed to minimize impacts and maintain air quality.

Two constraints apply specifically to fire suppression activities on Kanuti Refuge: 1) no use of retardant, except in defense of life and property; and 2) no use of heavy equipment. Other constraints to specific strategies (suppression, fire use, prescribed fire) are listed in the appropriate sections.

D. DESCRIPTION OF WILDLAND FIRE MANAGEMENT STRATEGIES BY FIRE MANAGEMENT UNIT

There are five Fire Management Units on Kanuti Refuge. The FMUs have been defined by fire management objectives and correspond with the suppression options in the Alaska Interagency Wildland Fire Plan. Increasing levels of fire protection extend across the refuge from southeast to northwest, as the areas of human habitation are approached (Figure 8). Wildland Fire Use is a fire management option in all FMU's.

Between 1997 and 1998, the USFWS, AFS, and native organizations came to a consensus to: 1) modify the Fire Management Units in the south and east of the refuge to the Limited Management Option; 2) apply the Modified Management Option to the central area of the refuge; 3) use the Full Management Option as the northerly and easterly borders are approached, and 4) place the Critical Management Option around the four villages. This pattern of management options reflects the pattern of human habitations, which are the primary values at risk (Figure 8).

The Modified Management Unit was expanded to the southeast in 2006 in order to protect remaining lowland lichen habitat for wintering caribou (Figure 7). This change to an increased level of suppression option was initiated by Kanuti Refuge staff and was supported by AFS. The extensive 2004 and 2005 fires (Clawanmenka and Old Dummy Fires) had burned much of this slowly regenerating lowland caribou habitat (Figure 5). Fire management units are validated annually to ensure resource objectives are being met.

The FMUs boundaries were placed to take advantage of natural barrier and landmarks on the ground rather than administrative boundaries.

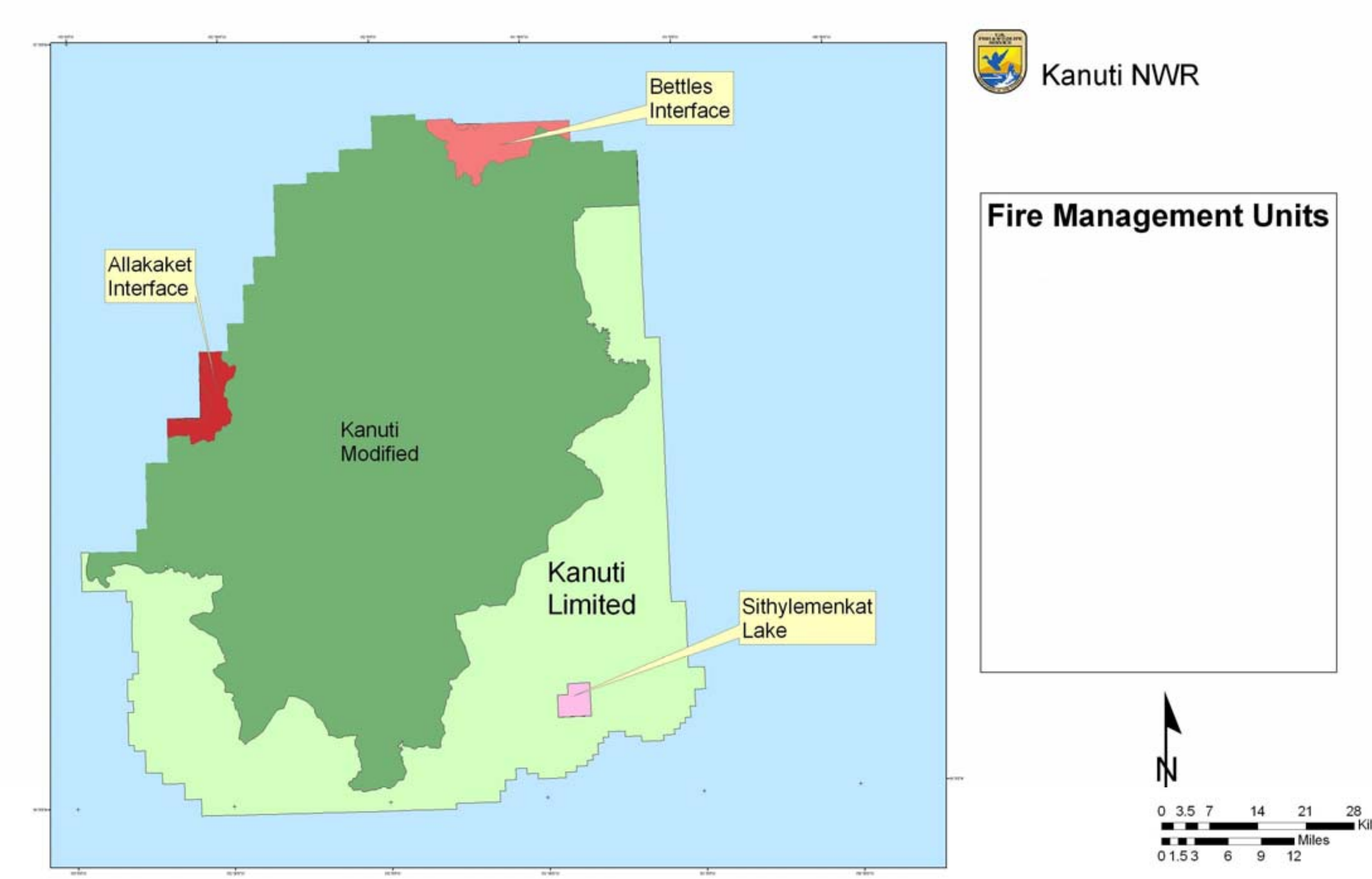

Figure 7. Kanuti Fire Management Unts.

TABLE 7. Fire management units on Kanuti National Wildlife Refuge

Fire management Unit	CCP management designation	Wildland fire management option**	Wildland fire management objectives
Kanuti Limited	Minimal	Limited	1. Allow fire to burn under the influence of natural forces within predetermined ar ecological role in the ecosystem. 2. Protect human life and site specific property within the unit 3. Prevent fire from burning into Full or Critical management option areas. 4. Reduce overall suppression costs through minimum resource commitment.
Kanuti Modified	Moderate	Modified	1. Protect human life and site-specific values. 2. Minimize acres burned in old growth lichen area. 3. Protect identified resources and prevent the fire from burning into Full or Critic option areas. 4. Reduce overall suppression costs through minimum resource commitment. 5. Use prescribed fire and mechanical treatments to reduce hazardous fuels around 6. Implement limited suppression options after yearly conversion date.
Bettles Interface	Minimal	Full and Critical	1. Protect human life, property, designated sites, and designated natural resources. 2. Minimize acreage burned during initial attack. 3. Use prescribed fire and mechanical treatments to reduce hazardous fuels around
Allakaket Interface	Moderate	Full and Critical	
Sithylemenkat Lake	Private	Full	

* The refuge CCP (USFWS 2007) placed most of the refuge under "minimal management". Any activities on refuge lands will use methods that minimize environmental damage.

1. **Kanuti Limited Management Unit**

This unit contains southern and eastern upland areas of the refuge to include Hodzana Highlands, Ray Mountains, and Indian River. All fuel types are present in this unit but the dominant types include black spruce/stunted white spruce as well as the herbaceous or shrub types caused by recent burns. Extensive portions of this unit (e.g., Hodzana Highlands; Ray Mountains) burned during the years of 1990–1992 (Figure 4).

Refer to Table7 for specific management objectives. Fires may be allowed to burn for resource benefits in this unit to maintain the current natural vegetation regime.

It is not uncommon for large acres of land in a given area to be burned by a few fires during periodic severe fire years. Limits may be placed on the number of wildland fires burning at one time or on the cumulative acreage burned during a year. Decisions to suppress fires in this FMU may be based not only on the number of fires burning and acreage burned, but such decisions will also be predicated by the anticipated fire behavior, the weather prediction, the acreage likely to be burned, and the direction in which the fire is moving. The decision process also includes existing and anticipated smoke problems, the likelihood of the actions' success, as well as the experience and judgment of the Refuge FMO and AFS zone personnel, and the decisions of the Multi-agency Coordinating Group (MAC Group)(see below). Non-standard decisions such as suppressing a fire in Limited or allowing a fire to burn in Modified before the conversion date will require documentation with a Decision Criteria Record (AWFCG 1998). This will be prepared jointly by the Kanuti Refuge FMO and the suppression FMO.

The refuge purposes include managing to maintain natural habitat diversity. Human-caused wildland fires, however, be they accidental or intentional, have also affected the landscape for centuries (Lutz 1956, Pyne 1982). Management of human-caused fires will be based on other factors, including protection of human life, property, and identified values, as well as suppression costs and potential damage from suppression operations. Human-caused wildland fires will not be managed for resource purposes, but will be suppressed.

2. Kanuti Modified Fire Management Unit

The Kanuti Modified FMU contains large sections of lowland marshes and wetlands. This modified unit was expanded by Kanuti Refuge staff in 2006 in the Lower Chalatna area to protect additional lowland caribou lichen habitat after the Old Dummy Fire (2005) and Clawanmenka Fire (2004) burned much of the area (Figure 7). Other fuel types present in this unit includes white spruce, hardwoods, and willow shrublands along the rivers (Figure 4). Some large areas of black spruce/stunted white spruce are also present in the Henshaw Creek drainage in the Northwest area, which burned in 1991 (Figure 5).

Refer to Table 7 for specific fire management goals and objectives for this FMU. Prior to July 10, fires in this unit are to be suppressed unless under special circumstances, such as weather conditions, higher priority fires elsewhere in the vicinity or shortages of available suppression resources. As a general rule, fire management units with modified designations <u>may</u> be allowed to burn after the normal evaluation/conversion date of July 10, since normal seasonal change is likely to extinguish or reduce fire activity and size. This date is evulated annually based on current and forecasted weather as well as current fire activity and fire resource availability.

Until the very dry summer of 2004, only portions of this largely lowland unit had burned since fire suppression began in the early 1950s in the area now within the Kanuti Refuge. Most of this modified area, with the exception of the Bettles Uplands and the Northwest area, lies in the wetlands between the two major rivers (Figure. 8).

3. Bettles Interface, Allakaket Interface and Sithylemenakat Lake Fire Management Units

Wildland fires in these units have high priority for suppression resources and the fires initially receive aggressive suppression action to minimize fire acres (Table 8). Safety and protection of identified sites or structures is a priority. These units are designated full suppression with small areas of critical suppression due to the proximity of inhabited villages and private lands.

Just over 2.5% of land within the refuge boundary has been designated in Full Management with less than 1% in critical option (Table 8). These lands encompassing the Critical zones are near the refuge boundaries where defensible boundaries were used (rivers) rather than the administrative boundary. Minimizing the acreage burned in the Full management option areas is an objective during initial attack, but costs should be an important factor in selecting strategies and tactics for extended attack and escaped fires. All fuel types are present in the Interface Units. Dominant types include lowland white spruce, hardwoods, and willow shrublands, although some large areas of black spruce/stunted white spruce are also present (Figure 4).

The suppression status of these Critical and Full Option designations may eventually result in hazardous fuel accumulations around the settled areas over the long term as fuel loadings increase. Hazard situations in two neighboring villages to Kanuti Refuge have been identified and mitigated by mechanical treatments in 1997-2007. (See WUI Section IV.E.9, below.)

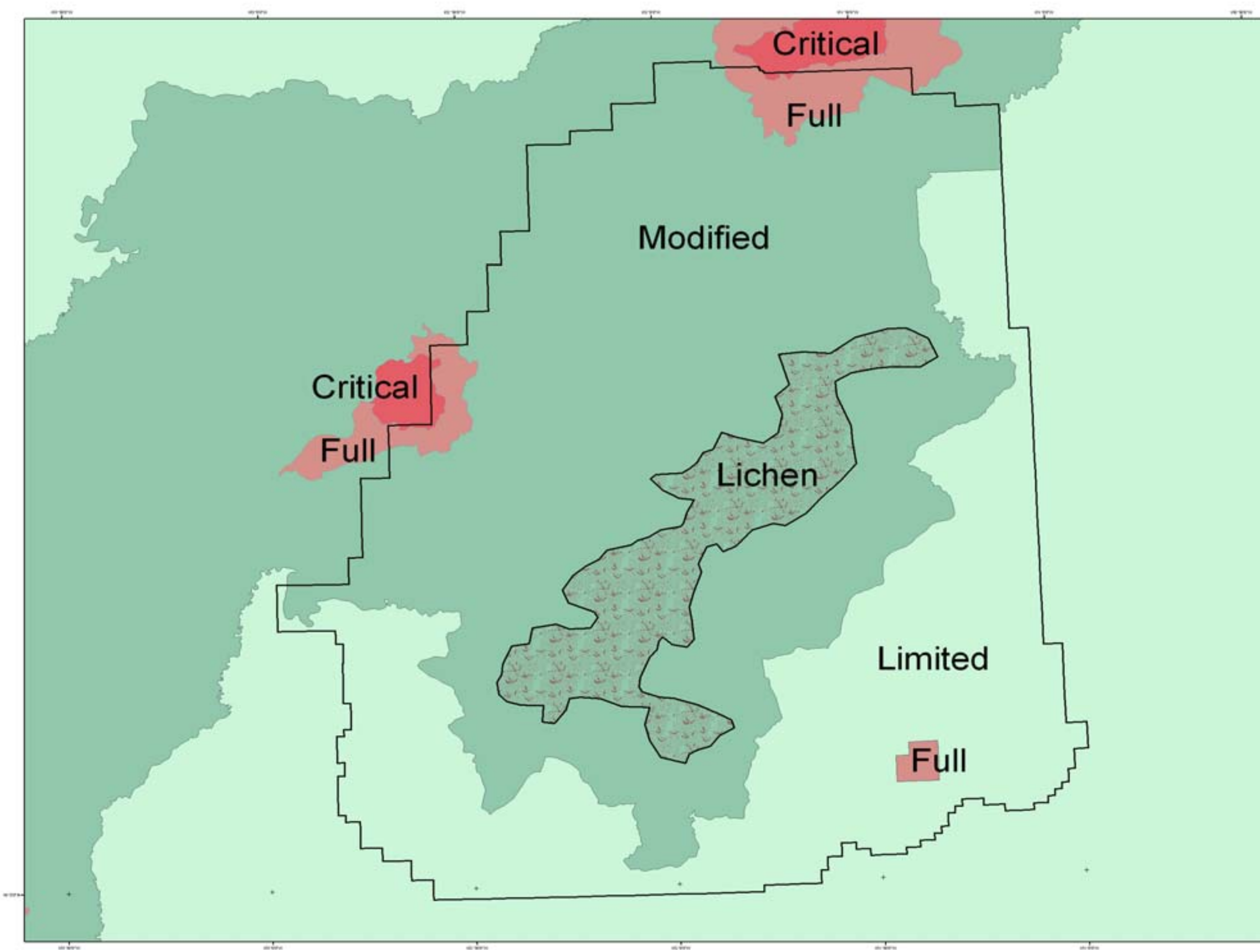

FIGURE 8. Fire Management Options: Limited, Modified, Full and Critical Protection Zones, on Kanuti NWR and surrounding areas.

IV. WILDLAND FIRE MANAGEMENT PROGRAM COMPONENTS

A. WILDLAND FIRE SUPPRESSION

Appropriate suppression responses are based on identified values to be protected. Fire management objectives are listed in Table 7 and fire suppression objectives are listed in Table 8.

Suppression is the act of putting a fire out. Suppression actions range from full suppression to extended surveillance. Initial attack suppression strategy is outlined in the interagency fire management plan. The basic strategy for fire management on Kanuti Refuge is to allow fire to burn in its historic and natural role while protecting identified values at risk. This is also the direction for suppression actions.

B. SUPPRESSION AUTHORITY AND PLANNING:

The Departmental Manual (620 DM 2.4 Policy) states that BLM will maintain the suppression organization and provide suppression services to DOI lands in Alaska. Suppression services must conform to fire management guidelines specified by the FWS and BLM agreement.

Initial attack of fires is largely preplanned with "wildland fire management option" designations described in the Alaska Interagency Wildland Fire Management Plan (for definitions see Table 8). The Alaska Interagency Wildland Fire Management Plan (AWFCG 1998), which is prepared by guidelines dictated by the refuge, provides methods for determining appropriate suppression action. This plan provides for a range of suppression responses to wildland fire that a) protect human life and property and other identified resources and developments, b) balances suppression costs with values at risk, and c) is in agreement with refuge resource management objectives.

1. Suppression Strategies Related to Designated Wildland Fire Management Option

Preferred <u>initial response</u> actions for wildland fires are described below for each wildland fire management option and are summarized in Table 8. Management option boundaries are shown in Figure 6. Management option designation is the main factor that determines initial response to a wildland fire, through the use of decision charts in the Alaska Interagency Wildland Fire Management Plan (AWFCG 1998). All actions are dependent on the availability of suppression resources and other factors, such as weather and current and expected fire behavior. Suppression responses that may vary from the AWFCG plan require documentation by a Decision Criteria Record (AWFCG 1998).

2. Wildland Fires in Critical Management Option Areas

Fires in Critical management option zones will receive priority for suppression over fires in all other management options throughout the year. Objectives are to protect human life and identified sites from fire. Aggressive suppression action will normally be pursued until the fire is declared out. Protecting human life, inhabited property, and designated physical developments are of top priority. Minimizing acreage burned is not a management priority, but the protection of identified values is, e.g., inhabited dwellings. The refuge has about 15,000 acres of land designated as Critical management option, or less than 1% of the surface area.

3. Wildland Fires in Full Management Option Areas

In terms of suppression priority, fires occurring in these areas are second only to fires in Critical management option areas throughout the year. Aggressive suppression action will normally be used on fires in Full areas until the fire is declared out. Protecting designated sites is a priority, and minimizing acreage burned is a management priority during initial attack.

This designation is intended for protection of cultural and historical sites, uninhabited private property, natural resource high-value areas that may be damaged by fire, and other high-value areas that do not involve the protection of human life, human health, and inhabited property.

The refuge has about 41,000 acres designated as Full, which is about 2.5% of the total area. These lands are around villages and concentrations of private parcels. Management option boundaries were placed on refuge lands to take advantage of natural barriers in order to maximize protection of adjacent nonfederal lands.

TABLE 8. Management option designation and suppression response to wildland fire.

Wildland Fire Management Option (formerly Fire Protection Level)	Appropriate initial response	Suppression Objectives Common to all is the top priority of protection of human life and secondarily the protection of property and natural/cultural resources.
Critical	Aggressive initial attack--usually direct attack	1. Protect inhabited property and designated developments. 2. Continue control tactics until fire is declared out. Protect inhabited dwellings. The objective is to control the fire ASAP, or within 18 hours.
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.

4. Wildland Fires in Modified Management Option Areas

Fires in this category are third in priority for receiving suppression resources, behind Critical and Full management option areas. The intent of this designation is to allow as much flexibility as possible in managing wildland fire, to balance acres burned with suppression costs, and to accomplish land and resource management objectives. Refuge objectives are to protect identified values and to prevent the fire from burning into Full or Critical management option areas.

Modified management option area boundaries were located to take advantage of natural barriers. This helps protect adjacent land in the Full category, provides flexibility to allow suppression of fires in cost-effective ways, and allows wildland fires to break up hazardous fuel stands and generate resource benefits.

Containment of fires with indirect attack is encouraged during initial attack before the conversion to Limited status. A fire in Modified before the conversion date is usually actively suppressed from time of discovery until it is out. Alternatively, it may have containment tactics used on the entire fire or only on part of it, as documented in a Decision Criteria Record.

After a standard evaluation date (July 10^{th}), these areas convert to Limited management option areas, where confinement tactics are preferred. Consideration will be given for earlier conversion if weather is cool and wet, fuel moisture levels are elevated, and temperature/dew point spread is moderate.

The refuge has about 753,220 acres in Modified, about 46% of the refuge area. The Modified to Limited evaluation date is generally July 10th. The decision to convert to Limited is made upon a consensus between fire management officers (FMOs) and the AWFCG, and is based upon seasonal conditions and fire activity.

5. Wildland Fires in Limited Management Option Areas

The overall objective in this category is to allow wildland fire to fill as much of its natural role as possible to help maintain natural habitat diversity. Fires in Limited are generally allowed to burn. Priorities in managing fires are to protect identified resources and to reduce the potential for fire to burn into Full or Critical management option areas. Minimizing acreage burned is not a management priority in this category. Preventing a fire from burning into a Modified management option area is not an absolute priority; the important factor is containing that fire from burning through Modified and into Full and/or Critical management option areas. Likelihood of success, suppression cost, and availability of resources, among other factors, will determine what actions are taken by using the Wildland Fire Situation Analysis (WFSA) described in Section IV.9.c., below.

Surveillance is used to ensure that the fire remains confined within the management option area. The frequency of surveillance depends on the regional fire situation, weather trends, potential threats, and past and anticipated fire behavior. Increased surveillance criteria include weather becoming hotter and drier, increasing cumulus buildup, elevated Duff Moisture Codes and Drought Codes, and increasing lightning strikes.

If suppression action is required, confinement tactics or site protection tactics are preferred. Cost-effective site protection tactics are preferred to extinguishment of the fire in Limited management option areas. Minimum resource commitment is desired, without compromising firefighter safety. Fire suppression actions in this option receive the lowest priority for allocation of suppression resources. The refuge has about 819,000 acres in Limited, about 50% of the refuge area.

6. Surveillance Requirements

Fire surveillance procedures follow those in the Alaska Interagency Fire Management Plan (AWFCG 1998). Frequency of surveillance will depend on current and predicted fire behavior and weather, values at risk, and other factors. (See criteria listed above.) Surveillance will normally be performed by air, although personnel are occasionally placed on the ground for more detailed fire behavior observations. Close cooperation with the suppression agency (AFS) is essential to avoid duplication of surveillance efforts. If surveillance is performed by refuge staff, the refuge Fire Management Officer (FMO) will provide a copy of the report to AFS zone dispatch as soon as possible following the flight and will notify the zone FMO. Daily fire situation reports summarizing both AFS and FWS surveillance flights as well as other fire activity are available at the AFS Website. Surveillance form Appendix D.

7. Protection of Permitted Cabin(s)

Fish and Wildlife Service policy (updated 2006) states that permitted cabins will not be guaranteed protection from wildfire. Burning out from a sprinkler system line surrounding a cabin is the recommended protection tactic, if a water source is available. Refuge cabin permits have the recommendation to follow FireWise techniques to reduce risk of ignition from encroaching wildfire. Updated FWS refuge cabin policy is included below (see U).

There is a single permitted cabin (a partial structure only) on the Kanuti Refuge. The incomplete cabin structure is located on T23N, R17W Section 6, about 4 miles south of the mouth of the Jim River on the South Fork Koyukuk River. The cabin, which remains roofless and covered with a blue tarp, is located in riparian white spruce. There are no other permitted cabins on Kanuti Refuge.

8. Use of Alternative Initial Response, Escaped Fires, and Extended Attack

a. Geographic Area Responses by MAC Group

The Multi-Agency Coordinating (MAC) Group is convened periodically and is made up of representatives from all agencies responsible for land management and wildland fire suppression in Alaska. The MAC Group has the authority to make local and broad-scale changes in fire suppression responses on a temporary basis. These decisions are based on factors such as severity of the fire season, demands on suppression resources, smoke management problems, firefighter safety, and life and property protection.

The Alaska Wildland Fire Coordinating Group (AWFCG) may also make broad changes in suppression response or adjust the conversion date of Modified management option areas to Limited management option (usually between July 10 and 15). The AWFCG may also determine that new fire starts will or will not be suppressed regardless of wildland fire management option designation because of a large number of fires, smoke problems, suppression resource shortages, weather conditions, firefighter safety, and life and property protection.

b. Nonstandard Initial Responses to Wildland Fires

The interagency plan states that "nonstandard responses" (such as extinguishing a fire in a Limited zone or allowing a fire to burn in a Modified zone before the conversion date) may be made for initial response to any fires in any of the Wildland Fire management option areas (AWFCG 1998:34). The refuge manager or refuge FMO may select a non-standard response because of firefighter or public safety concerns, lack of suppression resources, higher priority fires elsewhere in the vicinity, weather conditions, or other compelling reasons. A "Decision Criteria Record" (AWFCG 1998) will be completed for such responses.

c. Wildland Fire Situation Analysis

A Wildland Fire Situation Analysis (WFSA) is used for wildland fires that escape initial attack, fires that require a different suppression strategy than initially selected or for prescribed fires that have been declared escaped or not meeting prescription criteria.

The WFSA is a process that employs a systematic approach to determine the most appropriate suppression alternative. Suppression alternatives are identified, analyzed, and evaluated in light of the expected probability of success and consequences of failure. Evaluation criteria include anticipated suppression costs, resource impacts, and environmental, social, and political considerations. The evaluation of alternatives must clearly identify the point at which the failure of the alternative is imminent. This becomes the triggering mechanism for reevaluation of the WFSA, which should be validated daily.

The WFSA will be initiated and facilitated by either the Refuge or suppression agency in a collaborative process to develop suppression alternatives that consider costs, firefighter and public safety, benefits, values to be protected, and operational constraints per Memorandum of Agreement with BLM, July 2006. Participants include but are not limited to the suppression organization FMO, the Kanuti Refuge FMO, or the refuge manager. A WFSA lists suppression strategy alternatives, the pros and cons of each alternative, and management constraints and priorities. The suppression FMO prepares the technical fire behavior analysis, while the refuge FMO and staff provide the resource analysis. A preferred alternative is selected by the Refuge Manager or their designated line officer or acting. The WFSA is then approved and dated by the refuge manager or their designated official and validated daily. The completed WFSA provides direction to suppression forces and specifies the scope of the effort required. A wide array of alternatives, constraints, limitations, costs and objectives may be outlined in a WFSA. Any revisions must be approved by the Refuge Manager or their designated official.

d. Type I and Type II Incidents

For large or complex fires requiring Type I (highly-experienced, national level fire management teams) or Type II (regional level fire management teams) Overhead Teams, refuge staff will take an active role in providing direction to the local suppression organization and Incident Command Team. The Refuge Manager or Acting Refuge Manager will select a strategic alternative in cooperation with the Refuge FMO. Refuge staff (the Manager and FMO) will also have input into the delegation of authority, which authorizes the Incident Command Team to undertake suppression activities on the refuge and provides specific guidance and constraints on the suppression effort on Refuge lands. The WFSA will be validated daily by the Refuge Manager or designee, local suppression agency FMO, and Incident Commander to ensure that the strategic objective and financial costs are still appropriate.

All Type I and Type II incidents occurring on the refuge will have a line officer's representative designated by the refuge to provide and maintain a conduit of communication between the Incident Command Team and the Refuge Manager, as well as between the local suppression agency and the Refuge Manager. The refuge FMO will usually function as line officer's representative, but in the case of multiple incidents, other designated FWS staff (usually another FMO on TDY) may also be assigned. The local suppression organization will maintain direct supervisory control of the Incident Command Team at all times. Refuge staff (or designated officers) will provide strategic direction, not tactical supervision.

C. PREPAREDNESS

1. Wildland-Urban Interface (WUI), Hazard Reduction/Fuels Management, Prescribed Fire, and Wildland Fire Use

Given the demonstrated potential for landscape-level fires in the Kanuti area, prescribed fire for purposes of hazard reduction can be an important management tool. The statewide fire management policy implemented in 1984 (allowing some wildfires to burn under certain conditions) was primarily to aid in the prioritization of resources and to reduce costs. However, preparedness was also a benefit because the policy allows some wildland fires to burn under moderate conditions. This helps break up continuous fuel loading and reduces other fuels for unwanted wildland fires burning at other times under hotter, drier conditions. The refuge, however, may and has continued to cooperate with adjacent landowners on mechanical treatments of their lands where the treatment will benefit both parties.

Prescribed burning for hazard reduction is discussed below in Section IV.E.2.a. However, the frequency of natural ignition and resulting large scale wildland fires under the natural fire regime definitely reduces the need for large-scale prescribed fires on Kanuti Refuge.

2. Fire Prevention and Education

An aggressive fire prevention program is called for by Departmental and Service policy. In addition, follow-up on trespass fires (human ignition of unwanted and unplanned wildland fires) will be done by appropriate law enforcement authorities to recover cost of damages and suppression. Standard investigative procedures and reports will be used (see Departmental Manual, 620 DM 1; 50 CFR 28.32; and USFWS Fire Trespass Handbook). Historically, there have been very few such fires on Kanuti Refuge (only two escaped campfires have been reported since the Refuge was established in 1984).

Prevention of human-caused fires and techniques to protect dwellings from the threat of wildland fire have been actively promoted by the refuge. Residents of Allakaket and Bettles attended a statewide FireWise Conference in Fairbanks in 2003. The Allakaket fire crew completed three well-executed community fuels reduction treatments around their village in 1997-2004. This hazardous fuel reduction project was funded by the FWS and supervised by the Refuge FMO. Another similar hazard fuels reduction project is well underway at Bettles and Evansville in 2006, with a major FireWise component.

The refuge periodically prepares news releases that outline planned activities and/or discuss prevention of human-caused fires. School programs also include discussion of fire prevention. Plans are underway to adapt the Role of Fire curriculum to village schools. In addition, village residents maybe updated on fire-related activities at the end of the fire season by the Kanuti Refuge newsletter.

Thirty-one percent of ignitions between 1956–1982 were attributed to human causes within the AFS fire planning units that now include Kanuti refuge (SKPT 1984). Most of these were around villages and along water courses used for travel. These lands have been conveyed to Native corporations, the refuge itself has had very few human caused fires. Since the refuge's creation, less than 2% of fires on refuge-owned land have been caused by humans, and have accounted for a tiny percentage (<1%) of the refuge acreage burned. Because these fires are usually near inhabited areas, they are quickly reported and suppressed. However, they are also more likely to threaten human life and property than more remote fires. Both of the two very small human-caused fires reported on the refuge have been started by campfires or warming fires. An expanded public information program on campfire safety will address this issue. This is not considered a major issue. Campfire safety is best delivered as part of the FireWise program in the villages.

3. Emergency Funding Assistance (Step-up Plan Funding – Subactivity 9141)

The refuge will abide by regional interagency and national preparedness levels. (AWFCG 1998). Preparedness Levels (1-5) are determined by incremental measures of burning conditions, fire activity, and resource commitment. A refuge preparedness (step-up) plan guides preparedness actions based on extreme fire danger as indicated by the elevated regional Preparedness Levels 4 and 5. The refuge step-up plan follows guidelines in the Interagency Standards for Fire and Fire Aviation Operations (www.fws.gov/fire/redbook/index.htm)... Increasing fire danger results in increasing staffing levels.

A step-up plan is used to supplement preparedness funds when fire danger reaches HIGH levels on the Canadian Drought Index (CDI). The burning index (BI) is the standard for making comparisons based on objective historic weather data. Extreme fire behavior is usually defined when the Burning Index (BI) reaches the 90th percentile. A BI of 81 or higher in fuel model Q is the threshold for step up actions. A step-up plan will only be done and requested when these thresholds are met. It must be approved by the Regional Fire Management Coordinator. The plan is only done when conditions warrant.

Emergency preparedness planning may call for movement of additional firefighting resources to the area for a maximum of two weeks at times of high fire danger, and may occur several times during the fire season. Additional experienced FWS fire personnel have been sent to the Fairbanks office for two-week rotations at Preparedness Levels of 4 and 5 during the extreme fire seasons of 2004-2005. These actions were authorized by the Regional Fire Management Coordinator. The Step-Up Plan is not to be confused with severity funding.

Severity funding results from longer duration conditions that cannot be dealt with under normal staffing, such as the fire season either starting earlier or lasting longer, or an abnormal increase in fire potential. Severity funding authorizes suppression funds to be used for extraordinary preparedness activities. Severity funding in Alaska is usually conducted through the Bureau of Land Management – Alaska Fire Service.

4. Fire Detection

Detection activities on Kanuti Refuge are provided by AFS. Aerial detection is the predominant method for visual detection. A computerized lightning detection system that plots lightning ground strikes is also utilized. Daily Tanana zone detection flights are often planned by AFS based on the information from the lighting detection system. Updated information from this lightning detection system is also portrayed at the AFS internet site: http://fire.ak.blm.gov.

The Fairbanks FWS Refuge Offices share several aircraft. These aircraft are available to assist with detection and surveillance during critical times or periods when AFS aircraft are unavailable. Refuge aircraft are often in the field transporting refuge personnel during fire season and the flight personnel may act as observers providing supplemental, incidental detection assistance. Private and commercial aircraft frequently report fires or flare-ups for ongoing fires. Procedures for procuring and scheduling both OAS and charter aircraft are discussed below (Section IV.C.8.).

5. Pre-attack Plan

The refuge uses fire management option designation (Critical, Full, Modified, Limited) for pre-attack planning, because management option designations point out and automatically prioritize values at risk (Fig. 5). AFS maintains its own pre-attack planning checklist.

6. General Readiness– Snow Gauges and Kanuti Remote Automated Weather Station (RAWS)

At present, six USDA-NRCS snow level gauges on Kanuti Refuge are monitored by USFWS staff during monthly overflights in refuge aircraft from January to April. These and other observed snow levels are used on a statewide basis to evaluate pre-fire season forest moisture content levels and to predict possible river flood levels. Another general preparedness activity is the maintenance of the single Kanuti remote automated weather station (known as Kanuti RAWS #500321), located in the central portion of the refuge. AFS technical personnel will visit this site to make sure it is operating properly and to perform annual maintenance. The activity has been funded by refuge and regional fire funds. The refuge FMO will accompany the technicians and visit this site at least every 3 years to retain familiarity with its situation. To ensure that fire danger indices are reliable, refuge staff will visit the refuge during breakup to determine snow-free dates.

Fire equipment readiness will be refurbished before the commencement of each fire season. Prior to the beginning of each fire season in May, fire pumps and other related fire equipment, pre-positioned at the Kanuti Lake administrative cabin for the fire protection of the facilities, will be inspected and inventoried by the FMO. Detailed instructions on how to set up and run the pumps will be posted and maintained in the equipment storage building where the equipment is stored. Fuel loading and arrangement around the cabin will be monitored annually. Manual thinning of brush has been carried out twice before at Kanuti cabin, as necessary. AFS fire crews brushed out around the cabin for the third time in summer 2005, as the Old Dummy Fire approached, before successfully firing out from a defensive perimeter. The cabin now (2006) appears reasonably secure from wildland fire for a number of years.

Kanuti NWR has a UHF Base/UHF–VHF Base Link/VHF Repeater radio system that provides partial coverage from the Bettles base station to 90–95% of the refuge. One repeater tower (Tozi Repeater -1606) is located on top of Mt.Tozi (N 65:45.55 x W 150:57.55) while another tower (Pope Creek Repeater) is located northeast of the refuge (N 67232.58 x W 150:03.76). Kanuti Refuge staff uses Bettles Zone (BTT). The refuge has all handheld and mobile radio units (Motorola XTS 5000) programmed with refuge operations frequencies as well as frequencies designated for use by suppression forces (i.e., BLM Grey). Refuge operations frequencies are pre-programmed into the radio units and are not available for public distribution. The repeater system has been improved and coverage is largely line of sight and is marginal for some areas including isolated river canyons or valleys, which the repeaters cannot reach. All refuge radios have radio–telephone interface capability. Eight satellite (Iridium) telephones have also been purchased for the Refuge. These satellite telephones provide coverage from the refuge but lack a party-line function. This lack of party-line function inhibits crew coordination possible on the VHF-UHF radios. The primary use of the satellite phones has been to relay messages from the Fairbanks office to field crews and as a daily check-in basis.

Landsat-Thematic Mapping satellite scenes were taken in 1999, which have been used to classify vegetation cover in Kanuti NWR, allowing the development of a high quality earth cover map for the Kanuti Refuge (USDI and Ducks Unlimited 2001). This integrated GIS database can be used for improved natural resource planning. Succession and occurrence of new fires will require continual updating of this new map, possibly including mapping of new fires, documenting fire severity and modeling succession, digitizing, acquisition and classification of new remote data, and additional ground-truthing.

7. Training

The refuge FMO will meet NWCG standards and Interagency Fire Program Management (IFPM) standards and qualifications by 2009. Training will include all facets of fire management and closely related subjects and will meet current Departmental, Service, and NWCG requirements.

Refuge staff involved with fire management activities will attend the formal fire training identified in an annual training needs assessment and/or in their Individual Development Plans. Training opportunities will be provided by Region 7 and outside of Region 7. The refuge manager and/or deputy refuge manager and the FMO will assess the training/staffing needs of the refuge annually.

An effort will be made by each fireline qualified individual to maintain their qualifications according to the specifications found in the Wildland and Prescribed Fire Qualification System Guide PMS 310-1 January 2000. This will include attending the Annual Fireline Refresher course and qualifying at the physical fitness level required by their respective fireline position. All fire training, qualifications and experience will be maintained in the Incident Qualifications and Certification System (IQCS). The Refuge FMO or the Refuge Manager may issue Task Book assignments, but the Regional Fire Management Coordinator issues Task Book assignments to the Refuge FMO.

All current fireline qualified personnel will be expected to 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 supervisor and/or refuge manager will determine an individual's availability up to the time the Secretary of the Interior mandates that all fireline qualified personnel will be made available for fire assignments.

8. Aviation

Ordering, scheduling, and processing requests and payment for DOI or charter aircraft will follow Aviation Management Policies (112DM12) and Departmental Manual Aviation Chapters (350-353 DM 1-6 (www.amb.nbc.gov).

D. WILDLAND FIRE USE

Naturally-ignited fires play an important role in the boreal forest and on Kanuti NWR. A lightning-caused fire can be managed for resource benefits if it meets prescriptive criteria for the area. If the use of wildland fire to achieve resource management objectives is not appropriate, then suppression action will be taken. (Table 9).

For the Service, there are distinctions between a refuge wildland fire use program and how fires are managed under the scope of the Alaska Interagency Wildland Fire Management Plan (Table 9). Management of wildland fire use activities has not been delegated to another agency and is under direct refuge supervision. Wildland fire Use activities are not readily supported by the suppression organization. Differences between wildland fires managed under the interagency plan and those managed for wildland fire use are described in Table 9.

Federal and Service policy requires that the following elements be in place before wildland fire use is implemented: the refuge has an approved fire management plan; applicable environmental and subsistence regulations are adhered to; fire management units are already established; an implementation prescription is written; and management oversight is provided.

The refuge manager decides whether or not to implement wildland fire use based on current fuel moisture contents; past, present and future weather conditions; general fire conditions across the State; available staffing; and recommendation of the refuge FMO. Appendix S provides prescriptive criteria for wildland fires managed for resource benefits and provides parameters under which wildland fire use may be implemented.

The implementation path for wildland fire use is shown in Table 9. The over-riding factor in deciding to implement wildland fire use will be whether resource benefits will occur. Resource benefits would be associated with: 1. the maintenance of fire-dependent ecosystems and their processes; 2. the creation of early seral habitat and; and/or 3. the reduction in risk of hazardous fuel accumulations that would lead to catastrophic fire(s). The maximum manageable area (MMA) would be determined on the basis of past fire size in the affected area and proximity to areas of concern and/or full or critical fire management option areas. The MMA will have to be determined on a case by case basis depending upon the adjacent resources at risk. Specified trigger points will be common to all Wildland Fire Implementation Plans (WFIPs): 1. the fire burns into an extended dry period, fire behavior becomes erratic and control becomes difficult; and 2. resources at risk are within 2 miles of the fire perimeter with the fire actively burning towards those resources. If the fire exceeds the MMA or the refuge manager determines through periodic reassessment that resource benefits are no longer occurring and/or management capability is inadequate to accomplish the fire use objectives, AFS is consulted and a WFSA is jointly prepared by the Refuge FMO and the AFS Zone FMO.

The Wildland Fire Implementation Plan will be used to formulate and select all responses to wildland fire use. A detailed description of the WFIP is available in the Interagency Standards for Fire and Fire Aviation Operations (2006). Completion of the WFIP may entail as many as three distinct stages, depending on the nature and complexity of the incident.

> ***Stage I*** is triggered by any wildland fire detection within the refuge and consists of a fire situation report, decision criteria checklist and a recommended response action, the initial go-no-go decision. If the decision is to manage the fire for resource benefit, proceed to Stage II.
>
> ***Stage II*** provides managers with the information needed to continue managing an incident for resource benefit. This stage entails the prediction of direction, intensity and rate of spread as well as the identification of necessary short-term actions. Stage II also involves the initiation of periodic reassessment, including consideration of the incident's continued suitability for fire use as well as the possible need for long-term management actions. The periodic reassessment component may prompt the refuge manager to initiate WFIP Stage III.
>
> ***Stage III*** provides the necessary information and planning for the management of more complex instances of wildland fire use for resource benefit. This stage results in the definition of the ultimate acceptable geographic size of the fire, represented by the Maximum Manageable Area (MMA) and the planning and documentation of the actions needed to strengthen and defend the MMA.

Staffing of wildland fire use fires will depend upon the complexity of the fire and the availability of qualified personnel. The minimum staffing for non-complex wildland fire use will consist of a fire use manager (FUMA) and part-time help from the refuge pilot and other staff as needed. The recommended minimum staffing for a complex wildland fire use fire will be a FUMA, a rare event weather analyst, a long term fire analyst (LTAN), a situation unit leader (SITL), someone to handle logistics and a fire effect monitor (FEMO), depending upon the type(s) of benefiting resources being managed for. Refer to the Wildland Fire Qualifications Guide (PMS 310-1 2006) for the required qualifications of a fire use manager and other recommended WFU staffing needs.

The total number of wildland fire use fires occurring on the refuge at one time will depend upon overall fire activity on the refuge, available staffing, a mutual assessment by the refuge and AFS of the desired fire activity on the refuge and the overall total resource benefits desired. If the complexity of a wildland fire use fire exceeds the capability of the initially assigned staff, but the fire's resource benefit objectives remain the same, a fire use management team will be ordered through AFS Tanana Zone. The composition of fire use team will be determined jointly by the refuge and AFS.

The monitoring frequency of wildland fire use fires will be determined initially by the refuge FMO and later refined by the FUMA. Monitoring guidelines will be established by the refuge FMO and the FUMA and incorporated into the WFIP. Monitoring should include aerial observation flights, fire perimeter growth maps, first order fire effects, fire behavior, weather and fuel moistures.

The refuge FMO will ensure that a complete project record will be compiled and retained for each wildland use fire on the refuge. Each record will contain the following items: all WFIP and/or WFSA documents; monitoring summaries; funding codes used and cost; project maps; photographs/photo points; and the overall project summary, including the narrative, daily log, periodic assessments, contacts, decisions records, orders and what and how objectives were met.

In managing for wildland fire use resources benefit(s), the refuge FMO and the fire use manager will take into account both short- and long-term impacts of such activities upon all facets of refuge use, including subsistence. Although there may be some short-term effects (to subsistence hunting and trapping) of wildland fire use, it is important to remember that the maintenance of fire's natural role in the boreal forest ecosystem is vital to the long-term viability of the refuge's plant and animal communities. The refuge manager will in all cases consider the short-term impact of wildland fire use actions on subsistence activities. Such considerations may include the location of the fire, the time of season, and expected duration in proximity to use areas.

TABLE 9. Comparison of wildland fire managed under Interagency Plan and wildland fire use (WFU) managed for resource benefits under Refuge Fire Management Plan

	Alaska Interagency Wildland Fire Management Plan	Refuge Wildland Fire Use program
Primary goal	Provide an opportunity through cooperative planning, for land and resource managers/owners to accomplish fire-related, land-use and resource management objectives in a cost-effective manner, consistent	Wildland fire will be used to protect, maintain, and enhance resources and, as nearly as possible, be allowed to function in its natural ecological role.

	Alaska Interagency Wildland Fire Management Plan	Refuge Wildland Fire Use program
	with owner, agency, and departmental policies.	
Fire cause	human or natural	natural only
Prescriptive criteria applied	- predefined geographic location - threats to identified values at risk determine initial suppression response	- drought indicators, weather parameters - threats to identified values at risk - other criteria specific to incident or unit
Operational control	Incident Commander–> Suppression Agency–> Refuge Manager (under 620 DM 2)	Incident Commander–> Fire Use Manager Refuge Manager (under 620 DM 1)
Determination	- predefined initial responses - WFSA if predefined response fails or if incident beyond initial attack capability	- individual incident assessment by Refuge Manager required first to determine fire use or suppression - WFSA if fire use response fails
Documentation	periodic surveillance report and map	Wildland Fire Implementation Plan stage 1 and 2 complete. Stage 3 -Long-term implementation actions. Validated daily.

E. PRESCRIBED FIRE

Prescribed Fire Use:

Prescribed fires are fires ignited under conditions specified in an approved prescribed fire plan to achieve specific resource management, hazard reduction, or other objectives. Goals and procedures for administering prescribed fires are derived from ANILCA, Departmental and Service policy, the refuge FMP, and the refuge CCP (USFWS 1987). Preparedness level and guidance from the AWFCG or MAC Group may be used as criteria whether or not to implement prescribed burns, usually at times of elevated fire danger, such as at Preparedness Levels 4 or 5. A prescribed fire plan format is included in Appendix N.

Burns for resource purposes will be conducted to minimize negative impact on subsistence users and to improve hunting and gathering opportunities by increasing plant and animal productivity and diversity.

Hazardous fuels reduction or slash pile burns will be conducted for protection of life and property from wildland fire. Qualified Administratively Determined – (AD) or Emergency Firefighters (EFF) on temporary hire from local villages may be used to conduct these prescribed fires. Prescribed fire personnel qualifications are included in Appendix O.

1. Goals and Strategies

The Alaska Region of the Service "is committed to a prescribed fire management program that emphasizes hazardous fuels reduction, wildlife habitat improvement, and management-oriented research on the use and effects of fire on Service lands" (Region 7 Fire Management Policy, RW-25, March 1990:2).

The refuge CCP provides for prescribed burning for "hazardous fuel reduction or restoration of natural vegetation patterns" (USFWS 2007). Because the management alternative selected dictates "minimal management" for some areas of the refuge, prescribed burning is one of the few habitat management tools allowed.

2. Objectives

Overall prescribed fire objectives for the refuge, derived from overall fire management objectives (Section II.A.) are hazard reduction (including training), resource management, investigations into fire effects, and to help establish prescriptions.

a. Hazard Reduction

Prescribed fire can be used for reduction of hazard fuels. Prescribed fire, as a preparedness tool, can reduce direct risk from catastrophic wildland fire and make suppression operations easier by breaking up continuous fuels and reducing fuel loading. Prescribed fires can include slash pile burning after thinning projects or extend to large-scale habitat improvement projects. Local residents in villages near Kanuti Refuge have supported slash pile burning after thinning projects but have been reluctant to endorse large-scale prescribed fire for resource purposes.

Priority for hazard reduction efforts is highest near inhabited areas, which are surrounded by checkerboard landownership patterns. In order to shorten fuel breaks and to use natural barriers, which keep costs down and make for more secure lines, burns can involve both Service and Native corporation lands, under cooperative agreements. Hazard reduction objectives may include, but are not limited to:

- Break up continuous stands of black spruce that contribute to huge wildland fires.

- Reduce and remove hazardous fuels, especially dead and decadent black spruce that exhibit extreme fire behavior.

- Prescribed fire will be used for training of fire suppression crews in order to improve crew effectiveness and reduce hazard from fires. Availability of well-trained crews will aid suppression efforts and improve protection of public safety and identified resources. Use of wildland fires for training is preferred.

b. Desired Effects (See also Fuel Models and Fire Behavior as related to Fire Management Units – Table 7).

General goals for prescribed fire relating to plant communities are presented below. Burn patterns that include unburned areas and enhance the mosaic effect are generally preferred.

i. Meadows: Burn with low intensity to remove dead thatch and leave most of the root systems intact.

ii. Shrublands: Burn with low to moderate intensity to remove dead downed fuels and litter and promote regeneration of shrub species.

iii. Broadleaf and Mixed Forest: Burn with low to moderate intensity to consume dead downed fuels and litter and allow regeneration of deciduous species that are preferred by many wildlife species that are of interest to subsistence users.

iv. Black Spruce: Burn with moderate to high intensity to kill most of the live trees, consume dead downed fuels, and create favorable conditions for germination of deciduous plant species. However, black spruce stands tend to regenerate back into black spruce on Kanuti Refuge.

c. Prescribed Fire Constraints and Alternatives by Unit

Objectives and constraints are identical for all Fire Management Units on Kanuti Refuge. Management goals for a site determine if fire is needed, specific objectives for use of prescribed fire will be developed. Hazard reduction burns are more likely in the Allakaket and Bettles Interface units (Table 7). (Slash pile burns have already been successfully conducted at both villages (Allakaket 2003 and Bettles and Evansville 2006). These two areas of Full management option surround and include inhabited areas, where risk is higher and wildland fires have been largely excluded. Prescribed fires tend to be smaller and less intense than wildland fires (Baker 1994), so hazard reduction objectives may be met, but resource objectives may be only marginally or partly met. The quality of results will depend upon the objective of the prescribed fire; a hotter or more natural fire may not be better.

Constraints are identical to those listed for suppression operations (see Section IV.A.). The refuge CCP (USFWS 1987) placed most of the refuge under "minimal management," which means that the "minimum appropriate tool" concept will be used. Any activities on refuge lands will use methods that minimize environmental damage.

Resource management burns may occur in all units. Local residents, however, clearly differentiate between slash pile burning and prescribed fires for resource benefits. No interest has been expressed by villagers in having prescribed fire for resource reasons in the Full Management Options near their local communities. This has been a concern identified during the on-going collaborative process with Allakaket and Evansville regarding hazardous fuels reduction projects.

3. Environmental Parameters

Prescribed burns (either for resource benefits or slash pile burning) will not be conducted without an approved written plan. Generally, prescriptions will be written for prescribed burns that present a window of easily measured environmental conditions and a reasonable time frame. A fire burning within these parameters can reasonably be expected to achieve the stated objectives without undue risk. The refuge will suspend burning when fire behavior exceeds that called for in the burn prescription. Extended drought conditions, which can result in very low duff moistures and live fuel moistures, must be monitored. For instance, prescribed fire plans with a Drought Code over 70 are unlikely to be approved.

Fires burning above an intensity level of 100 BTUs/foot/second may be difficult or impossible for hand forces to control using direct attack. However, fires of this intensity may be necessary for resource benefits to remove hazardous fuels and thick moss and litter layers to achieve regeneration of desired species. Refer to guidelines contained in the Interagency Standards for Fire and Fire Aviation Operations. Using high intensity fires requires extra precautions, including construction of fire breaks or use of substantial natural barriers or burned fire line.

Prescribed fire burn parameters are discussed below. The documenting and reporting of prescribed fires will be detailed in the prescribed fire burn plan.

Consult the current Interagency for the documenting and reporting of prescribed fires as well as NFPORS funding, tracking and reporting requirements (www.fws.gov/fire/redbook/index.htm).

4. Drought indices

The refuge preparedness plan incorporates regional fire activity and local drought indicators into preparedness levels, which are used to determine whether prescribed burns may be initiated or continued. Using the National Fire Danger Rating System (NFDRS) is of limited value in Alaska because of the lack of weather data and the questionable accuracy of fuel models. The refuge currently uses the Canadian Drought Index (CDI) system to track drought conditions for fire management planning. Drought indices developed in Canada apply to fuel types found in interior Alaska.

The buildup index (BUI) generated by the CDI system is a useful indicator of drought conditions. The BUI combines a Drought Code value and Duff Moisture Code value, both of which are measures of subsurface fuel dryness. The Drought Code represents moisture conditions at a deeper soil level than the Duff Moisture Code. Drought codes are started up each spring 3 days after the snow-free date (less than 10% cover) for each weather station. Refuge staff and AFS staff cooperate in reporting annual snow-free dates to the National Weather Service. Drought affects fire behavior and therefore fire effects and resistance to suppression efforts. Drier conditions result in deeper burns, which kill plant roots and seeds deeper in the duff and makes suppression more difficult.

5. Burn Complexity

Completion of a National Wildland Fire Coordinating Group prescribed fire complexity-rating guide is mandatory for all prescribed fires. The burn boss level will be determined by the complexity rating:

Prescribed fires rating low complexity (e.g., slash pile burning) require an RxB3 burn boss. Prescribed fires rating low to moderate complexity require a RxB2. Prescribed fires rating a moderate to high complexity require an RxB1.

6. Seasonal Parameters

Seasonal differences in weather and fuel moisture can be used to meet different goals.

a. <u>Spring burning</u>

Before green-up (Apr to mid-May), meadows and black spruce or shrub fuel types with continuous grass/sedge cover can be burned. Fire spread and duff consumption are limited because ground fuels are still relatively moist. In addition, these open sites are surrounded by snow in adjacent sites with denser tree cover. South-facing deciduous forest and shrubland sites may be burned to remove leaf litter and dead downed material and generate resprouting from April to mid-May. During this time, there is still snow in adjacent spruce fuels and on other aspects. Suppression and mop-up are relatively easy during this period.

b. <u>Summer burning</u>

Prescribed fire activities between early June and mid-July will be scheduled with caution. This is often the peak of the fire season, and contingency forces may not be available. Fires can quickly become difficult to control because of changes in weather. Prescribed fires started during the spring period can cause problems if they burn into this period.

c. <u>Late summer/fall burning</u>

Marsh margins can be burned after waterfowl broods have hatched and grasses have cured, usually between early July and early August. This is often the best time to burn shrubland and broadleaf forest sites if the summer has been somewhat dry. With the normal rain pattern during the summer, Duff Moisture Content and Drought Code indices are at their highest levels toward the end of summer, meaning forest floor fuels are drier, especially in spruce types. This increases impact of the burn, risk of escape, and cost of suppression and mop-up (Hawkes and others 1990). Hawkes and others also note that the time from late July to early September can be the best time to burn in black spruce fuel types because "end of fire season" weather is imminent. Days are much shorter and nights are cooler by August, and weather often turns cool and rainy. However, relying on the normal weather pattern to help control fire spread and extinguish the fire does have risks. August can have little rain, and fires have burned well into September in some years. Low complexity prescribed fire (slash pile burning) may occur during any season as along as prescriptive criteria are met.

7. Annual Activities for Implementation

Guidelines about publicizing burns are contained in the Service Fire Management Handbook (Red Book-USFWS 2000). Adjacent landowners will be kept informed during the entire planning process and will be advised of impending burns. Written approval for burn permits is required from the Alaska Department of Environmental Conservation for smoke management purposes. The department will be consulted during initial stages of planning for burns to ensure compliance with state regulations. Because of the very active natural fire regime on Kanuti Refuge, the need for a long term prescribed fire program for resource purposes has been diminished. However, fuels reduction burns will continue in association with Village WUI projects.

Different prescribed burning activities dictate different levels and amounts of coordination. Because the refuge has very limited staff, AFS personnel and village fire crews will fill most positions on larger prescribed burns. On small burns, AFS/village involvement will be as holding crews or backup suppression forces. The low-complexity 2003 Allakaket slash pile burn and the similar 2006 Evansville slash pile burn at the conclusion of the hazardous fuels reduction projects were cooperative projects between FWS, AFS, and members of the local EFF fire crew. The local fire crew was paid from the respective WUI projects with FWS funds administered through the village governments.

The areas around villages are the locations where hazard reduction burns are most needed to protect life and property. Many of the most advantageous sites for these burns include Native corporation lands, and thus will be cooperative efforts. AFS equipment may be available for use, although these burns are the refuge's responsibility, and AFS is not mandated to outfit resource projects. Preparation for early season burns using emergency firefighters will require administering the fire-line safety refresher and fitness (pack) test.

Because of the remote setting and lack of a road system within the refuge, prescribed burning may be accomplished through aerial ignition. Hand ignition (drip-torch) may be used on small slash-pile burns or on parts of large burns. Wetlands, open gravel bars along rivers, or old burns may provide excellent natural fuel breaks that can be used to confine these prescribed fires. These barriers may be supplemented by hand-line or black-line when necessary. A go/no-go checklist will be completed prior to ignition.

8. Certification of Fires Remaining in Prescription

The Interagency Standards for Fire and Fire Aviation Operations states that the Refuge Manager or the designated Acting Refuge Manager will certify in writing, daily, (including weekends and holidays) for all prescribed fires not contained in the first burning period that:

- The prescribed fire is within prescription and is expected to remain in prescription for the next 24 hours.
- Adequate funds are available to manage the prescribed fire.
- Sufficient fire management resources have been assigned or committed to manage the prescribed fire and implement the approved suppression alternatives.

While it is understood that the information for making this certification will be collected and compiled by the prescribed fire staff, the final, certifying signature must be the Refuge Manager's.

Prescribed fires that exceed the limits of an approved prescription will be managed as escaped wildland fires and handled under appropriate management response(s) as defined in the contingency section of the Prescribed Fire Plan or by the Wildland Fire Situation Analysis. Once a prescribed fire has been declared an unwanted wildland fire, a Wildland Fire Situation Analysis will be completed to determine the appropriate management action to be taken. Once a prescribed fire has been reclassified to an unwanted wildland fire it cannot revert back to prescribed fire status. All situations where prescribed fires are reclassified as unwanted wildland fires will be reviewed by the Refuge Manager or their designated representative.

9. Wildland Urban Interface (WUI) Risk Assessments and Non-fire Fuels Applications

The Service is in the early stages of planning and developing a region-wide risk assessment for national wildlife refuges in Alaska, to be implemented over the next ten years. A risk assessment is designed to identify cultural resources, community values, cabins, historical resources, private parcels and other values at risk from wildland fire. After a determination of the level of risk, plans and strategies to protect those values are being developed and funding to implement approved projects requested. Fuel reduction projects go through multiple stages. Planning, environmental analysis, risk assessment, and mitigation are conducted first. Secondly, funding is requested, and if approved, the project is implemented. The focus is on using local labor from the host villages. Thirdly, the project is monitored. All of these identified steps add to the complexity of managing fire on refuge lands.

The villages of Alatna, Allakaket, Bettles, and Evansville are located near and/or have village corporation lands within the legislative boundaries of the Kanuti National Wildlife Refuge. An interagency group has been developing a preliminary risk level for communities listed by the State of Alaska. Allakaket and Evansville have been identified as communities at especially high risk from wildland fire. Scattered cabins and a few cultural resource sites also have been identified as values at risk from wildland fire on Kanuti Refuge. Not all sites have been assessed for level of risk. A cabin protection plan is under revision (2006) in conjunction with other Alaska refuges and the regional office.

Other lands at risk include private parcels. Alaska Native Claims Settlement Act (ANCSA) of 1971, as amended, [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.

38 private parcels encompassing nearly 13, 434 acres are on the Kanuti NWR. Another ten parcels, 1,066 acres, have been selected but not conveyed. An additional 11 parcels, 1,135 acres, may be selected under the Veteran Allotment provisions. The refuge works closely with its neighbors and adjoining landowners in the selection of wildland suppression options. These values are considered in developing a Wildland Fire Situation Analysis (WFSA) and determining the best fire incident management strategy to implement.

Kanuti Refuge takes an active role in working with local communities to develop and implement non-fire treatment plans to reduce the risk of wildland fire to life and property. Both the villages of Allakaket and Evansville have recently implemented FWS-sponsored mechanical treatments for hazardous fuels reduction projects (1997-2006). These projects have focused on local hire of chainsaw crews to reduce hazardous fuels by thinning and removal of slash from predetermined community-owned areas. The community treatment plans have been written by the Kanuti Refuge FMO, with considerable local input from the villages. The actual treatment sites include areas within the villages, and buffer zones adjacent to the community housing developments, but no treatments on individual house lots per se. The treatments on the individual house lots remain the responsibility of the individual homeowners.

FWS has assisted in securing funding for these two non-fire village community fuels applications, as well as helping develop local infrastructure capacity to do the fuels work, and supporting the hazard reduction concepts. These concepts include promoting *FireWise* education and information for the individual homeowners. The *FireWise* concepts are intended to allow the individual homeowners to take the risk reduction actions on their own house lots in conjunction with the thinning projects on community lands at Allakaket, Bettles and Evansville.

10. Preparedness Level Restrictions on Prescribed Burning

The statewide interagency fire preparedness plan details agreed upon restrictions for prescribed burning. That plan calls for suspension of some prescribed burning at preparedness level IV and possible suspension of all prescribed burning at preparedness level V. The plan is included in the Alaska Fire Service Operational Procedures, Policies, and Guidelines "Brown Book." During the fire season, fire situation reports issued by AFS list the daily preparedness level (www.fire.ak.blm.gov). The indicated preparedness level may influence decisions on whether to proceed with prescribed fire ignitions.

F. EMERGENCY REHABILITATION AND RESTORATION

Soils and plant communities on the refuge are highly sensitive to some types of disturbance, mainly because of permafrost (see Section I.H.). Rehabilitation of damages resulting from suppression activities will be carried out before demobilization. The site will be returned to pre-fire condition or to standards set by the Refuge Manager. Section IV.F. contains specific standards for rehabilitation.

Department of Interior policy states that fire rehabilitation funds (subactivity 9262) can be used for repair or rehabilitation of damage to lands, resources, and facilities directly attributable to the wildland fire suppression effort or activities. Fire Emergency Stabilization/Burned Area Rehabilitation (sub activity 9142, 9262) may be done "to stabilize and prevent unacceptable resource degradation or to minimize threats to life or property resulting from the fire." Nonemergency replacement of facilities and resources damaged by wildland fire or the reestablishment of ecosystem structure and functions must be budgeted and funded through normal procedures. Fuels management project rehabilitation will be included in the fuel treatment project description and funding request. Specific guidelines are found in the Interagency Standards for Fire and Fire Aviation Operations. An approved plan for stabilization and rehabilitation is required. For instance, an approved Burned Area

Emergency Rehabilitation (BAER) Plan was prepared for the 2005 fires on Kanuti Refuge, following specific guidelines, and was coordinated through the Regional Office. Specific NFPORS guidelines for BAER projects are also included in the Redbook (www.fws.gov/fire/redbook/index.htm).

V. ORGANIZATION AND BUDGET

A. FIRE MANAGEMENT ORGANIZATION AND RESPONSIBILITIES

1. Authorities for Implementing Plan. (See also Appendix G)

Alaska National Interest Lands Conservation Act of December 2, 1980 (94 Stat. 2371; 43 U.S.C. 1602-1784).
Alaska Native Claims Settlement Act of December 18, 1971 (88 Stat. 668; 43 U.S.C. 1601).
Disaster Relief Act of May 22, 1974 (88 Stat. 143; 42 U.S.C. 5121)
Economy Act of June 30, 1932 (47 Stat. 417; 31 U.S.C. 315).
Federal Fire Prevention and Control Act of October 29, 1974 et seq. (88 Stat. 1535; 15 U.S.C. 2201) as amended.
Federal Grants and Cooperative Act of 1977 (P.L. 95-244, as amended by P.L. 97-258, September 13, 1982; 96 Stat. 1003; 31 U.S.C. 6301–6308).
Federal Property and Administrative Services Act of 1949.
National Wildlife Refuge System Administrative Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997 and the Refuge Recreation Act of 1962. (80 Stat. 927; 16 U.S.C. 668dd–668ee; 16 U.S.C. 460k-460k4).
National Environmental Policy Act of 1969.
Protection Act of September 20, 1922 (42 Stat. 857; 16 U.S.C. 594).
Reciprocal Fire Protection Act of May 27, 1955 (69 Stat. 66, 67; 42 U.S.C. 1856, 1856a and b).
Supplemental Appropriation Act of September 10, 1982 (96 Stat. 837).
Kanuti National Wildlife Refuge Final Comprehensive Conservation Plan, Environmental Impact Statement, and Wilderness Review, 1987.
Wildfire Suppression Assistance Act of 1989, (P.L. 100-428, as amended by P.L. 101-11, April 7, 1989).

2. Fire Management Responsibilities and Suppression Authority

The Fish and Wildlife Service is responsible for fire management activities on refuge lands. Through agreement, the Alaska Fire Service (AFS) provides fire suppression on refuge lands in northern Alaska. The suppression services must conform to fire management guidelines specified by applicable interagency fire management plans and the refuge fire management plan.

The Refuge Manager has overall responsibility for all fire management activities on the refuge, including wildland fire suppression (in coordination with Alaska Fire Service), wildland fire use, and prescribed fire. Wildland fires are any lightning-caused or human-caused fires that occur on the refuge that are not designated as prescribed fires in an approved prescribed fire plan. Appropriate management response (AMR) action must be taken on all wildland fires, Surveillance may be an appropriate suppression action. Fires managed as Wildland Fire Use Plan must be lightning-caused.

3. Refuge Fire Management Team Organization, Responsibilities, and Qualifications

Historically, there has been only one shared permanent fire management position on the Kanuti refuge staff. The FMO for the Kanuti Refuge is permanent full-time, but also serves Yukon Flats and Arctic NWRs. Interagency Fire Program Management Qualifications Standards for the refuge FMO include being qualified as Burn Boss 2 (RxB2) and Incident Commander Type 3 (ICT3) by 2009.

At times of high fire danger, at Preparedness Levels 4 or 5, or during extreme fire seasons (e.g., 2004-2005), the workload requires additional fire management personnel be sent to the Fairbanks office (Step-Up Plan funding). (See recommended staffing levels, below).

Emergency firefighters from the village of Allakaket near the Kanuti Refuge can provide a pool of fire suppression personnel for use on prescribed burns. Prescribed burns of moderate or high complexities will require assistance from other stations or agencies. The refuge fire management officer may participate in refuge fire suppression assignments, including monitoring fires, and be available for regional and national callout during high fire occurrence periods. Availability of any refuge employee is based in part on decision criteria for individual preparedness levels listed in the refuge preparedness plan.

Individuals and qualifications can change annually and are listed in the Dispatch portion of the Annual Refuge Fire Management Plan. Qualifications for fire positions are set by Departmental and Service policy.

4. Interagency Coordination

Interagency coordination is critical for successful implementation of the refuge fire management program, especially because another agency provides fire suppression. In addition, fire has ecosystem-wide effects that affect neighboring landowners and managers: Arctic NWR, Yukon Flats NWR, Gates of the Arctic NP, BLM, State of Alaska (Department of Natural Resources, Division of Forestry and Department of Fish and Game, Division of Wildlife Conservation), Tanana Chiefs Corporation, Doyon Corporation, and other Native corporations and local and/or tribal governments for the villages of Allakaket, Alatna, Bettles, and Evansville. Contacts are listed in the Dispatch Plan.

5. Current and Future Budgets

Kanuti's FMO is funded by Preparedness (9131) with the money going to the refuge. The Kanuti Refuge FMO oversees fire management activities at Yukon Flats and Arctic NWR's. There are limited funds available for program support for the FMO. Hazard Fuel and Wildland Urban Interface projects are funded on a yearly basis and it is the FMO's responsibility to identify fuel treatment projects and request project funding in NFPORS.

In 2007 a workforce analysis plan is to be completed by the FMO to identify future staffing needs to the Regional Fire Coordinator.

Future base and fuels budget allocations are being formulated on an interagency basis using Fire Program Analysis to be implemented in FY09. This system will replace Firebase, the budget process currently being used by the service.

VI. MONITORING AND EVALUATION

Monitoring and evaluation are the functions used to determine if the FMP is being implemented as planned to meet its goals and objectives. Wildland fire is one of the primary sources of disturbance on the Kanuti Refuge. As such, it is integral to the management of the refuge's wildlife and plant communities. Through monitoring and evaluation methods, we seek to better understand the relationships between fire and other refuge resources. Monitoring also helps us improve our wildland–urban interface at the four villages near Kanuti Refuge, test hazardous fuels treatment techniques, and provides documentation to show how we address our performance measures.

This chapter is divided into two primary sections: A. Fire Effects Monitoring and B. Implementation Monitoring. Fire effects monitoring is focused on the ecological effects that result from fire management on the refuge. Implementation monitoring covers the five management components in this fire management plan, and provides guidance to ensure that our actions within these areas meet the goals of the refuge and are in compliance with other national and service policies.

A. FIRE EFFECTS MONITORING

Fire effects monitoring applies to all aspects of the fire program that involve changes on the ground. The goals of fire effects monitoring are to:

- Understand the relationship of fire to refuge resources, especially those dependent on advanced seral stage habitats.
- 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 underrepresented in existing statewide 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 ensure 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 preburn or pretreatment data, and for documenting effects within 1 year of the burn or treatment. Project plans will include discussions of which monitoring level would be implemented and will specify funding for monitoring to meet their objectives. The *minimum* variables of the three 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 USFWS 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 USFWS 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 National Park Service (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 and requires 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 will also be collected. An estimate of burn severity using Viereck's burn severity classes will be included in post-fire monitoring.

Level II – Moderate Intensity Monitoring. The five 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 difference between the two levels is that 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 will 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 (Viereck et al. 1992)	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 dependant)
Tree canopy closure (by class)	Soil type (if expertise is available)
Tree seedlings/resprout 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 will be collected (for example the Composite Burn Index protocols by NPS http://fire.org/firemon/lc.htm).

B. IMPLEMENTATION MONITORING

The Fire Management Plan implementation is monitored for compliance with the National Fire Plan and resulting performance standards, National Wildlife Refuge System, Wildland Fire Management Program Strategic Plan (now in draft), Alaska Interagency Wildland Fire Management Plan, compatibility with refuge plans, support of the applicable National Wildlife Refuge promises, and national and region policies of the Fish and Wildlife Service. Periodic reviews are conducted by staff to determine if the Fire Management Plan goals and objectives are being addressed.

The fire plan outlines five management components: suppression, fire use, prescribed fire, non-fire fuels application, and emergency stabilization and rehabilitation; all require some level of monitoring and evaluation. These five components may have more specific plans that define implementation strategies, ecological effects of fire, and the relationship to monitoring goals. The goals listed in this chapter are not exhaustive and additional goals may be added as circumstances dictate. The FMO and staff are responsible for the accomplishment and documentation of monitoring objectives.

Suppression. As described in Chapter IV.A., suppression activities can range from surveillance monitoring of limited fires to ground-disturbing suppression techniques like installing fire breaks with bulldozers in order to control unwanted fires. Monitoring for any suppression level involves two phases. Phase One is monitoring the fire while it is active and the second phase is monitoring the ecological effects of the fire. During phase one, document the cause and 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 appropriate management response.

The Phase One implementation monitoring goals for suppression activities are to:

- Ensure public and firefighter safety.
- Determine if the suppression tactics being employed are compatible with the FMP, refuge plans, and the smoke management plan.
- Determine if there are any critical sites or natural resources threatened.
- Gather daily situation data to validate or change the selected WFSA 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 fire breaks 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 1 year of the fire to determine if rehabilitation activities are needed to meet refuge objectives.

Fire Use. Fire use involves two phases. Phase one is monitoring the fire while active and the second phase is monitoring the ecological effects of the fire. During phase one a three-stage process is used to monitor the fire to determine if the fire is meeting planning and resource objectives. Specific guidelines are found in the Interagency Standards for Fire and Fire Aviation Operations.

The implementation monitoring goals for fire use activities are to:

- ❖ Determine if the fire will remain within or exceed the maximum manageable area.
- ❖ Determine short- and long-term implementation actions.
- ❖ Predict fire behavior and weather prognosis based on historical and current behavior and weather.
- ❖ Based on periodic fire assessments determine if current implementation actions are valid or need changing.
- ❖ Determine if the fire is meeting resource objectives as outlined in this fire plan.
- ❖ Provide a data platform from which to make decisions regarding risk, threats, and resource benefits.

The same fire effects monitoring levels and methods and procedures apply for fire use fires.

Prescribed Fires. The implementation monitoring goals for prescribed fire are to:

- ❖ Determine if prescribed fires are compatible with refuge goals and objectives.
- ❖ 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 will 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 meets resource objectives. The level of post-fire effects monitoring may be similar to that of suppression or fire use; however the burn monitoring plan will specify the level and elements that will be monitored.

All activities involving fire must be in compliance with the smoke management plan (Lawton 2003).

Non-fire Fuel Application. 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.
- ❖ 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 be monitored 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 will specify the level and elements that will be monitored.

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.
- ❖ Determine what actions of a nonemergency 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 will be determined by incident specific attributes. Refer to the Interagency Burned Area Emergency Stabilization and Rehabilitation Handbook.

C. RECORDS, REPORTS, AND PLAN UPDATES

Surveillance reports are available at AFS zone dispatch offices. Daily situation reports are also available via the Internet. Fire reports are completed by AFS, sent to the Service Regional Fire Management Coordinator and then entered into the Fire Management Information System (FMIS) or sent to the refuge FMO for entry. The Alaska Fire Service maintains a file on all active fires in their zone dispatch center, and they are available for inspection at any time by refuge staff.

The Service Fire Management Handbook (USFWS 2000) states that individual fire reports, annual narrative reports, fire weather records, records on vegetation, and records about fires will be kept permanently on file at the refuge. An accomplishment report will be completed each calendar year and sent to the regional Fire Management Coordinator.

All fires involving Type I and Type II Overhead Teams will be evaluated before demobilization of the team. Evaluations will be attended by key team members, representatives from the refuge, representatives from AFS, and other individuals if warranted. Evaluations on other fires may be scheduled if warranted. Other after action reviews which may be conducted include cases of escaped prescribed fire, or an incident that results in fatality, serious injury, or controversy involving another agency.

The refuge fire management plan is updated periodically--at a minimum of every 5 years. New information may be substituted (e.g., new fuels maps) or added as appendices. Changes in policy and regulations (e.g., Departmental policy, new state air control regulations) may prompt revision of certain parts of the plan.

The annual refuge fire management plan is prepared annually by April 30 to allow for adequate time for approval and review of individual prescribed burn plans prior to the fire season. The annual plan includes the refuge dispatch plan, the refuge preparedness plan, and individual prescribed burn plans.

Refuge maps of wildland fire management option designation are reviewed annually. Any changes in management option designation should follow procedures adopted by the AWFCG and should be submitted to AFS by their deadline (usually around May 1) to allow for timely incorporation into the master fire suppression atlas. (See appendix F for details.)

VII. AIR QUALITY AND SMOKE MANAGEMENT GUIDELINES

Under some conditions, smoke from wildland fires may threaten human health. Policy states that provisions of the Clean Air Act and the State Implementation Plan for that Act must be followed (621 FW 3.4) in relation to prescribed burns (Lawton 2003). In addition, the refuge is to take "aggressive action to manage smoke from wildland fires to minimize impacts and maintain air quality" . No Class I airsheds are nearby to the Kanuti Refuge. The nearest nonattainment area (for carbon monoxide) is Fairbanks, which is 130 air miles from the refuge boundary.

Wildland fires can have a significant impact on air quality. Local residents have telephoned or submitted written complaints about discomfort caused by smoke, especially to the elderly. In addition to local fires, smoke also enters the Kanuti area from fires in Siberia, Canada, and other parts of Alaska (Barney and Berglund 1974). Smoke from large fires in the Kanuti area can drift as far south as the Yukon River to Tanana and into Fairbanks.

Smoke concentrations are usually localized and quickly dispersed. However, extremely large fires (such as occurred in 2004 and 2005) can affect air quality over a wide area of Alaska, including the entire Yukon Valley from the Canadian border to the Bering Sea. Multiple large fires may produce smoke that covers hundreds of square miles and is several miles thick (Barney and Berglund 1974). Fires that develop convection columns take smoke higher into the atmosphere, allowing smoke to be transported farther and dispersed better (Hawkes and others 1990).

A strategy that employs wildland fire and prescribed fire helps maintain air quality and human health in the long term. Attempting to exclude fire actually results in fire "deferral" (Stocks 1993). Control attempts will fail in the periodic severe fire years that usually occur with high drought codes and outbreaks of numerous lightning fires. Fires that burn under drier conditions consume more of the moss/duff layer and produce more emissions per unit area than fires burning under more damp conditions (Kasischke and others 1995). A more natural fire regime includes fires of all sizes and severities, and the smaller burns produce less smoke, break up continuous spruce stands, and therefore help limit spread of potentially larger, deeper-burning fires.

Smoke management objectives will be included in all prescribed burn plans and fire situation analyses for wildland fires. Smoke management will follow the Interagency Prescribed Fire Handbook and the Alaska Smoke Management Plan. The Alaska Smoke Management Plan is currently in draft form (Appendix L).

VIII. PUBLIC INFORMATION AND EDUCATION

Information about routine suppression operations is normally handled by AFS staff. The refuge FMO and other staff may be called upon and should, when the situation dictates, issue statements to the media about wildland fires and prescribed fires burning on the refuge. Those situations may include major fires, smoke problems, or controversial fires. Information about prescribed fires will be given out as early as possible in the planning process. Benefits and potential impacts will be explained.

If extensive media contact is anticipated or experienced, Service fire information officers may be requested. AFS and Service information officers are included in the dispatch plan. A list of media contacts and the regional policy on contacts with the press are available at the Kanuti Refuge office in Fairbanks. Copies of press releases will be sent to regional External Affairs offices at the time they are issued. Press questions about national or regional Service policy, individual employees, or topics of extreme sensitivity or controversy will be referred to External Affairs. The refuge FMO will brief staff on the refuge and in the regional office as appropriate to keep them current on the fire situation.

It is important to the success of the refuge fire management program that local organizations and residents are involved in the fire planning process, kept informed about refuge fire management activities and progress of wildland fires, and educated about the role of fire in the region. This is accomplished through personal contact, press releases, and broad public education efforts. Cooperating with the local EFF and city fire crews at Allakaket, Bettles and Evansville during fuels reduction projects has proven particularly effective in this sort of information exchange.

Incorporating fire management information into the environmental education program on the refuge has been a priority and will continue to be an important part of the refuge fire management program. The "Teach About Fire" curriculum was designed for use by school teachers in their classrooms. Refuge staff reviews the curriculum with teachers and assist them in teaching it to their students. The "Role of Fire in Alaska" display is normally set up at the Kanuti NWR headquarters, but is portable and is taken to meetings and environmental education programs.

A more extensive program of sharing knowledge about fire effects with local residents will be considered. Part of that program would be discussing results of fire effects and fire ecology studies on Kanuti NWR and other refuges nearby. Villagers' knowledge about the natural history of the area would complement and may help explain scientific data.

It is also important for local residents to participate in operational aspects of wildland fire and prescribed fire management activities. Involvement of local people results in an increased awareness of the role of fire on the refuge and in refuge operations in general, allows local residents a voice and role in protecting and enhancing refuge resources that many of them use, and benefits local residents through employment and improved subsistence opportunities. The Allakaket and Evansville fuels reduction projects have proven exceptional opportunities for this sort of operation cooperation. The local governments and EFF fire crews have completely endorsed these projects.

A. GENERAL WILDLAND FIRE MANAGEMENT CONSTRAINTS

An economic analysis that incorporates commodity, noncommodity, and social values" (USDI and USDA 1995) would be consider in fire management programs and activities. Fire management on the refuge has been very successful in holding down suppression costs and protecting values. This low level of spending was achieved because about 50% of the refuge is under Limited management option, where suppression costs are lowest on a cost per acre basis.

B. PREFERRED METHODS OF SUPPRESSION

"Light hand on the land" is the preferred approach for suppression activities occurring on the refuge. For fires requiring containment in Limited and Modified management option areas, strategies that use natural barriers, indirect attack, and changes in weather are preferred. Innovative approaches and adoption of techniques to foster cost-effective fire suppression are encouraged.

In compliance with the "light hand on the land" concept, suppression methods that minimize the potential for environmental damage are preferred in all areas. Except for fires that threaten identified values or are in Critical or Full management option areas, minimizing acreage burned is <u>not</u> a priority. For example, indirect attack on larger fires using natural barriers is an effective strategy that allows fires to be suppressed on the suppression force's terms rather than the fire's terms. The use of suppression forces can be timed to take advantage of changes in the weather to maximize effectiveness.

On fires that must be suppressed, black-lining is the preferred method of direct attack on smaller fires. Aerial ignition in combination with indirect attack strategy is encouraged on larger fires. Suppression restrictions are detailed in Sections IV.A.

C. PUBLIC SAFETY

Public safety is a critical concern in all aspects of the refuge fire management program. One way that the refuge seeks to improve public safety is by managing wildland fire so that hazardous fuels are broken up or reduced. The main benefit of this hazardous fuels reduction activity is in the protection of villages and specific sites from burning.

People may have to leave villages because of fire for a variety of reasons. Smoke may require evacuation of all residents or only those who are particularly sensitive to smoke (e.g., very young or old, asthmatic). In addition, there may be a precautionary evacuation because of fire threat, or there may be an evacuation under imminent threat from fire. The FWS may assist with developing evacuation plans.

There are no developed recreational sites on the refuge. Refuge staff are unable to notify recreational users of hazards because the users are widely scattered, and their locations are not known to refuge staff. Nearly all recreation is associated with river systems, which provides high mobility and will allow recreational users to avoid fire and smoke.

D. COORDINATION WITH ADJACENT LANDOWNERS

The refuge places a high priority on informing owners of lands adjacent to and within the refuge and local villages of the fire situation. Strategy decisions about fires that threaten to encroach onto adjacent lands must take into account landowner's/manager's and local government concerns and priorities. A contact list with telephone numbers is included in the refuge dispatch plan.

E. SPECIFIC CONSTRAINTS FOR IMPLEMENTING STRATEGIES

Protection of human life is the highest priority at all times. Departmental policy (620 DM 1.4H) states:

Protection priorities are human life and property and natural/cultural resources. If it becomes necessary to prioritize between property and natural/cultural resources, this is done based on relative values to be protected, commensurate with fire management costs. Once people have been committed to an incident, these human resources become the highest value to be protected.

Specific constraints for extended attack situations will be addressed in a Wildland Fire Situation Analysis. Final authority for actions not authorized by this plan or that are specifically prohibited herein lies with the Refuge Manager.

To the extent possible, all actions will use the minimum practical tools. See suppression guidelines for additional requirements (Section IV.A.). Any person who takes a bear in defense of life or property must comply with all state regulations and immediately report the incident to refuge personnel through their chain of command. A Service bear incident report will be completed and filed. Artifacts are not to be collected. The refuge will be notified of any artifacts found and none are to be disturbed.

The constraints for Kanuti NWR are listed below:

Peregrine Falcon protection

- Raptor nesting and/or staging areas depending upon time of year and number of flyovers required.
- Peregrine falcons were recently removed from the Endangered Species list but are still a species of management concern. The falcons often nest on the tops of bluffs, which are attractive as helispots and fire camp locations. Nesting sites are marked on interagency fire maps; they are all in Limited management option areas, but some are near private parcels. AFS will notify the refuge immediately when fires are discovered near these areas. The

refuge will notify AFS of new nest sites. Extreme care must be taken to not disturb nests during the critical period from April 1 to August 15 because adults may abandon eggs or young.

- Ground personnel are to keep away from nesting sites unless absolutely necessary. If they must be near a nest site, they should stay there the absolute minimum of time required and be as unobtrusive as possible.
- Camps must be located at least 2 miles from nesting sites.

Aircraft/mechanical equipment

- Aircraft will avoid operating within 1 mile horizontal distance and below 1,500 feet above ground level over known nesting sites unless it is absolutely necessary to do so.
- No retardant or foam is to be dropped on Kanuti Refuge without specific written authorization from the Refuge Manager, except in cases of defense of life and property. This prohibition is especially valid over known raptor nesting sites.
- Every effort will be made to avoid getting retardant or foam (from aircraft) or fuel (from pump operation, camps, helibases, etc.) in surface water, especially:
  - Directly upstream from villages, where surface water is commonly used for drinking;
  - In fish spawning areas during and after spawning.
- All-terrain vehicles, tractors, tracked vehicles, or other equipment that causes long-lasting adverse impacts on resources will not be used without specific written approval of the Refuge Manager.

Fire Line Construction

- Natural fuel breaks will be used where possible to reduce construction and rehabilitation cost and to reduce resource damage. Fire-lines will be built with the following considerations:
- Control lines constructed during suppression activities will be located to minimize erosion. If possible, lines dug down to mineral soil or permafrost will be located to meander obliquely across slope rather than to run straight downhill. Straight lines will be avoided, especially on large fires.
- A buffer of vegetation will be left immediately adjacent to water bodies to avoid running control lines directly into them.
- Any control lines constructed on fires will have appropriate erosion control measures taken prior to the demobilization of suppression forces. Those measures include building waterbars on slopes and replacing organic material back into lines where permafrost or mineral soil has been exposed. Standards for rehabilitation will be set by the Refuge Manager or designee in a timely manner. Rehabilitation standards will be developed based on assessed needs.
- Saw-lines will be used sparingly and only where they are essential for holding and accessing hot perimeter and for holding indirect attack line during burnout operations. Direct attack black-lining is encouraged where possible, to reduce the amount of saw-line that would be visible from the air.
- Fire-line explosives may not be used for surface trenching without specific approval by the Refuge Manager, to be documented in writing.

- Constructed fire-lines will avoid known cultural sites. If cultural sites (e.g., graves, collections of artifacts) are discovered during fire suppression operations, care will be taken to not damage the sites, and refuge staff will be notified of the site as soon as possible.

Helispots:

- Helispots will only be constructed where they are essential for the safe and efficient deployment and retrieval of suppression resources.
- Avoid sensitive biological communities.
- Minimize the cutting of large trees. Sites will be made by enhancing natural openings if possible.

Camps

- Camps must be located away from known historic or archaeological sites.
- Camps must be located away from sensitive biological communities.
- Latrines must be located at least 200 feet from lakes, ponds, and streams.

Camp site rehabilitation:

- Create minimal disturbance during rehabilitation.
- Dismantle and remove all tent and shelter frame materials. Local plant materials (e.g., logs and poles) used for construction will be spread throughout the site.
- Completely fill fire pits with natural materials, such as duff, plant litter, and branches.
- Remove all garbage, such as food waste and plastics, from campsites and fire-lines. Trash such as paper products, and small amounts of visqueen, may be burned.
- For large camps or camps that have been used for several days, camp rehabilitation must be approved by Refuge Manager or designee before demobilization is completed.
- Both black bears and grizzly bears are very abundant on parts of the refuge; adhere to all food storage regulations.
- Incident commanders will emphasize preventive measures. Camps will be kept clean. Food waste is to be removed as promptly as possible. All attempts at driving a bear away from camp or suppression operations must be exhausted before destroying the bear.

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IX. PROTECTION AND MANAGEMENT OF ARCHAEOLOGICAL/CULTURAL/ HISTORIC RESOURCES

The objectives of cultural resource management include to "protect, maintain, and plan for the use of Service managed cultural resources for the benefit of present and future generations" (614 FW 1.2.A). Cultural resources include archaeological resources, historic property, objects of antiquity, cultural items, and traditional/religious values. The CCP (USFWS 1987, 2007) and the refuge Cultural Resources Guide (USFWS 1996b) state that archaeological and historical sites will be protected if resources are available. It has been proposed that archeological and historical sites be evaluated in consultation with State Historical Preservation Office (SHPO) to determine if protection is necessary. Section IV.B.9 discusses constraints to fire suppression tactics imposed to protect these cultural/historic sites.

A. HUMAN HISTORY

The Kanuti area is considered to have been part of the route traveled by the ancestors of the American Indians from Asia to the Americas. The earliest human inhabitants may have arrived in the area about 12,000 years ago (Clark 1981). Historically, these peoples spent much of the year wandering the region in bands to exploit seasonal abundances of fish, wildlife, and plant materials (Nelson 1973). Native people currently living in the Kanuti area are mainly of Koyukon Athabascan descent, but also include Kobuk Eskimo people at the village of Alatna (Clark 1996). Alatna is on the opposite side of the Koyukuk River from the Athabascan village of Allakaket (USFWS 1987). Contact between these two groups was peaceable and at times they intermingled and became culturally convergent (Clark 1996).

Lt. Henry T. Allen first explored the Koyukuk River for the U.S. Government in 1885. Before that time, almost nothing was known about the upper Koyukuk (Allen 1985). The pure subsistence lifestyle of local Natives began to change when the first steamboats ascended the Koyukuk River in 1897, bringing an influx of gold miners to the area (Wyman 1988). A local cash economy then began in the late 1800s, involving cutting wood for steamboats, hauling freight for the miners, and building boats (Tobuk 1980).

All the gold mining camps were abandoned by 1906 on lands which later became the Kanuti Refuge. Mining continued sporadically near Wiseman and Coldfoot, located on the Middle Fork of the Koyukuk, north of the refuge.

All of these historic sites deserve further protection and management. Two other related historic mining sites of the late nineteenth and early twentieth centuries, known as Bergman and Arctic City, have also been abandoned. These sites were found on the Koyukuk River a few miles south of the present villages of Allakaket and Alatna, which are located just northwest of the current refuge boundaries (Alaska Geographic 1983). Old boiler parts, flywheels and dredge buckets are the only obvious features remaining at several of these camps.

The economy of the upper Koyukuk area developed somewhat later by other occasional wage employment in supply industries and most recently, in firefighting (Nelson 1973, 1983; Hosley 1981; McClellan 1981). Despite these changes, in the 1940s, subsistence hunting and fishing was still providing all or a major part of the food to 70% of the people in the area (Marcotte and Haynes 1985).

Allakaket, the principal village in the vicinity, lies just to the northwest of the refuge. The village was established in 1906 as an Episcopal mission. Schools and medical facilities led to the establishment of a permanent town at the site and at Alatna, across the river. Allakaket is largely inhabited by people of Athabascan heritage while people in Alatna are largely Kobuk Inupiaq. The two other villages adjacent to the refuge at present, Bettles and Evansville, by comparison, are located on the Koyukuk River just north of the refuge boundary. “Old” Bettles had also originally developed as a gold mining town near the head of navigation on the Koyukuk, but continued as a supply center until an airfield was built at Bettles Field, 5 miles away, during the 1940s (Alaska Geographic 1983). Bettles is the name often used today in reference to the area including Evansville and Bettles Field.

B. ARCHAEOLOGICAL RESOURCES

Numerous cultural sites, including the Inupiaq (Kobuk) Eskimo hunting sites, Athabascan Indian fish camps, and remnants of turn of the century gold mining camps exist on the refuge. However, few archaeological or historic sites have been extensively documented (Andrews 1977, Smith 1984, Hart-Crowser and Associates 1985). Three sites are listed in the State of Alaska Heritage Resources Survey. These prehistoric sites include village and hunting sites. All such sites are now difficult to locate because they are hidden by moss growth, leaf litter, and thick plant growth, or because they have been obliterated by changing water courses or wildland fire.

Both Athabascan and Kobuk peoples lived in semi-subterranean houses in the area (Clark 1996b). At least one known existing cemetery is associated with an old village site along the Koyukuk River within refuge boundaries. Many other ancient sites in river line lowlands have been destroyed and their artifacts redistributed by the meanderings of the rivers (West 1965).

As a result of Alaska Native Claims Settlement Act, the areas most heavily used by Native peoples within refuge boundaries at the present time have been selected for conveyance or have already been conveyed to local village corporations or regional corporations (USFWS 2002). Many historic sites identified from records of the Alaska Historical Survey are on corporation, village, or private land (Andrews 1977). Known cultural sites are identified on refuge fire maps.

X. FIRE CRITIQUES AND ANNUAL PLAN REVIEW

The Refuge Fire Management Plan is updated every five years. The Annual Refuge Fire Management Plan is prepared annually, with a deadline of April 30 to allow for adequate time for approval and review of individual prescribed burn plans prior to the fire season. The Annual Plan includes the Refuge dispatch and preparedness plans and individual prescribed burn plans (for prescribed fire plan format see Appendix N).

Refuge management option (fire suppression) 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.

All Type I and Type II fires that occur on the Refuge will have critiques scheduled prior to demobilization of the overhead team. The Refuge Manager and FMO and the Alaska Fire Service FMO – Tanana Zone will attend 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.

XI. CONSULTATION AND COORDINATION

Consultation and coordination with the Alaska Fire Service occurs on an annual basis. A coordination meeting is scheduled every spring with Alaska Fire Service – Tanana Zone to discuss fire management activities planned on the Refuge for the upcoming fire season. At that time the Annual Refuge Fire Management Plan will be reviewed; memorandums of understanding and cooperative agreements in effect will be addressed; Refuge equipment and personnel available for suppression will be identified; standard operating procedures regarding suppression responses will be discussed; and, both agencies will familiarize themselves with each other’s concerns and issues.

Regular contact is made with the Regional Fire Management Coordinator throughout the year to provide information on Refuge fire management activities and to obtain support to accomplish planned activities. The Regional Fire Management Coordinator reviews Refuge and Annual fire management plans prepared by the Refuge. An annual Fire Management Accomplishments Report is required to keep the Regional Fire Management Coordinator apprised of all Refuge fire management activities. The report is combined with other annual reports by the RFMC to prepare the regional report due to the National office.

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Appendix A

Alaska Interagency Communities at Risk Assessment - Revised October 27, 2005

Name	Population	Ground Fire Encroachment Threat	Crown Fire Encroachment Threat	Community Category	Fire Behavior Potential	Values at Risk	Infrastructure	Ranking	Lead Agency	Interested Agencies
Alcan	23	Y	Y	4	1	2	2	1	FWS	FWS, AK
Allakaket	197	Y	Y	4	1	2	1	1	FWS	BLM, FWS,TCC,BIA
Anchor Point	1227	Y	Y	2	1	2	2	1	AK	AK
Anchorage	261446	Y	Y	2	1	1	3	1	AK	AK, BLM, BIA
Anderson	480	Y	Y	4	1	2	1	1	AK	
Bettles	36	Y	N	4	1	2	1	1	FWS	NPS, BLM
Big Delta	511	Y	Y	2	1	2	2	1	AK	AK, BLM
Big Lake	2162	Y	Y	2	1	1	2	1	AK	AK
Butte	2699	Y	Y	2	1	2	2	1	AK	AK
Central	62	Y	Y	4	1	3	1	1	AK	AK
Chickaloon	212	Y	Y	4	2	3	1	1	AK	
Chitina	94	Y	Y	2	1	2	1	1	AK	NPS, BLM, BIA
Chuathbaluk	127	Y	Y	4	1	2	1	1	FWS	AK
Circle Hot Springs	35	Y	Y	4	1	3	1	1	AK	FWS, BLM
Clam Gulch	113	Y	Y	2	1	3	1	1	AK	FWS
Clear Airforce Statio		Y	Y	2	1	2	2	1	AK	BLM
College	12122	Y	Y	2	1	2	2	1	AK	AK
Cooper Landing	285	Y	Y	2	1	2	2	1	AK	AK, USFS, FWS
Crooked Creek	137	Y	Y	4	1	2	1	1	BLM	AK, BIA, BLM. AVCP
Crown Point	91	Y	Y	4	2	2	2	1	AK	USFS
Delta Junction	898	Y	Y	2	1	2	2	1	AK	AK, BLM
Dot Lake	61	Y	Y	4	1	3	1	1	BLM	AK, TCC, BLM, BIA
Dry Creek	115	Y	Y	4	1	3	1	1	AK	USFS, AK
Eagle	171	Y	Y	4	2	2	1	1	BLM	NPS, TCC
Eagle River	not avail.	Y	Y	2	1	1	2	1	AK	AK, BLM, Ft. Rich
Eagle Village	32	Y	Y	4	1	2	1	1	BLM	NPS, TCC
Ester	240	Y	Y	2	1	2	2	1	AK	

Evansville	24	Y	N	4	1	3	1	1	FWS	NPS, BLM
Fairbanks	31423	Y	Y	2	1	1	3	1	AK	AK
Ferry	74	Y	Y	2	1	2	2	1	AK	NPS
Fort Greely	not avail.	Y	Y	2	1	1	2	1	BLM	BLM, AK
Fox River	439	Y	Y	4	1	2	2	1	AK	AK
Fritz Creek	2097	Y	Y	4	1	2	2	1	AK	AK
Funny River	not avail.	Y	Y	2	1	1	2	1	FWS	AK, FWS
Glennallen	494	Y	Y	2	1	2	2	1	AK	BLM, NPS
Happy Valley	401	Y	Y	2	1	2	2	1	AK	AK
Healy	646	Y	Y	4	1	2	1	1	AK	NPS
Healy Lake	61	Y	Y	4	1	3	1	1	FWS	AK, TCC, BIA, BLM, FWS
Homer	4205	Y	Y	2	1	1	2	1	AK	AK
Hope	130	Y	Y	4	1	3	1	1	AK	
Houston	951	Y	Y	2	1	1	2	1	AK	AK
Kalifonsky	338	Y	Y	2	1	2	2	1	AK	AK
Kaltag	251	Y	Y	4	2	2	1	1	FWS	
Kasilof	548	Y	Y	2	1	2	2	1	AK	AK,FWS
Kenai	7039	Y	Y	2	1	1	2	1	AK	AK,FWS
Kokhanok	163	Y	Y	4	2	2	1	1	AK	BIA, BBNA
Lazy Mountain	1109	Y	Y	4	1	2	2	1	AK	AK
Lime Village	62	Y	Y	4	1	3	1	1	BLM	AK, BLM
Lower Kalskag	297	Y	Y	4	1	2	1	1	FWS	BIA
McGrath	533	Y	Y	2	1	2	1	1	AK	AK,BLM,TCC,BIA
McKinley Park	169	Y	Y	4	1	2	1	1	AK	NPS
Meadow Lakes	5232	Y	Y	4	1	2	2	1	AK	
Moose Creek	677	Y	Y	2	1	1	2	1	AK	
Moose Pass	118	Y	Y	2	1	2	2	1	AK	USFS
Nikiski	3038	Y	Y	2	1	2	2	1	FWS	AK, FWS
Nikolaevsk	488	Y	Y	4	1	2	1	1	AK	
Nikolai	101	Y	Y	4	1	2	1	1	AK	TCC, NPS
Ninilchik	687	Y	Y	2	1	2	2	1	AK	AK, BIA
North Pole	1557	Y	Y	2	1	1	2	1	AK	AK
Northway	113	Y	Y	2	1	2	1	1	FWS	AK,BIA,BLM,FWS,TCC
Northway Junction	116	Y	Y	2	1	3	1	1	FWS	AK,BIA,BLM,FWS,TCC
Northway Village	103	Y	Y	2	1	3	1	1	FWS	AK,BIA,BLM,FWS,TCC
Nulato	347	Y	Y	4	1	2	1	1	BLM	AK,BLM,TCC,BIA

Primrose	62	Y	Y	4	1	2	2	1	AK	USFS
Salamatof	1122	Y	Y	4	1	3	1	1	AK	AK,BIA,FWS
Shageluk	128	Y	Y	4	1	2	1	1	FWS	TCC,
Soldotna	4157	Y	Y	2	1	1	2	1	AK	AK,FWS
Tanacross	86	Y	Y	4	1	2	1	1	BLM	AK,BLM,TCC,BIA
Tanana	300	Y	Y	4	2	2	1	1	BLM	BIA
Tetlin	89	Y	Y	4	1	2	1	1	FWS	AK
Tok	1235	Y	Y	2	1	2	2	1	AK	TCC, BIA, FWS
Two Rivers	660	Y	Y	2	1	2	2	1	AK	
Upper Kalskag	262	Y	Y	4	1	2	1	1	AK	FWS, AVCP
Aleknagik	226	Y	Y	2	2	2	1	2	AK	BBNA, FWS, BIA
Alexander Creek	39	Y	N	4	2	3	2	2		
Cantwell	166	Y	Y	2	2	3	1	2	AK	NPS
Chase	55	Y	Y	4	2	2	2	2		
Chistochina	52	Y	Y	4	2	3	1	2	AK	NPS, BIA
Circle	89	Y	N	4	2	2	1	2	BLM	FWS, TCC
Cohoe	602	Y	Y	4	2	2	2	2	AK	
Coldfoot	18	Y	Y	4	2	2	1	2	BLM	NPS, FWS
Copper Center	553	Y	Y	2	2	2	1	2	AK	NPS
Copperville	194	Y	Y	2	2	2	2	2	AK	NPS
Dillingham	2400	Y	Y	2	2	1	2	2	AK	FWS, BIA, BBNA
Douglas		Y	Y	2	2	1	3	2	AK	
Eielson Airforce Base	4751	Y	Y	2	2	1	3	2	BLM	
Eklutna	434	Y	Y	2	2	2	2	2	AK	
Fort Yukon	565	Y	N	2	2	2	1	2	FWS	BLM, BIA
Fox	332	Y	Y	2	2	2	2	2	AK	
Ft. Richardson		Y	Y	2	2	1	3	2	BLM	
Ft.Wainwright		Y	Y	2	2	1	3	2	BLM	
Gakona	22	Y	Y	4	2	3	1	2	AK	NPS, BIA
Galena	592	Y	Y	2	2	2	1	2	FWS	
Gulkana	90	Y	Y	4	2	3	1	2	AK	NPS, BIA
Haines	1808	Y	Y	2	2	2	2	2	AK	
Halibut Cove	71	Y	Y	4	2	2	2	2	AK	
Harding Lake	30	Y	Y	2	2	2	2	2	AK	
Hughes	77	Y	N	4	2	2	1	2	FWS	BLM, TCC

Huslia	283	Y	N	4	2	2	1	2	FWS	BLM, TCC
Jakolof Bay	40	Y	Y	4	2	2	2	2	AK	
Juneau	31262	Y	Y	2	2	1	3	2	AK	USFS
Kachemak	425	Y	Y	4	2	2	1	2	AK	FWS
Kenny Lake	507	Y	Y	2	2	3	1	2	AK	NPS
Klukwan	136	Y	Y	2	2	2	1	2	AK	USFS
Knik	483	Y	Y	4	2	2	1	2	AK	
Kodiak Station	1831	Y	Y	2	2	1	2	2	AK	FWS
Lake Minchumina	38	Y	N	4	2	2	1	2	BLM	NPS
Lignite	131	Y	Y	4	2	2	1	2		
Lutak	53	Y	Y	2	2	2	2	2		
McCarthy	37	Y	Y	2	2	2	1	2	AK	NPS
Mendeltna	80	Y	Y	4	2	2	2	2	AK	
Mentasta Lake	125	Y	N	4	2	2	1	2	AK	
Minto	248	Y	N	4	2	2	1	2	BLM	TCC
Mosquito Lake	94	Y	Y	2	2	1	2	2		
Nabesna	0	Y	Y	4	2	3	1	2	AK	NPS, FWS
Nelchina	0	Y	Y	4	2	3	1	2	AK	BIA
Nenana	452	Y	Y	2	2	2	2	2	AK	
Nondalton	216	Y	Y	2	2	2	1	2	AK	NPS, BIA
Palmer	4495	Y	Y	2	2	1	3	2	AK	
Paxson	30	Y	Y	4	2	3	1	2	AK	
Pleasant Valley	584	Y	Y	2	2	2	2	2	AK	NPS
Port Alsworth	88	Y	Y	4	2	2	1	2	AK	
Red Devil	44	Y	Y	4	2	2	1	2	AK	AVCP
Ridgeway	2382	Y	Y	4	2	2	2	2	AK	BIA
Ruby	179	Y	Y	4	2	2	1	2	FWS	TCC, BLM
Salcha	387	Y	Y	4	2	2	2	2	AK	
Skagway	880	Y	Y	2	2	1	2	2	AK	
Skwentna	72	Y	Y	4	2	2	1	2	AK	
Slana	55	Y	Y	4	2	3	1	2	AK	NPS
Sleetmute	103	Y	Y	4	2	2	1	2	AK	BLM, BIA
Sterling	6138	Y	Y	2	2	2	2	2	AK	FWS
Stevens Village	92	Y	N		2			2	FWS	BLM, TCC
Sutton	470	Y	Y	2	2	2	2	2	AK	
Takotna	48	Y	Y	2	2	2	1	2	AK	TCC

Talkeetna	363	Y	Y	2	2	2	2	2	AK	
Tazlina	294	Y	Y	2	2	3	1	2	AK	BIA, NPS
Telida	2	Y	Y	4	2	2	2	2	AK	TCC
Tonsina	47	Y	Y	4	2	3	1	2	AK	NPS
Trapper Creek	344	Y	Y	4	2	2	2	2	AK	
Tuluksak	443	Y	N		2			2	FWS	
Wasilla	5568	Y	Y	2	2	1	3	2	AK	
Willow	507	Y	Y	2	2	2	2	2	AK	
Wiseman	20	Y	N		2			2	BLM	NPS
Ambler	298	Y	N	4	2	2	1	3		
Andreafsky	442	Y	N	4	2	2	1	3		
Aniak	594	Y	N	2	2	2	1	3		
Anvik	91	Y	N	4	2	2	1	3		
Beaver	126	Y	N	4	3	2	1	3		
Chalkyitsik	102	Y	N	4	2	2	1	3		
Chena Hot Springs	0	Y	Y	4	2	3	1	3		
Chicken	28*	Y	N	4	1	3	1	3	BLM	AK
Ekwok	123	Y	N		3			3		
Flat	0	Y	Y	4	2	3	1	3		
Georgetown	0	Y	Y	4	2	3	1	3		
Grayling	187	Y	N	4	2	2	1	3		
Holy Cross	259	Y	N	4	2	2	1	3		
Iditarod	0	Y	N	4	2	3	1	3		
Iliamna	93	Y	N	2	2	2	1	3		
Kiana	366	Y	N	4	2	2	1	3		
King Salmon	499	Y	N	2	2	2	2	3		
Kobuk	96	Y	N	4	2	2	1	3		
Koliganek	205	Y	N	4	2	2	1	3		
Koliganek	205	Y	N		3			3		
Koyuk	289	Y	N	4	2	2	1	3		
Koyukuk	100	Y	N	4	2	2	1	3		
Larsen Bay	120	Y	N	4	2	2	1	3		
Livengood	0	Y	N	4	2	3	1	3		
Lower Tonsina	0	Y	Y	4	2	3	1	3		
Manley Hot Springs	88	Y	N	4	2	3	1	3		
Marshall	340	Y	N	4	2	2	1	3		

Marys Igloo	0	Y	N	4	2	3	1	3		
Medfra	0	Y	Y	4	1	3	1	3		
Napamiute	4	Y	N	4	2	2	1	3		
New Stuyahok	468	Y	N	2	2	2	1	3		
Noatak	423	Y	N	4	2	2	1	3		
Noorvik	634	Y	N	4	2	2	1	3		
Ophir	0	Y	Y	4	2	3	1	3		
Petersville	0	Y	Y	4	2	3	1	3		
Pilot Station	582	Y	N	4	2	2	1	3		
Pitkas Point	146	Y	N	4	2	2	1	3		
Rampart	66	Y	N	4	2	2	1	3		
Russian Mission	307	Y	N	4	2	2	1	3		
Saint Marys	482	Y	N	4	2	2	1	3		
Seldovia	291	Y	Y		2			3		
Shungnak	257	Y	N	4	2	2	1	3		
Stony River	35	Y	Y	4	3	2	1	3		
Susitna	0	Y	Y	4	2	3	1	3		
Venetie	232	Y	Y	4	2	2	1	3	FWS	BLM, BIA
Womens Bay	675	Y	N	4	2	3	1	3		
Adak	106				3			4		
Adak Station	4633				3			4		
Akhiok	99		N		3			4		
Akiachak	560		N		3			4		
Akiak	325		N		3			4		
Akutan	425		N		3			4		
Alakanuk	677		N		3			4		
Alatna	34	Y	N		3			4		
Amchitka	0				3			4		
Anaktuvuk Pass	312	Y	N		3			4		
Angoon	616				3			4		
Arctic Village	138	N	N		3			4		
Atka	99		N		3			4		
Atmautluak	296		N		3			4		
Atqasuk	273		N		3			4		
Attu	0		N		3			4		
Ayakulik	0				3			4		

Barrow	4541		N	3	4
Belkofski	0		N	3	4
Bethel	5449	Y	N	3	4
Bill Moores	0			3	4
Birch Creek	35	N	N	3	4
Boundary	0			3	4
Brevig Mission	291		N	3	4
Buckland	442			3	4
Candle	0	Y	N	3	4
Cape Lisburne	0			3	4
Cape Yakataga	0	N	N	3	4
Chefornak	408		N	3	4
Chenega Bay	69			3	4
Chevak	769		N	3	4
Chignik	96		N	3	4
Chignik Lagoon	68		N	3	4
Chignik Lake	136		N	3	4
Chiniak	75			3	4
Chuloonawick	0			3	4
Clarks Point	76		N	3	4
Coffman Cove	200			3	4
Cold Bay	104		N	3	4
Cordova	2512	N	N	3	4
Council	0			3	4
Covenant Life	67			3	4
Craig	2124			3	4
Cubecove	139			3	4
Deadhorse	2	N	N	3	4
Deering	155		N	3	4
Diomede	133	Y	N	3	4
Edna Bay	55			3	4
Eek	289	Y	N	3	4
Egegik	123	Y	N	3	4
Ekuk	2		N	3	4
Elfin Cove	50			3	4
Elim	316	Y		3	4

Elmendorf Airforce Ba		Y	Y		3			4
Emmonak	804		N		3			4
Eyak	162				3			4
False Pass	73		N		3			4
Fort Glenn	0				3			4
Gambell	653		N		3			4
Game Creek	50				3			4
Golovin	142	Y	N		3			4
Goodnews Bay	235		N		3			4
Grayling	187	Y			3			4
Gustavus	377	Y			3			4
Hamilton	0				3			4
Hobart Bay	48				3			4
Hollis	111				3			4
Hoonah	880				3			4
Hooper Bay	1066	Y	N		3			4
Hydaburg	369				3			4
Hyder	126				3			4
Igiugig	62	Y	N		3			4
Ivanof Bay	29		N		3			4
Kaguyak	0				3			4
Kake	702				3			4
Kaktovik	254	N	N		3			4
Karluk	41	Y	N		3			4
Kasaan	44				3			4
Kasigluk	528		N		3			4
Ketchikan	8295				3			4
King Cove	671	Y	N		3			4
King Island	0	Y	N		3			4
Kipnuk	573	Y	N		3			4
Kivalina	382	Y	N		3			4
Klawock	750				3			4
Kodiak	6836	Y	Y	2	2	1	2	4
Kongiganak	359		N		3			4
Kotlik	567		N		3			4

Kotzebue	3000	N	N	3	4
Kupreanof	24			3	4
Kwethluk	762	Y	N	3	4
Kwigillingok	360		N	3	4
Levelock	131			3	4
Manokotak	405			3	4
Mekoryuk	191		N	3	4
Metlakatla	1499			3	4
Meyers Chuck	30			3	4
Mountain Village	757	Y	N	3	4
Naknek	624	Y	N	3	4
Nanwalek	170			3	4
Napakiak	357	Y	N	3	4
Napaskiak	395	Y	N	3	4
Naukati Bay	164			3	4
Nelson Lagoon	87		N	3	4
Newhalen	183	Y	N	3	4
Newtok	284		N	3	4
Nightmute	214		N	3	4
Nikolski	39			3	4
Nome	3620	Y	N	3	4
Nuiqsut	468	Y	N	3	4
Numan Iqua	193			3	4
Nunapitchuk	480		N	3	4
Ohogamiut	0			3	4
Old Harbor	257	Y	N	3	4
Oscarville	64	Y	N	3	4
Ouzinkie	259			3	4
Paimiut	0			3	4
Pauloff Harbor	0		N	3	4
Pedro Bay	36			3	4
Pelican	135			3	4
Perryville	102			3	4
Petersburg	3387			3	4
Pilot Point	85			3	4
Platinum	36		N	3	4

Point Baker	51			3	4
Point Hope	792			3	4
Point Lay	217			3	4
Polk Inlet	16			3	4
Poorman	0			3	4
Port Alexander	90			3	4
Port Alice	4			3	4
Port Clarence	22			3	4
Port Graham	178	Y	Y	3	4
Port Heiden	121		N	3	4
Port Lions	246			3	4
Port Moller	0			3	4
Port Protection	50			3	4
Portage Creek	18	Y	N	3	4
Portlock	0			3	4
Prudhoe Bay	47	N	N	3	4
Quinhagak	582		N	3	4
Rowan Bay	0			3	4
Saint George	164		N	3	4
Saint Michael	368	Y	N	3	4
Saint Paul	585		N	3	4
Sanak	0			3	4
Sand Point	871		N	3	4
Savoonga	652		N	3	4
Saxman	370			3	4
Scammon Bay	501	Y	N	3	4
Selawik	792	Y	N	3	4
Seward	3085	Y	N	3	4
Shaktoolik	227	Y	N	3	4
Shemya Station	0		N	3	4
Shishmaref	547	Y	N	3	4
Sitka	8788			3	4
Solomon	3	Y	N	3	4
South Naknek	132	Y	N	3	4
Squaw Harbor	0			3	4
Stebbins	543	Y	N	3	4

Tatitlek	105	N	N	3	4
Teller	281	Y	N	3	4
Tenakee Springs	105			3	4
Thorne Bay	603			3	4
Togiak	824		N	3	4
Toksook Bay	527		N	3	4
Tuntutuliak	350	Y	N	3	4
Tununak	331		N	3	4
Twin Hills	76	Y	N	3	4
Tyonek	160	Y		3	4
Uganik	0			3	4
Ugashik	8			3	4
Umkumiute	0			3	4
Unalakleet	757	Y	N	3	4
Unalaska	4283		N	3	4
Unga	0		N	3	4
Uyak	0			3	4
Valdez	4271	Y		3	4
Wainwright	545	Y	N	3	4
Wales	154		N	3	4
Whale Pass	62			3	4
White Mountain	207	Y		3	4
Whitestone Logging Ca	118			3	4
Whittier	289	Y	N	3	4
Woody Is.	0			3	4
Wrangell	2569			3	4
Yakutat	744	Y	Y	3	4

* summer residents reported by James Higgins

Participants: Mary Kwart, James Higgins, Sam Patton, Gene Long, Mike Roos, Mark Musitano, Dan Warthin, Morgan Miller, Dale Haggstrom, Jim Bell, Arlene Weber-Sword, Harold Andrews, Brad Cella, Tom Kurth, Mike Butteri

2005 Fuels Group changed the category of these communities.
2005 Fuels Group moved Venetie and Chicken to 1 category, James Higgins send message wanted both to be place in the 3 category

FINAL DECISION NEEDED

Community Totals	2005	2001
Category 1	73	44
Category 2	70	81
Category 3	46	57
Category 4	187	196
Total	376	378

Difference in total is the removal of two duplications discovered in 2005

Appendix B.
Wildland Urban Interface (WUI) Preliminary Risk Assessment for the Four Villages Adjacent to the Kanuti Refuge

Wildland Urban Interface (WUI) fire risk assessments will be conducted and prioritized in collaboration with all federal, state, and local agencies, as well as Native entities, for all communities in Alaska. All communities (defined as communities by the State of Alaska) where assessed for risk from wildland fire in a collaborative effort among federal, state, local and Native entities in 2001. The following criteria were used in the community assessments: Ground fire encroachment threat; Crown fire encroachment threat; Fire behavior potential; Values at risk; and Infrastructure. These ratings where combined to determine an overall Wildland fire risk rating of low**,** moderate**,** or high for each community. As more detailed assessments are accomplished the overall wildland fire risk may change.

Four communities in or near the Kanuti National Wildlife Refuge have been identified as being potentially impacted by wildland fire occurrence on the refuge. These communities and risk ratings are as follows:

Community	Population	Ground Fire Encroachment Threat	Crown Fire Encroachment Threat	Fire Behavior Potential	Values at Risk	Infra-structure	Overall Wildlan Fire Ris
Alatna	34	Yes	No	Low			Low
Allakaket	197	Yes	Yes	High	Moderate	High	High
Bettles	36	Yes	Yes	High	Moderate	High	High
Evansville	24	Yes	Yes	High	Moderate	High	High

The cost to conduct a detailed assessment is estimated at $5,000. The cost includes risk assessment, mitigation plan and NEPA requirements. Implementation costs for fuels treatment are estimated to be $2,000 per acre for hand thinning and piling of slash, plus an additional $500 per acre to burn the slash piles. Mechanical treatments are estimated to cost in the range of $300 to $500 per acre depending on type of treatment, machinery used and site conditions. The size of the treatment unit around a community depends on the findings of the risk assessment and the mitigation elements developed in collaboration with the community.

Private parcels receive full wildland fire protection . These parcels are surrounded by Service lands. Risk assessments and treatment options for private parcels would be developed in conjunction with the owners, the Bureau of Indian Affairs and/or the local compacting Tribal entity. Most private parcels are isolated, remote parcels and very few have full-time occupied dwellings, therefore the risk for wildland fire entering a parcel is higher than may be for a community. Treatment costs around parcels would be the same as for community protection, however, the values to be protected would generally be lower primarily due to lack of residences. The cost to fully implement parcel fuels treatment projects could potentially be shared by the Bureau of Indian Affairs. If the treatment was on Service lands, the cost to the

Service would be much higher. Private parcels average 160 acres. Assuming a 300-foot border around a parcel, approximately 36 acres would be treated to reduce the risk of wildland fire for a single parcel. Including all status there are 38 private parcels. If each parcel was treated separately 4,932 acres would need to be treated. The planning cost per parcel is estimated at $1,000. A total of $137,000 in planning cost would be required. Full implementation of the WUI treatment for private parcels would cost approximately $12,330,000.

Cabins and cultural resources are other values at risk from wildland fire on Service lands. An assessment of all cabins and cultural sites has not been completed as of July 2005. Typically, one or two acres of hazard fuel treatment are required per cabin or cultural resource site. The cost to implement cabin or cultural resource site fuels treatment is estimated at $6,000 per site. The cost includes planning, NEPA, treatments, and monitoring activities.

Appendix C.

Kanuti Refuge - +Normal Unit Strength – Fire Cache

Fire suppression for Kanuti NWR by agreement is conducted by the Alaska Fire Service. Kanuti NWR currently has no fire-dedicated staff, but one shared Fire Management Officer with Arctic and Yukon Flats Refuges. The refuge's Fire Management Officer is officially assigned to Yukon Flats NWR, which maintains a small fire cache including standard-issue field gear and PPE for a small prescribed fire crew.

Firebase analysis indicates that Normal Unit strength for Kanuti Refuge should include three full-time equivalents (i.e., an FMO, AFMO, and Fire Technician).

If needed, fire supplies can be acquired either from:

Yukon Flats NWR cache;
AFS warehouse (place a resource order with the cache equipment desk at 356-5687);
National cache;
or
Commercial vendors.

Appendix D.
Fire Surveillance Form for Wildland Fire Use

WFIP Stage	Planning and Assessment Element	Requirement Status			Maximum Completion Time Frame
		Initial Attack	Other Suppression-oriented appropriate management response	Fire use actions	
WFIP Stage I: Initial Fire Assessment	Fire Situation	1	1	1	As soon as possible
	Decision Criteria Checklist (initial GO/NO-GO Decision)	3	1	1	2 hours after first fire detection
WFIP Stage II: Short-term Implementation Action	Short-Term Fire Behavior Predictions and Risk Assessment	3	1	1	24 hours after Stage I completion
	Short-term Implementation Actions	2	1	1	
	Complexity Analysis	3	1	1	
	Stage III Needs Assessment Chart	NA	1	1	
WFIP Stage III: Long-term Implementation Actions	MMA Determination	3	4	4	Within 24 hours after Stage II or Periodic Fire Assessment indicates need
	Fire Behavior Prediction	3	4	4	
	Long-term Risk Assessment	3	4	4	
	Long-term Implementation Actions	3	4	4	
Periodic Fire Assessment	Part 1: Re-validation	NA	1	1	On assigned frequency
	Part 2: Stage III Need Assessment Chart	NA	1	1	
WFSA		5	5	6	Before implementing new strategy

1. mandatory
2. mandatory, but can be preplanned
3. optional
4. completed if Stage II or Periodic Fire Assessment, Part 2 indicates need
5. completed if fire exceeds management capabilities
6. completed if Periodic Fire Assessment, Part 1 indicates need

Appendix E.
General Fire Behavior - Kanuti Refuge

Deep organic layers are made up of partly decomposed plant parts, and although some may burn during the flaming front passage, much consumption occurs in a smoldering fire. If deeper layers are dry, fires can be sustained during rainy periods when precipitation keeps surfaces wet. Surface fuels largely determine whether a fire will spread, and are composed of dead foliage, litter, mosses and lichens, and fine shrubs. Down woody fuels may be heavy and contribute to crowning and flare-ups. Live foliage is highly flammable in some species, and crown fire behavior depends on the presence of ladder fuels, the amount of foliage present and its density, moisture content, and content of flammable waxes, oils, and/or resins.

Ignitions usually occur when there has been no rain for one to two weeks and on days with low relative humidity, high temperatures, high wind, and when lightning from “dry” thunderstorms occurs (Trigg 1971). Ignitions can also happen during wet thunderstorms, but these "holdover" fires may not spread much until dry conditions return. Van Wagner (1983) describes five main types of fires: smoldering fires in deep organic layers; surface backfires (burning against the wind); surface headfires (burning with the wind); crown fires (advancing as a single front); and high-intensity spotting fires.

Johnson (1992) states that the climate and vegetation of the boreal forest produce high intensity crown fires that have created some of the largest fires in the world. Large fires and extreme fire behavior are most common in black spruce and stunted white spruce stands. Burned areas are generally not susceptible to large fires for 20–50 years after burning. This amount of time is usually required for black spruce stands to develop a continuous moss/litter layer and a fairly continuous canopy. These fuel-loading characteristics are largely responsible for carrying a fire in black spruce (Van Wagner 1983). Often fire behavior in burned-over stands is still significantly less severe than in surrounding long-unburned areas.

Increases in wind speed can also have major impacts on fire behavior, quickly turning creeping ground fires into crown fires. The Alaska Fire Service (AFS) Alaska Fire Suppression Field Handbook (BLM 1995:7) contains applicable information on fire behavior. For black spruce, the handbook states that a relative humidity from 30 to 40% and mid-flame wind speed above 10 miles per hour will likely generate increasing fire intensity and some crowning. With those winds and humidity below 30%, conditions are referred to as "dangerous," creating a "full-blown, running crown fire that spots ahead."

During "extreme" burning conditions the flaming front may be more than a mile wide, fires may run several miles during a day, flame lengths may reach a hundred feet, and spot fires may occur hundreds of yards ahead of the main fire. Suppression options will be severely limited by the fire, and direct attack is rarely possible (Alexander and Cole 1994, BLM 1995).

Alexander and Cole (1994:Table 1) state that under "super critical" conditions, extreme fire behavior is certain, with behavior including "rapid spread rates, continuous crown fire development, medium to long-range spotting, firewhirls, massive convection columns, (and) great walls of flame." Suppression is "virtually impossible," and the only place for effective and safe control action is at the back and along the flanks until the fire stops its run.

ALASKA INTERAGENCY WILDLAND FIRE MANAGEMENT PLAN

Amended
October 1998

As Administrator of a Land Management Agency or Land Owner Organization represented on the Alaska Wildland Fire Coordinating Group, I concur with the recommendation of the Alaska Wildland Fire Coordinating Group to implement the 1988 amendment entitled the "Alaska Interagency Wildland Fire Management Plan." The amendment enables a single document to provide guidance for wildland fire management activities in Alaska. The amendment does not change any fire management option selections or boundaries. Land manager/owner(s) are responsible for changes to fire management options in accordance with procedures described in the amendment and agency/owner policies.

Commissioner
Alaska Department of
Natural Resources

Date 10/29/98

Commissioner
Alaska Department of
Fish & Game

Date 11·13·98

Area Director
Bureau of Indian Affairs

Date 11-09-98

State Director
Bureau of Land Management

Date NOVEMBER 12, 1998

Regional Director
Fish & Wildlife Service

Date 11/12/98

For Regional Forester
U.S.D.A. Forest Service

Date 12/4/98

~~Act.~~ Regional Director
National Park Service

Date 10/29/98

President
Tanana Chief Conference, Inc.

Date 12/4/98

Anne M. Walker

Executive Director
Chugachmiut

Date 12 November 1998

The following organizations are represented by Chugachmiut:

Bristol Bay Native Association
Association of Village Council Presidents
Aleutian/Pribilof Islands Association

TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

LIST OF FIGURES

EXECUTIVE SUMMARY

Interagency Fire Management Plans (IFMPs) for thirteen geographic areas of the state were prepared under the oversight of the Alaska Interagency Fire Management Council between 1980 and 1988 to provide a coordinated and cost effective approach to fire management on all lands in Alaska. All fire management decisions by land manager/owner(s) are based on values warranting protection, protection capabilities, firefighter safety and/or land and resource management needs. Before the IFMPs, existing policy required the immediate suppression of all wildfires. This policy was costly, of questionable effectiveness, and had a negative effect on the diversity and productivity of the fire-dependent ecosystems in some regions of Alaska. In addition, during periods of high fire activity it was not possible to provide immediate and effective suppression on many fires because of the shortage of personnel, equipment, supplies or aircraft. It was recognized that an improved system was needed for establishing priorities and levels of suppression.

Prior to 1998, it was necessary to refer to three documents to understand fire management in Alaska. The three documents included: (1) Alaska Interagency Fire Management Plan, Tanana/Minchumina Planning Area; (2) the interagency fire management plan for the local area; and (3) the 1984 amendment entitled, "The Alaska Interagency Fire Management Plan. This 1998 amendment called the Alaska Interagency Wildland Fire Management Plan (AIWFMP) consolidates the original 13 plans and eliminates the need to refer to multiple documents while providing the land manager/owner(s) and fire suppression organizations a single reference for interagency fire management operational information. The amended AIWFMP also incorporates operational changes that have occurred since the inception of the statewide fire management planning effort. This amendment also accomplishes the Fire Management Planning Group objective to eliminate planning area boundaries once the 13 plans were completed (personal communication, F. Malotte).

The AIWFMP contains the common elements from the approved thirteen plans. Area-specific support documentation exists in the original planning documents. Copies of the 13 area specific plans are available at the locations identified in Appendix A. Local land and fire management agency/owners should have a copy of the area specific plan that applies to their area on file. The interim draft of this plan was entitled "Alaska Consolidated Interagency Fire Management Plan 1993." It was also determined that dropping "consolidated" simplified the title. "Fire" was replaced with "Wildland Fire" to adhere to terminology changes approved by the National Wildland Fire Coordinating Group in June 1997.

Since the beginning of the statewide fire planning effort, the goal has been to provide an opportunity through cooperative planning for land manager/owner(s) to accomplish individual fire-related land-use objectives in the most cost-effective manner. Within the AIWFMP, land managers/owners are defined as state and federal land managing agencies, Regional and Village Native corporations, and Native allotment owners represented by the Bureau of Indian Affairs or local tribal organizations.

The AIWFMP continues the requirement for an annual, pre-season land manager/owner review of the fire protection needs on lands under their management authority. Once fire protection needs are determined, the lands are placed in Critical, Full, Modified, or Limited management option. Option selections are based on land manager/owner(s) values to be protected as well as land and resource management objectives. The fire management strategies selected vary from initial attack and sustained suppression efforts in the critical and full management areas to surveillance in the limited management areas. This categorization and ensuing prioritization ensures that: (1) human life, private property, and identified resources receive an appropriate level of protection with available firefighting resources, (2) the cost of the suppression effort is commensurate with values identified for protection, and (3) the ability of land manager/owner(s) to achieve their individual management objectives is optimized.

THE AIWFMP AFFIRMS THAT:

• Lightning caused wildland fires are an important component of the boreal forest and arctic tundra ecosystems, and the complete exclusion of these fires is neither ecologically sound nor economically feasible.
• In the Southeastern Alaska coastal forest, lightning caused wildland fire is not ecologically significant. People cause the majority of the fires while undertaking logging operations and recreational activities in the coastal forest.
• The natural role of fire in the environment must be tempered by the need to protect human life and health, private property, developments, and certain valued natural and cultural resources.
• During the fire season availability of suppression resources may become limited due to commitments on numerous initial attack assignments and/or large fires.
• The pre-fire season assignment of management options establishes priorities for allocation of suppression forces and substantially improves the cost-effectiveness of wildland fire management.
• Non-standard responses become necessary when situations such as unusual burning conditions, critical shortages of suppression resources, or human safety and health issues arise. These responses occur rarely and are limited to specific instances and specific geographic locations. A convened Multi-Agency Coordinating (MAC) group or the involved fire suppression organization and land manager/owner(s) will document all non-standard responses.
• Well-trained, well-equipped, and adequately funded suppression forces are essential to maintain public safety and public confidence in the fire management programs, and to provide cost effective suppression while recognizing the role of fire in Alaska ecosystems.
• Pre-suppression efforts, such as fuel break construction and prescribed fires for hazard fuel reduction will reduce the potential threat to human life and private property, and help meet fire-related land and resource management objectives to reduce fire suppression expenditures on adjacent lands.
• Prescribed fire is a viable fire management tool in a variety of situations including:

requires an in--Site-specific land and resource management objectives are not met by the existing fire regime.

--The spread of human developments makes it unsafe or not cost-effective to use any alternative fire management strategy other than prescribed fire.

--Reduction of accumulated vegetation (fuels) is necessary to protect human life, developments, and high-value resources.

In addition to the AIWFMP, the Wildland Fire Situation Analysis (WFSA) process is critical to the fulfillment of land manager/owner(s) and suppression organization responsibilities. A WFSA is completed when one of the following occurs:

- a fire escapes initial attack,
- resource shortages prevent prompt implementation of the appropriate suppression response,
- significant additional resources are required to meet suppression objectives because a significant change in suppression strategy/action is anticipated,
- an ongoing fire threatens to or moves into an area that creased suppression response, or
- land manager/owner(s) or suppression organization requests the completion of a WFSA.

The land manager/owner(s) of burning and/or threatened lands together with suppression organization personnel prepare the WFSA to determine the appropriate suppression action. The land manager/owner(s) approve the WFSA, with concurrence by the suppression organization.

Fires are classified either as wildland fires that are managed under the AIWFMP, or prescribed fires, which are ignited to accomplish land and resources objectives, and are managed under agency policies and procedures.

The events of the 1994 wildland fire season created a renewed awareness and concern about the impacts of fire and firefighter safety among the Federal land management agencies, State land management agencies and their constituents. As a result of these concerns and in response to specific recommendations in the report by the South Canyon Fire Interagency Management Review Team (IMRT), the Federal Wildland Fire Management Policy and Program Review was chartered to ensure that Federal policies and cohesive interagency and intergovernmental fire management programs exist. Guiding principles outlined in the Final Report of the Federal Wildland Fire Management Policy and Program Review, dated December 18, 1995, are embodied in the AIWFMP. The Secretary of Agriculture and Secretary of Interior accepted and endorsed the principles, policies and recommendations in the Federal Wildland Fire Management Policy and Program Review Report.

The State of Alaska recognizes the importance of the Federal Wildland Fire Management Policy and Program Review. The State supports most of the concepts in the policy and is dedicated to working with its federal agency cooperators in assisting them in implementing it in Alaska. If contradictions occur between the Federal Wildland Fire Management Policy and State of Alaska Policy, they will be mitigated on a case-by-case basis.

INTRODUCTION

The Alaska Interagency Wildland Fire Management Plan (AIWFMP) combines the common elements in the existing 13 area Interagency Fire Management Plans into one operational document (Figure 1). The intent of this effort is to clarify and streamline the existing fire management planning documents and incorporate operational changes that have occurred during and since the inception of the statewide fire management planning effort. This consolidation does not alter the intent of the common elements, any fire management option selections or fire management option boundaries delineated in the area-specific plans and map atlases.

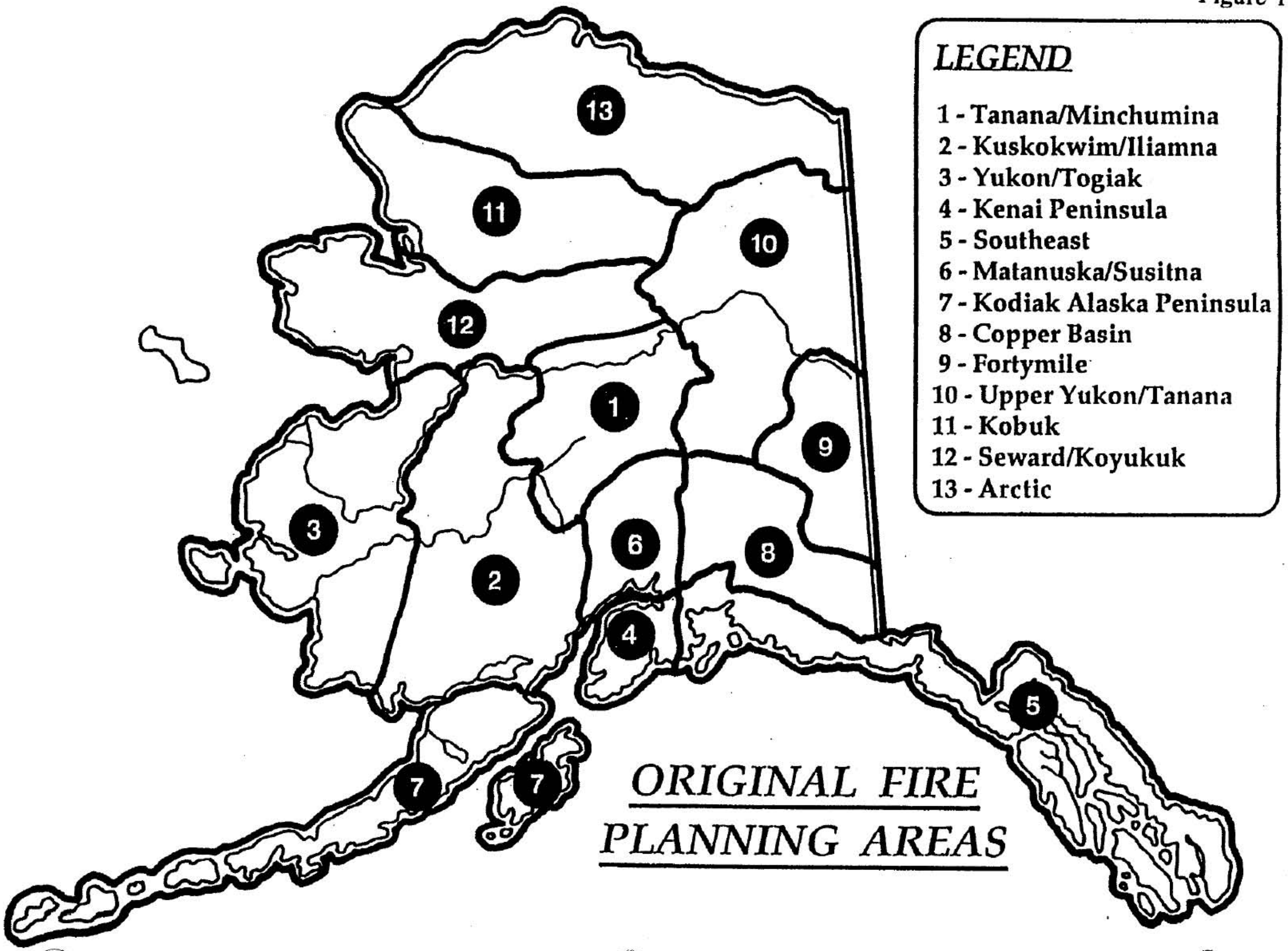
Before this consolidation effort, it was necessary to refer to three documents to understand fire management in Alaska: (1) Alaska Interagency Fire Management Plan, Tanana/Minchumina Planning Area; (2) the interagency fire management plan for the local area; and (3) the 1984 amendment to the original fire plans. This consolidated AIWFMP eliminates the need to refer to multiple documents and provides the land manager/owner(s) and fire suppression organizations a single reference for interagency fire management operational information. This also accomplishes the original Fire Management Planning Group objective to eliminate planning area boundaries once the 13 plans were completed (personal communication, F. Malotte).

The area specific interagency fire management plans were developed between 1980 and 1988. The Alaska Land Use Council, formed in 1980 by a provision of the Alaska National Interest Lands Conservation Act (ANILCA), designated the Fire Management Project Group (FMPG) to organize and coordinate interagency fire management. This initial planning group was composed of representatives from land and resource management agencies, fire suppression organizations, and regional Native corporations. The state was divided into 13 planning areas, based upon physiographic/hydrologic boundaries. Local planning teams were established with individuals from state and local government, land and resource management agencies, and regional and village Native organizations within the area fire planning boundaries.

The first area plan completed in that interagency fire planning effort was the Alaska Interagency Fire Management Plan, Tanana/Minchumina Planning Area. The Tanana/Minchumina (T/M) area plan served as the prototype for the remaining twelve plans. Specific sections of the T/M plan were referenced in the 12 plans that followed.

Each of the 13 area plans contains a description of the local environmental and socioeconomic conditions, natural and cultural resources, fire history and behavior,

Figure 1



ORIGINAL FIRE PLANNING AREAS

and local subsistence activities. In addition to this information, land manager/owner(s) resource values and resource management objectives, mandates and policies were initially used to select the fire management options.

In June 1984, the plan titled, "Alaska Interagency Fire Management Plan" was amended. The environmental assessment for Tanana/Minchumina Plan was authorized to serve as the programmatic Environmental Assessment of the fire planning effort statewide. An U.S. Solicitor's opinion was requested by two Federal agencies. The following language was added to the Environmental Assessment, "Federal solicitors have informally determined that planning for natural fire and fire suppression does not meet the threshold requirements of an ANILCA 810 evaluation." Following review of the environmental assessment, a finding of no significant impact was determined for each of the area plans. Public meetings were held in each planning area prior to the approval of the area specific plan. The appropriate officials for state and federal land and resource management agencies, Native Regional and Village Corporations, and local governments approved the plans.

The 13 original area plans serve as reference materials for this AIWFMP. This consolidated plan does not change the intent of management options, existing management option boundaries or basic operations, nor will the information on local environmental and economic conditions, fire history and behavior, and subsistence activities be included. Copies of the AIWFMP and the area plans are available for review for anyone who is interested in the background information (Appendix A.). Copies of the specific area plans may be available for review at the local land/resource managing agencies and Native Regional Corporation offices within the planning area.

Although the fire plan is interagency by nature, each land/resource management agency's mandates and policies shape the selection and application of fire management options. Decisions regarding the appropriate suppression response to wildland fires will be consistent with departmental and/or individual land manager/owner policy. Land managers/owners recognize the beneficial role of fire in most Alaska ecosystems and manage fire with that consideration in mind within the constraints of policy and land management objectives. The AIWFMP does not supersede individual agency policies and mandates.

The map atlas is the official record that delineates the fire management boundaries, and identifies natural and cultural resources, structures, and locations of sensitive, threatened and endangered species to be protected (Appendix B.). The fire plan, supported by the map atlas, provides initial attack guidance and establishes priorities for the suppression organizations. Local land managers/owners are responsible for providing the suppression organizations (Figure 2) with current information on changes in human use patterns, development and natural and cultural resources pertinent to fire management concerns. The map atlas is maintained at the suppression organization's operation centers (Figure 3).   The map atlases are dynamic and updated to show annual changes of fire management options designations and/or boundaries.

Until May 1995, two working groups comprised of land and resource managers, land owner representatives and fire suppression personnel provided guidance and direction on interagency fire management issues and activities. The initial Fire Management Project Group evolved into the Alaska Interagency Fire Management Council (AIFMC). The Alaska Interagency Fire Management Council addressed fire planning, fire weather data collection, fire management data archiving and use, prescribed fire, fire prevention and non-suppression fire management issues and research needs. The Multi-Agency Coordinating (MAC) group was created under the Department of the Interior Manual 910 DM 3.7. The MAC group addressed Type I team selection, alteration of evaluation dates for modified management option areas, open burning restrictions, suppression priorities during periods of suppression resource shortages, and emergency departures from planned responses.

The existence of two working groups resulted in confusion by the land manager/owner(s), fire suppression organizations, and the public. In addition, there was some overlap in responsibilities. To establish one statewide coordinating group and improve efficiency, effectiveness and productivity, the Alaska Wildland Fire Coordination Group (AWFCG) was created through a Memorandum of Understanding. The AWFCG assumes the responsibilities of the former Alaska Interagency Fire Management Council and the Multi-

Agency Coordinating (MAC) Group. The AWFCG is responsible for the oversight of the AIWFMP and will determine when updates, amendments or revisions are needed. A MAC group of affected land manager/owners and suppression organizations will be activated on a situational basis during high levels of fire suppression activities.

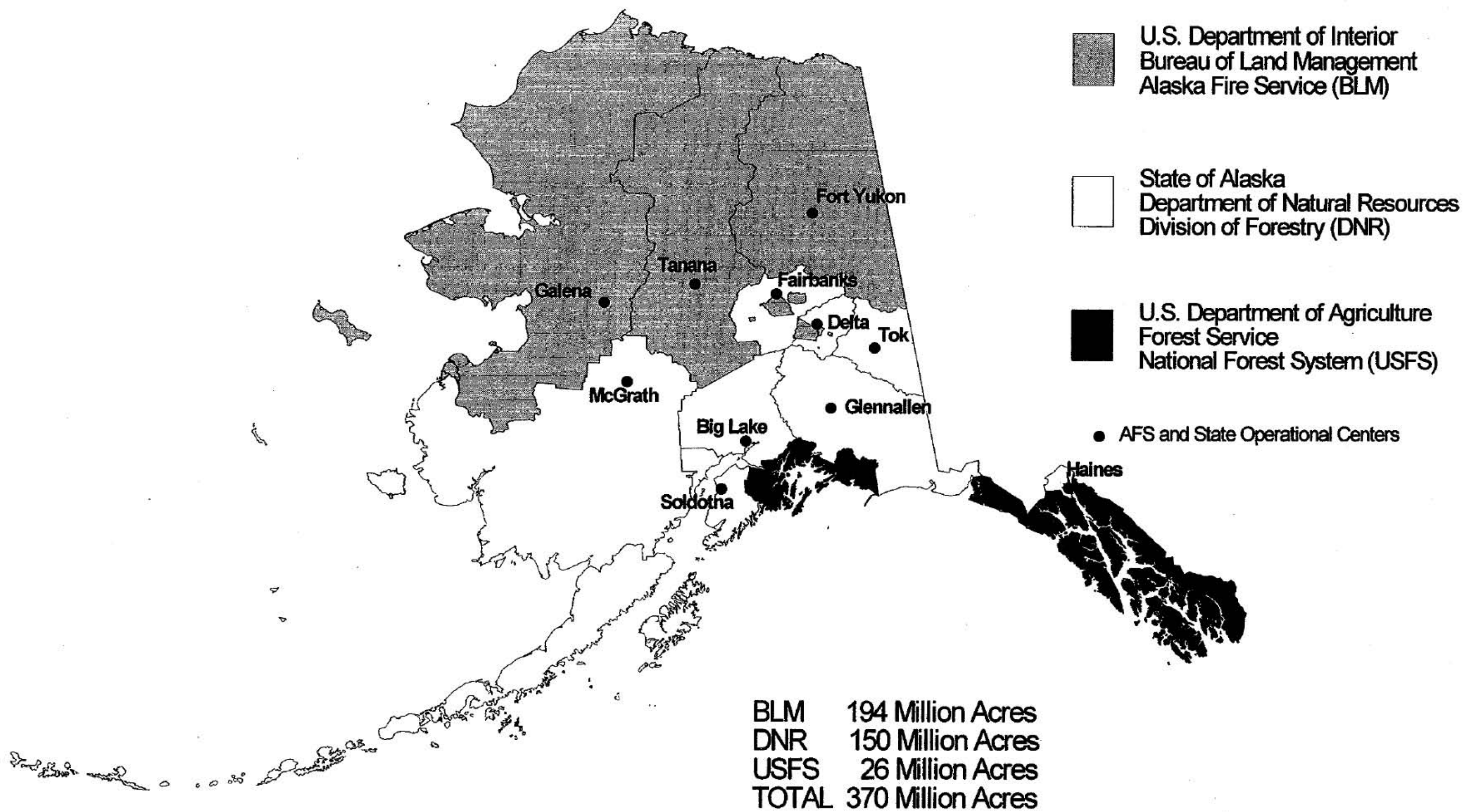
The events of the 1994 wildfire season created a renewed awareness and concern about the impacts of fire and firefighter safety among the Federal land management agencies, State land management agencies and their constituents. As a result of these concerns and in response to specific recommendations in the report of the South Canyon Fire Interagency Management Review Team (IMRT), the Federal Wildland Fire Management Policy and Program Review was chartered to ensure that Federal policies and cohesive interagency and intergovernmental fire management programs exist. The policy and program review represents the latest stage in the evolution of wildland fire management. The new policy marks substantial changes from the previous policy while still directing federal agencies to manage fire to accomplish desired objectives. This policy, far from a one-dimensional fire control approach, attempts to associate suppression and management of wildland fire into a single direction achieving multi-dimensional fire, land and resource management objectives. This policy directs federal agencies to achieve a balance between suppression to protect life, property, and resources, and fire use to regulate fuels and maintain healthy ecosystems. Most of the previous barriers and constraints to expanded fire use are removed through this policy. The new policy provides opportunities to dramatically increase the use and accomplishment of resource management objectives.

The State of Alaska recognizes the importance of the Federal Wildland Fire Management Policy and Program Review. The State supports most of the concepts in the policy and is dedicated to working with its federal agency cooperators in assisting them in implementing it in Alaska. If contradictions occur between the Federal Wildland Fire Management Policy and State of Alaska Policy, they will be mitigated on a case-by-case basis.

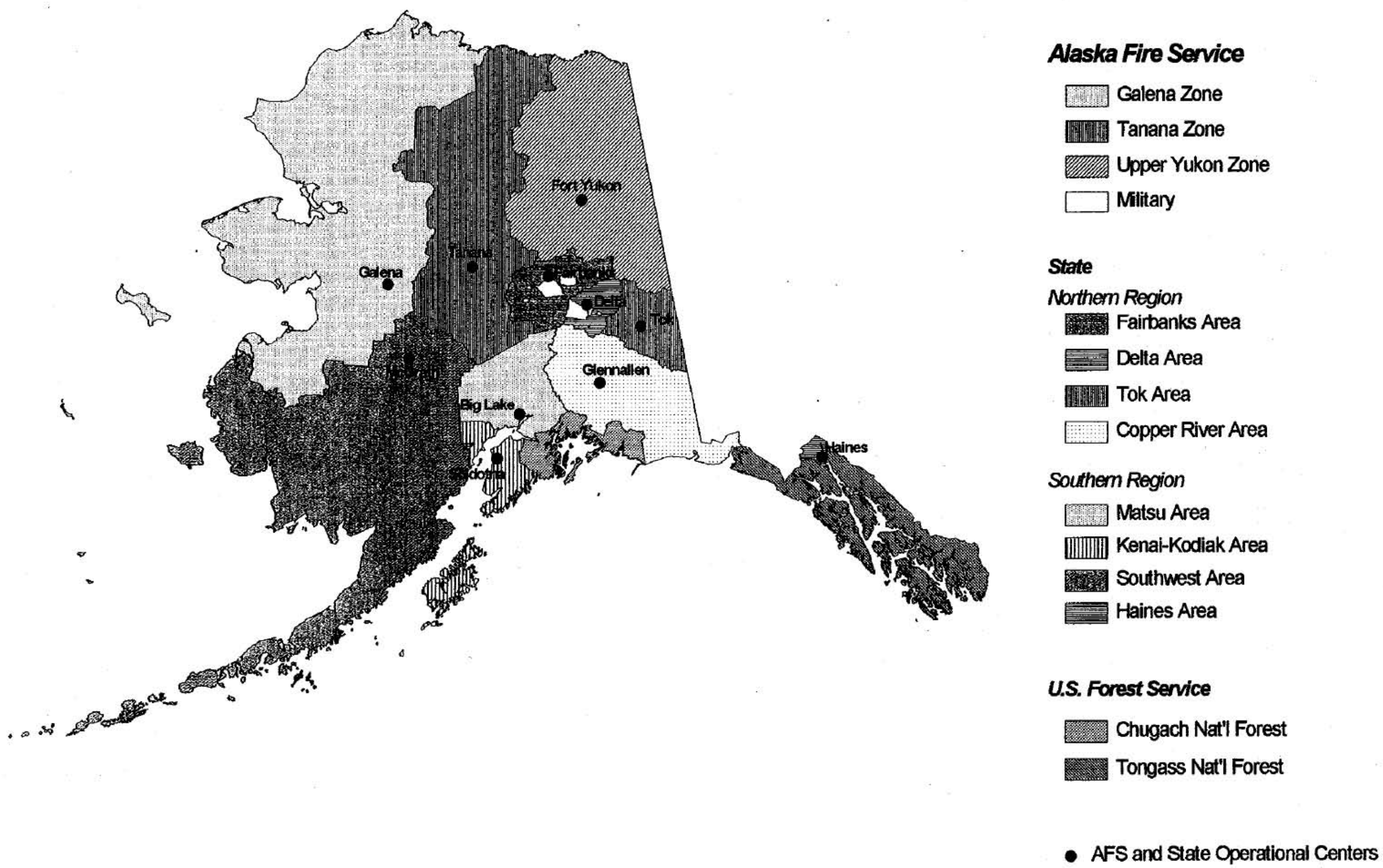
An international agreement between the U.S. Department of Interior and the Canadian government allows for cooperative detection and suppression of fires within a ten mile buffer zone on either side of the Alaska and Yukon Territory boundary (Appendix C.).

Figure 2

Alaska Wildland Fire Protection Areas



Alaska Wildland Fire Organization
Administrative Units and Operational Centers



GOALS AND OBJECTIVES

For over 30 years, occurrence of wildland fire was treated as an emergency situation wherein aggressive and complete suppression was the only option available. It was demonstrated that the costs associated with suppressing all wildland fires had reached the point of diminishing returns; that damage created by the suppression action often was more harmful than the fire itself; and research documented the need for ecologically-based fire management policies.

Fire is now recognized as a critical feature of the natural history of many ecosystems. The evolutionary development of plants and animals has occurred in natural systems where fire was a dominant feature of the environment. Humans occupying an area were also subjected to the natural fire regime, and fire occurrence increased due to human activity. In Alaska, the natural fire regime is characterized by a return interval of 50 to 200 years, depending on the vegetation type, topography and location.

The goal of this plan is to provide an opportunity, through cooperative planning, for land and resource managers/owners to accomplish fire-related, land-use and resource management objectives in a cost-efficient manner, consistent with owner, agency and departmental policies. Management options selected should be ecologically and fiscally sound, operationally feasible, and sufficiently flexible to respond to changes in objectives, fire conditions, land-use patterns, resource information, and technologies.

The objectives of this plan are to:

1. Establish wildland fire management option boundaries based upon protection of human life, private property, high-value resources to be protected, and fuel types and their associated fire behavior -- not based on administrative boundaries.

2. Take aggressive and continued suppression action on fires that threaten human life, identified private property, or high-value resources to be protected without compromising firefighter safety.

3. Review annually the fire management needs of land manager/owner(s) with common boundaries and/or concerns.

4. Maintain land manager/owner(s) responsibility and authority for the selection of fire management options for the lands that they administer.

5. Enable land managers/owner(s) to select fire management options which help accomplish land and resources management objectives within the scope of their specific policies and regulations.

6. Ensure that the cost of fire suppression actions is commensurate with the value of the resources warranting protection.

7. Minimize adverse environmental impact of fire suppression activities.

8. Recognize prescribed fire as an important resource management tool to accomplish land and resource management objectives.

In addition to the aforementioned objectives, the AIWFMP embodies the Guiding Principles established in the Federal Wildland Fire Policy Program Review, 1995. The Guiding Principles are:

• Firefighter and public safety is the first priority of every fire management activity.
• The role of wildland fire as an essential ecological process and natural change agent will be incorporated into the planning process.
• 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.
• Fire management programs and activities are economically viable, based on 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 and local interagency coordination and cooperation are essential.
• Standardization of policies and procedures among Federal agencies is an ongoing objective.

GENERAL GUIDELINES

1. The boreal forest and tundra environments are fire-dependent ecosystems, which have evolved in association with fire, and will lose their character, vigor, and faunal and floral diversity if fire is excluded.

2. Land ownership and land management objectives as well as knowledge of natural and cultural resources will continue to change. As a result of these ongoing changes, yearly review, modifications, and updates of the fire management options must be made accordingly. Each land manager/owner is expected to annually review the existing levels of protection afforded their lands to validate current designations (See Fire Management Option Revision section, page 37).

3. This plan documents fire management options that land manager/owner(s) can apply to their lands. Selection of fire management options does not preclude the development of a prescribed burn program by a land manager/owner in any fire management option area.

4. Cost effective strategies will be explored to reduce fire suppression costs while maintaining responsiveness to all land managers'/owners' objectives. This will be done within the scope of existing legal mandates, policies and regulations.

5. Suppression force preparedness and mobilization will be provided by the suppression organizations to the extent necessary to reasonably ensure that the management goals of the AIWFMP are met.

6. Documentation of wildland fire decisions will be in accordance with applicable Federal or State wildland fire management policies and procedures.

In addition to the aforementioned General Guidelines, the AIWFMP embodies the following key points from the Federal Wildland Fire Policy Program Review, 1995:

• Protection of human life is reaffirmed as the first priority in all wildland fire management activities. Property and natural/cultural resources jointly become the second priority, with protection decisions based on values to be protected and other considerations.
• Where wildland fire cannot be safely introduced because of hazardous fuel build-ups, some form of pretreatment must be considered, particularly in wildland/urban interface areas.
• Wildland fire management decisions and resource management decisions go hand in hand and are based on approved fire management and land and resource management plans. At the same time, agency administrators must have the ability to choose from the full spectrum of fire management actions – from prompt suppression to allowing fire to function in its natural ecological role.
• All aspects of wildland fire management should be conducted with the involvement of all partners; programs, activities, and processes will be compatible.

WILDLAND FIRE MANAGEMENT OPTIONS

The Alaska Interagency Wildland Fire Management Plan establishes four fire suppression management options:

Critical
Full
Modified
Limited

These wildland fire management options range from immediate and aggressive suppression to periodic surveillance. The land manager/owner(s) select fire management option(s) for their lands from the four categories.

Land manager/owner(s) select wildland fire management options based upon an evaluation of their individual legal mandates, policies, regulations, resource management objectives, and local conditions. Local conditions include but are not limited to fire history, fire occurrence, environmental factors and identified values. Land manager/owner(s) should annually review selected options to ensure that they are appropriate (See Fire Management Option Revisions, page 37). Only the land manager/owner(s) can select or change the wildland fire management options for the lands that they manage or own.

The authority to determine fire management options for lands selected within the boundaries of federal conservation units rests with the Departments of the Interior and Agriculture. The State of Alaska and Native corporations may request fire management option(s) to the land manager/owner for lands they have selected but the conveyance process has not been completed. For the purposes of the AIWFMP, land managers/owners who have received interim conveyance or tentative approval for conveyance of land will select the fire management option for those lands.

Several areas exist within the State where lands are not classified as one of the four fire management options. These include a few areas where the land manager/owner did not participate in the planning process. These areas are identified as Unplanned on the map atlas and represent less than one percent of the lands within Alaska. Lands within this category receive suppression response equivalent to the Full management option**.**

Boundaries between management options should be readily identifiable from both the air and on the ground throughout the fire season and also be feasible for potential placement of suppression control lines. The absence of readily available boundaries should not result in providing protection to very large geographic areas when the land manager/owner only wants to protect a small area or specific site. Any management option may border against any other management option. Either the suppression organization or land manager/owner(s) may make recommendations for relocating or reinforcing fire management option boundaries through prescribed fire or mechanical methods. Only the land manager/owner(s) can approve boundary changes or boundary reinforcement activities for the lands they manage or own. Consensus between land manager/owner(s) adjacent to proposed fire management option boundary changes should be attempted to minimize establishing boundaries that reflect administrative unit boundaries or creates boundaries that are not operationally or ecologically feasible. Hazard reduction plans may be developed to reinforce fire management option boundaries. Any reinforcement activities will be reviewed by the suppression organization, but can only be authorized by the land manager/owner(s).

Fire suppression organizations use the management options to determine initial attack priorities. The highest priority for suppression response is given to fires occurring in or threatening a Critical management site followed in order of priority by Full, Modified and Limited management areas. Although Modified management areas receive a higher priority in allocation of fire suppression resources than Limited management areas, the Limited management option is described before the Modified option because an understanding of both Limited and Full management options is necessary before the Modified option can be fully understood.

Critical Management Option

Intent

The Critical 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 (Appendix D.). Fires that threaten a critical site have priority over all other wildland fires. The fire management strategy of the Critical management option is to provide complete protection of the specific identified sites from fire. For clarification, a site referred to in this section could range from a single inhabited structure to an entire village or town.

Policy

Fires occurring in or immediately threatening this designation will receive highest priority for protection from wildland fires by immediate and continuing aggressive actions dependent upon the availability of suppression resources.

Objectives

1. Protect human life, inhabited property and designated physical developments without compromising fire fighter safety. Protection of the aforementioned elements is the primary objective, not control of the wildland fire.

2. Limit damage to Critical sites from wildland fire.

Operational considerations

1. The Critical management option is restricted to designated sites or small areas made up of an aggregation of critical sites.

2. Place highest priority on the allocation of available suppression forces to fires threatening sites in this option.

3. Managers are encouraged to exercise restraint in designating physical developments for the Critical management option, limiting the application of this option to just those sites which are currently or routinely occupied as a dwelling.

Operational procedures

1. Preparedness

   Land manager/owner(s) are required to identify each critical site.

2. Operations

   A. Detection

      Critical sites will receive maximum detection coverage.

B. Suppression response

1) Fire occurring within or immediately threatening a critical management site will receive the highest priority in allocation of initial attack resources. Protection of life or occupied property will have priority over National Historic Landmarks (Appendix D.).

2) The decision chart (Figure 4) describes the appropriate procedures and course of action for both the suppression organization and the land manager/owner(s).

C. Notification requirements

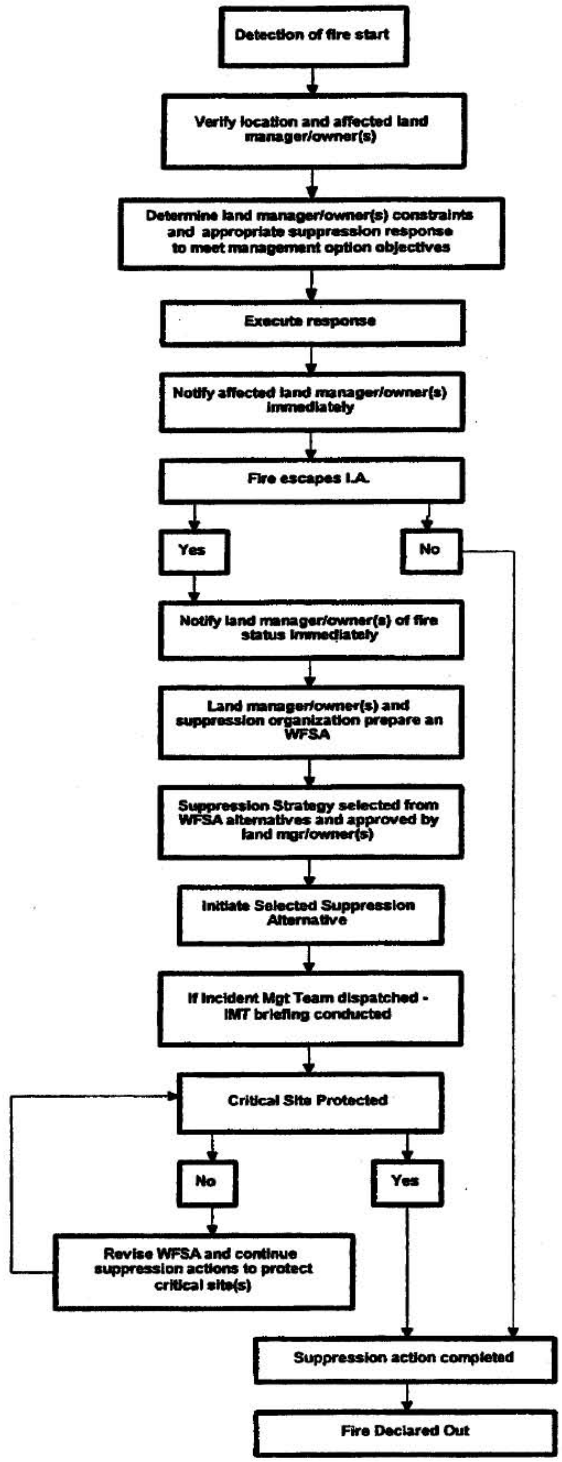
1) Land manager/owner(s) will be contacted immediately when fire threatens a critical site.

2) When a fire escapes initial attack the affected land manager/owner(s) will be contacted immediately.

D. Escaped Fire The completion of the WFSA report is required if a fire escapes initial attack.

Figure 4

OPERATIONAL DECISION CHART FOR FIRES WITHIN OR IMMEDIATELY THREATENING CRITICAL MANAGEMENT SITES



Full Management Option

Intent

This option was established for the protection of cultural and historical sites, uninhabited private property, natural resource high-value areas, and other high-value areas that do not involve the protection of human life, and inhabited property. Either broad areas or specific sites within a lower management option may be designated as Full Management.

Policy

Fires occurring within or immediately threatening this designation will receive aggressive initial attack dependent upon the availability of suppression resources.

Objective

1. Control all wildland fires occurring within this management option at the smallest acreage reasonably possible on initial attack without compromising fire fighter safety.

2. Protect sites or areas designated as Full management from the spread of wildland fires burning in a lower priority management option.

3. Minimize damage from wildland fires to the resources identified for protection within the Full management designation commensurate with values at risk.

Operational considerations

1. Only wildland fires within or threatening a critical management area receive a higher priority for allocation of suppression resources.

2. Suppression tactics are selected after balancing suppression costs with the values identified for protection.

3. Structures on or eligible for inclusion on the National Register of Historic Places and non-structural sites on the National Register are placed within this category (Appendix D.).

4. Suppression activities must be coordinated with land manager/owner(s) to develop tactical responses in sensitive areas, including cultural resource sites being excavated (Appendix D.).

Operational procedures

1. Operations

   A. Detection

      Lands designated in this management option will receive the maximum detection coverage available.

   B. Suppression response

      1) Aggressively initial attack all fires occurring within or immediately threatening full management areas with available forces.

2) The decision chart (Figure 5) describes the appropriate procedures and course of action for both the suppression organization and the land manager/owner(s).

3) Wildland fires occurring within or immediately threatening a full management area will receive priority for the allocation of initial attack resources after the protection of critical management area/site(s).

4) The suppression organization in conjunction with the affected land manager/owner(s) will determine the appropriate suppression action on fires that did not receive immediate initial attack and have grown beyond initial attack capabilities through the WFSA process.

C. Notification requirements

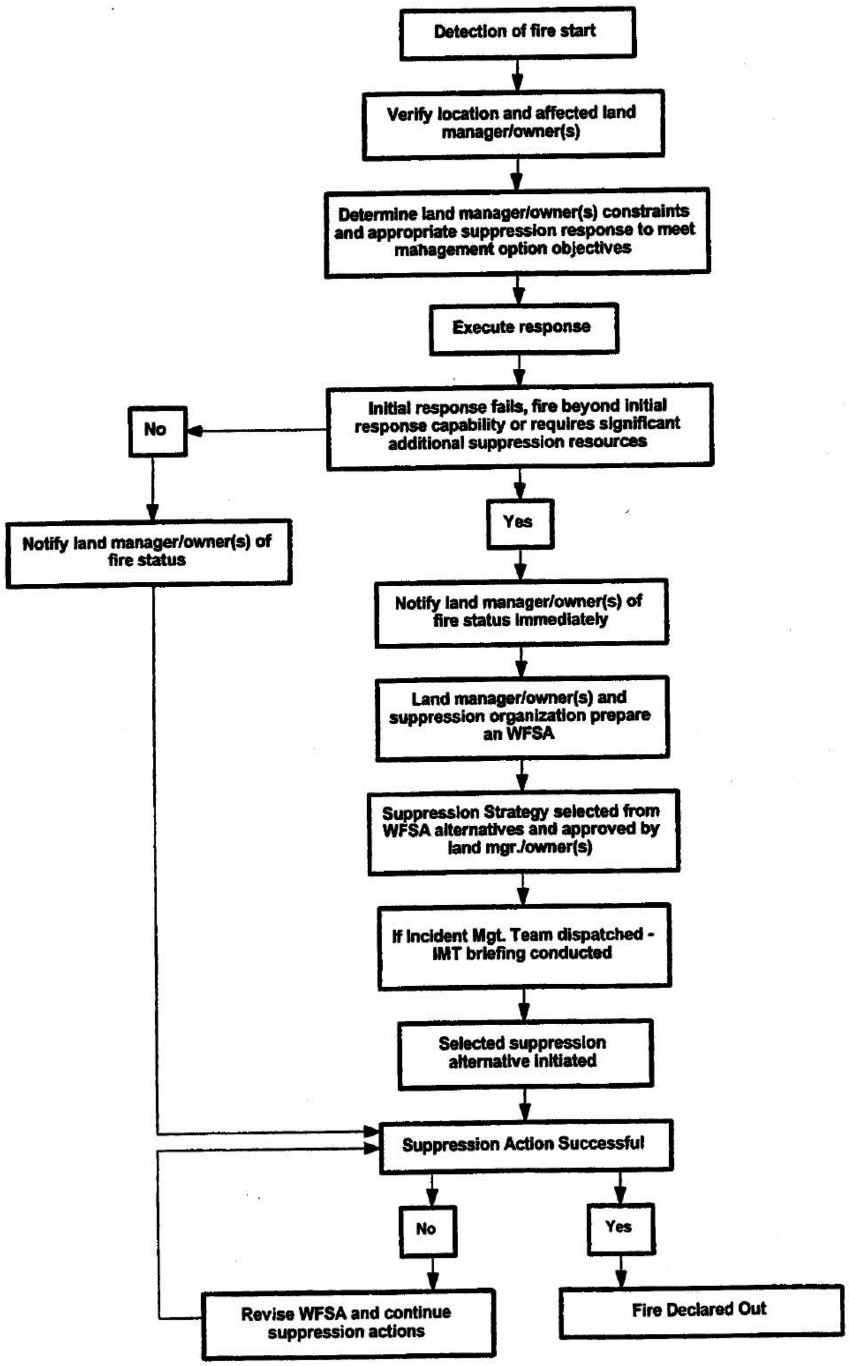
1) On wildland fires where initial attack is successful, the fire suppression organization will notify the affected land manager/owner(s) of these fires through normal briefing procedures.

2) If initial attack is not possible or when a wildland fire escapes initial attack and requires continued suppression efforts, the affected land manager/owner(s) will be contacted promptly.

D. Escaped Fire. The completion of the WFSA report is required if a fire escapes initial response, requires a significant change in suppression strategy or if suppression response is delayed beyond 24 hours from discovery.

Figure 5

OPERATIONAL DECISION CHART
FOR
FIRES WITHIN OR IMMEDIATELY THREATENING
FULL MANAGEMENT OPTION



Limited Management Option

Intent

This category recognizes areas where the cost of suppression may exceed the value of the resources to be protected, the environmental impacts of fire suppression activities may have more negative impacts on the resources than the effects of the fire, or the exclusion of fire may be detrimental to the fire dependent ecosystem. The Limited management option reduces both long-term suppression risks and costs by reducing the frequency of large fires that may burn out of boundaries of Limited management regardless of the suppression effort. It also reduces current suppression costs and makes suppression goals more attainable in years of drought and intense fire activity. The Limited management option may also be chosen for areas where fire occurrence is essential to the biodiversity of the resources protected and the long-term ecological health of the land. Suppression actions may be initiated to keep a fire within the boundary of the management option or to protect identified higher value areas/sites. Site-specific areas that warrant higher levels of protection may occur within limited management areas. Appropriate suppression actions to protect these sites will be taken when warranted, without compromising the intent of the limited management area.

Policy

Wildland fires occurring within this designation will be allowed to burn under the influence of natural forces within predetermined areas while continuing protection of human life and site-specific values within the management option. Generally this designation receives the lowest priority for allocations of initial attack resources; however, surveillance may be a high priority.

Objectives

1. Within land manager/owner(s) policy constraints, accomplish land and resource management objectives through the use of wildland fire while protecting identified values.
2. Reduce overall suppression costs through minimum resource commitment without compromising firefighter safety.
3. Prevent fires from burning out of the management area to protect human life and identified resources while ensuring that suppression costs and associated environmental impacts of suppression actions are commensurate with the potential damage to values to be protected.
4. Use low impact suppression tools and tactics whenever possible.

Operational considerations

1. Conduct periodic surveillance of fires within the management option to evaluate threats to sites assigned higher management levels, and assess the potential for escape from the Limited management area. Surveillance also provides land manager/owner(s) and suppression organizations with information on fire behavior, environmental conditions, fire weather, actual and potential fire growth to assist with management decisions and provide accurate information to the general public.
2. An immediate threat from a wildland fire in Limited to Critical, Full or Modified (before conversion date) management areas may receive an initial attack response if suppression forces are available. The land manager/owner(s) will be notified immediately, preferably before actions are taken, but actions will not be delayed for notification due to the imminent threat. The reasons for the action will be documented in writing, provided to the land manager/owner(s), and maintained in the fire record.
3. When a suppression action other than surveillance is needed because of a potential long-term threat to a higher management option, the fire suppression organization and the affected and adjacent land manager/owner(s) will jointly prepare a WFSA. The selected suppression alternative must be approved by land manager/owner(s).
4. Unless designated for protection by the land manager/owner, abandoned structures that are not eligible for

inclusion on the National Register of Historic Places will be given the same level of protection as the surrounding lands (Appendix D.).

Operational procedures

1. Operations

A. Detection

Designated lands will receive detection effort commensurate with available detection resources and fire conditions. Additional detection will be provided when requested by individual agencies consistent with availability of detection resources and conditions.

B. Suppression response

1) The decision chart (Figure 6) describes the appropriate procedures and course of action for both the suppression organization and the land manager/owner(s).
2) If a suppression action in the Limited management option is necessary, low impact or indirect suppression methods will be used wherever possible.

3) Suppression responses on fires within the Limited management option will receive the priority for allocation of resources equivalent to the standard of protection given to the area/site to be protected. For example, if an action on a fire within the Limited management option is an attempt to keep the fire from burning into a Full management area, the priority for suppression resources allocation should be commensurate with that given to a full management area.

C. Notification requirements

1) The land manager/owner(s) will be notified through normal briefing procedures of all wildland fires detected and their subsequent status.

2) If a wildland fire threatens to burn out of the option boundary or requires a suppression action, the land manager/owner(s) will be contacted immediately.

D. Surveillance

1) The fire suppression organization will maintain the surveillance responsibilities on wildland fires while they are burning. Joint surveillance may be conducted when situations warrant or the land manager/owner(s) wishes to implement their own surveillance/fire effects monitoring procedures.
2) Any flights within the vicinity of an active fire, particularly fires with ongoing suppression actions, should be coordinated with the appropriate fire suppression dispatch office.

3) Routine surveillance will be performed and documented until resources are dispatched or the fire is declared out. Surveillance frequency will be determined by the suppression organization or in coordination with land manager/owner(s). This information will be used to update or revise the WFSA when necessary.

4) Surveillance responsibilities include:

a. 1-3 day weather forecast.

b. A local area weather summary including precipitation, drought indices, and fire danger indices.

c. A map of the fire which may include the following: fire perimeter, location, topography, fuel type(s), natural barrier locations and areas of special concern such as potential threats to higher management options or other resources requiring protection.

d. Fire behavior, including estimated rate of forward spread, direction of spread, estimated flame lengths, description of fire (i.e., crowning, ground fire, surface fire), and spotting activity (including distance).

e. Smoke behavior, including estimated plume height and direction of movement.

f. General weather forecast.

5) Projection of fire perimeter

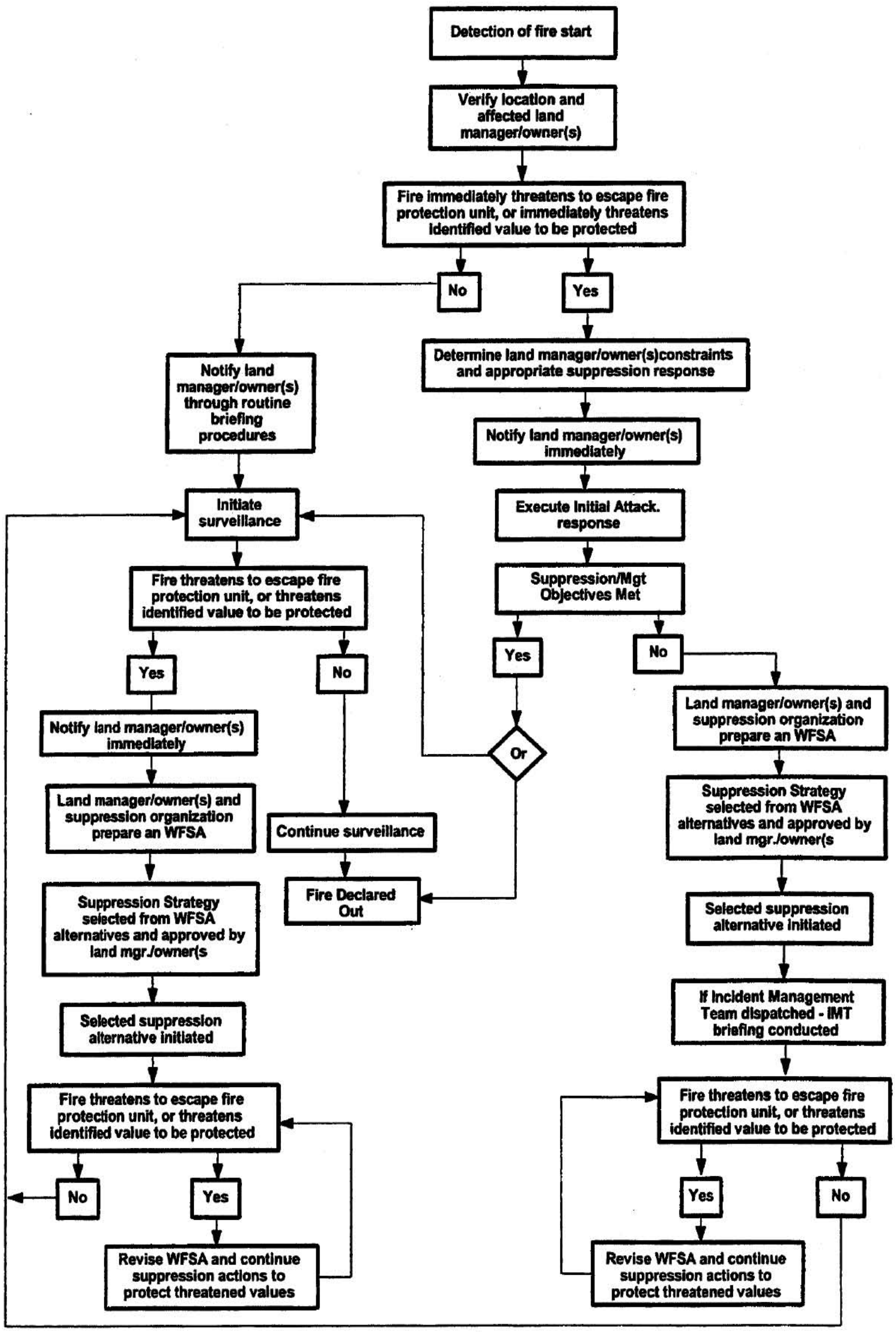
a. Information obtained from the suppression organization and the fire site may be used to predict the fire perimeter at the close of the next 24-hour period if requested by land manager/owner(s). Using this information the land manager/owner(s) and the fire suppression organization will determine if a WFSA should be prepared to determine an appropriate suppression in response to changing conditions.

b. Information and analysis will be documented to provide a chronological administrative history of the fire.

E. Escaped Fire. A WFSA will be completed if a wildland fire threatens to cross the Limited management boundary and requires a suppression response (excluding Operational Considerations 2.), or a significant change in suppression strategy is needed.

Figure 6

OPERATIONAL DECISION CHART
FOR
LIMITED MANAGEMENT OPTION



Modified Management Option

Intent

The Modified management option is intended to be the most flexible option available to land managers/owners. The intent of the Modified management option is to provide a higher level of protection when fire danger is high, probability of significant fire growth is high, and probability of containment is low. A lower level of protection is provided when fire danger decreases, potential for fire growth decreases and the probability of containment increases. This option should reduce commitment of suppression resources when risks are low. This option also provides increased flexibility in the selection of suppression strategies when risks are high. The Modified option provides a management level between Full and Limited. Unlike Full management areas, the intent is not to minimize burned acres, but to balance acres burned with suppression costs and to accomplish land and resource management objectives. As stated in the original Alaska Interagency Fire Management Plan, Tanana/Minchumina Planning Area, "Lands placed in this category will usually be suited to indirect attack." The essential elements of this option are the evaluation and conversion dates, described below, and the WFSA process.

Evaluation and Conversion Dates

Standardized evaluation dates will be established for the Modified Management option areas based on an assessment of the values to be protected and the historical seasonal fire occurrence. Evaluation dates serve as guidelines and are intended to be flexible enough to adjust suppression actions when weather conditions or fire activity appreciably change. The evaluation dates will be recorded on the map atlases.

The AWFCG is responsible for the adjustment, either later or earlier to the evaluation/conversion date for Modified management option areas. An individual may request, through an AWFCG representative, that the AWFCG consider an earlier evaluation date during unusually wet fire seasons or postpone the evaluation date during unusually dry fire seasons. The individual desiring the change must inform land manager/owners potentially affected by the proposed change and solicit their opinion. The Area Forester/Zone FMO may facilitate this process. The individual must provide the AWFCG representative a written rationale with supporting data for the change as well as the opinions of affected land manager/owners. The written rationale and supporting data will be included with the AWFCG decision record. If the conversion date is postponed, the AWFCG will reconsider a new evaluation date at intervals no longer than 10-days until conversion takes place. Unless altered by the AWFCG, the evaluation date becomes the conversion date and the Modified management option automatically converts to Limited management option.

If the AWFCG decides to convert the Modified management option area(s), the changes are communicated in writing to land manager/owner(s) and suppression organizations through their AWFCG representatives and to the general public through media releases coordinated through the Alaska Incident Coordination Center (AICC).

Policy

Fires occurring within this designation, before the conversion date, will receive initial attack, dependent upon availability of suppression resources, unless otherwise directed by the land manager/owner(s) and documented by a WFSA. After the conversion date, the default action for all fires occurring within the Modified management option areas will be routine surveillance to ensure that identified values are protected and that adjacent higher priority management areas are not compromised. Critical and Full management areas are higher priorities for suppression resources than Modified management areas.

Objectives

1. Reduce overall suppression costs with minimum resource commitment without compromising firefighter safety.

2. Within land manager/owner policy constraints, provide opportunities for wildland fire to help achieve land and resource management objectives.

Operational Considerations Before Conversion Date

1. If a wildland fire escapes initial attack, the fire suppression organization and the manager/owner will prepare a WFSA to determine the appropriate suppression response.

2. Suppression tactics are selected based upon balancing of suppression costs with values identified for protection and to accomplish land and resource management objectives.

3. Evaluation dates will be identified on the map atlas.

4. Unless designated for protection by the land manager/owner, abandoned structures that are not eligible for inclusion on the National Register of Historic Places will be given the same level of protection as the surrounding lands (Appendix D.).

Operational Considerations After Conversion Date

1. An immediate threat from a fire in Modified to an area in Critical or Full management option will receive an initial attack response if suppression forces are available. The land manager/owner(s) will be notified immediately, preferably before actions are taken. Actions, however, will not be delayed for notification due to the imminent threat. The reasons for the action will be documented in writing, maintained in the fire record and identified in the situation report.

2. Unless designated for protection by the land manager/owner, abandoned structures that are not eligible for inclusion on the National Register of Historic Places will be given the same level of protection as the surrounding lands (Appendix D.).

Operational procedures

1. Operations

   A. Detection

      Before the conversion date, designated lands will receive detection coverage with available detection resources.

   B. Suppression response

1) The decision chart (Figure 7) describes the appropriate procedure and course of action for both the suppression organization and the land manager/owner(s).
2) Before the conversion date, all wildland fires will receive initial attack with available resources. Fire containment is the primary objective.
3) Fires occurring within a Modified management area will receive priority for allocation of initial attack resources after the protection of Critical management site(s) and Full management areas from existing fires or new starts anticipated imminently in Critical or Full management areas.
    4) The suppression organization, in conjunction with the affected land manager/owner will determine, through the WFSA process, the appropriate suppression action on fires that did not receive immediate initial attack and have grown to a size that initial attack is not feasible.

5) Any suppression action that is under way when the conversion date is reached may continue to completion with the approval of the land manager/owner(s).

C. Notification requirements

1) On wildland fires where initial attack is successful, the fire suppression organization will notify the affected land manager/owner(s) of these fires through normal briefing procedures.
2) When a wildland fire escapes initial attack and requires continued suppression efforts or if initial attack cannot be initiated, the affected land manager/owner(s) will be contacted immediately.

3) The land manager/owner(s) will be notified immediately if suppression actions are initiated after the conversion date, otherwise the status of the wildland fires will be communicated through usual briefing procedures.

D. Surveillance

See Surveillance section (page 25) in the Limited Management Option.

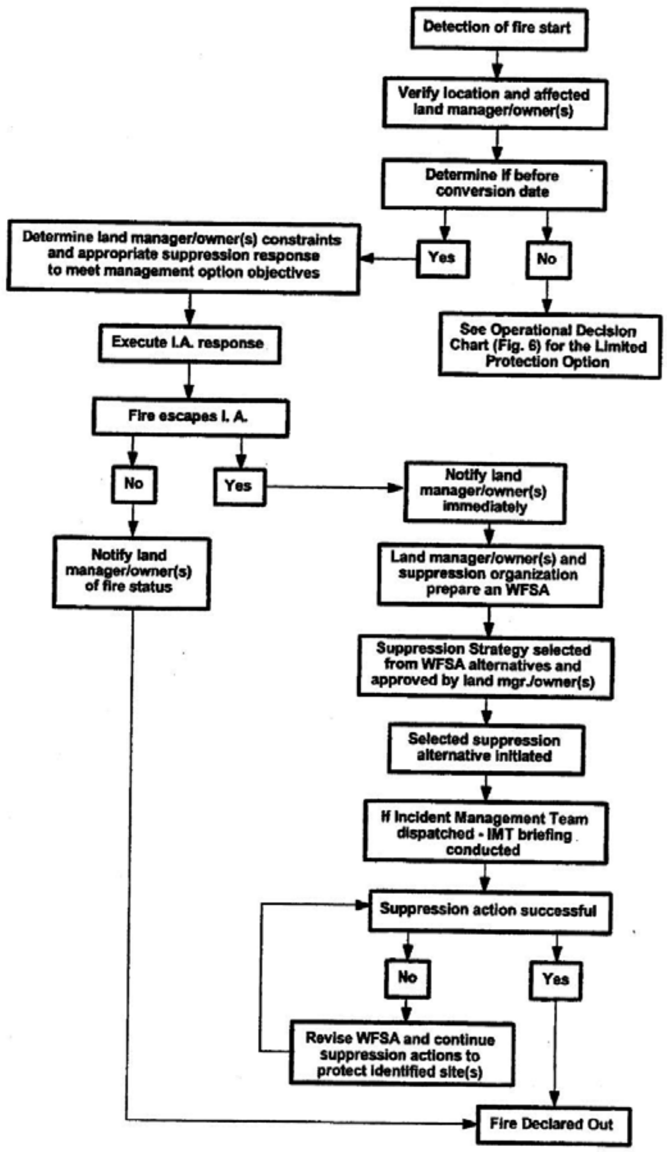
Figure 7

OPERATIONAL DECISION CHART

FOR

FIRE WITHIN OR IMMEDIATELY THREATENING

MODIFIED MANAGEMENT OPTION



NON-STANDARD RESPONSES TO SELECTED MANAGEMENT OPTIONS

The four fire management options address a high percentage of wildland fire situations that occur in Alaska. On rare occasions, however, situations arise where non-standard responses to the selected management options are prudent and justifiable. All non-standard responses that occur will be reviewed at the annual fall fire review.

Individual Fire Response

- Land manager/owner(s) may authorize the suppression organization to provide an increased level of suppression on a fire regardless of the fire management option. Examples of the reasons for such an authorization are the amount of acreage that has already burned that year in a particular geographic area or the number of fires already burning in a particular administrative unit. The Decision Criteria Record (Appendix E., page 53) will be completed to document the rationale for increased suppression response and the action taken. The Decision Criteria Record must be completed immediately and placed in the fire record. The written record of this authorization must satisfy federal wildland fire policy documentation and timeframe requirements if federal/native lands or federal suppression organizations are involved. When a suppression action other than that of the selected management option is authorized by a land manager/owner the selected fire management option area must be re-evaluated during the next annual review period.
- A land manager/owner(s) may authorize the suppression organization to take a suppression action that is less than the pre-identified fire management option. The Decision Criteria Record will be completed to authorize a reduced suppression response within a Critical management option area, Full management option area, or a Modified management option area prior to the date of conversion. The Decision Criteria Record (Appendix E., page 53) must be completed immediately and placed in the fire record. The written record of this authorization must satisfy federal wildland fire policy documentation and timeframe requirements if federal/native lands or federal suppression organizations are involved. If the suppression organization does not concur with the request for reduced suppression response, their concerns will be documented in writing and included in the fire record within the identified timeframes. When a suppression action other than that of the selected management option is authorized by a land manager/owner the selected fire management option area must be re-evaluated during the next annual review period.

Geographic Area Response

- A statewide Multi-Agency Coordinating (MAC) group may be convened to implement a temporary change from the selected management options for a specific geographic area(s) during periods of unusual fire conditions (e.g., numerous fires, predicted drying trends, smoke problems, unusually wet conditions or suppression resource shortages). This does not include adjustment of the evaluation/conversion date for Modified management option levels. Past actions have included discretionary suppression of all new starts regardless of fire management options. These departures usually do not apply statewide but to specific regions of the state.

- An individual may request a temporary management option change for a specific geographic area through a representative on the MAC group. The individual desiring the change must inform manager/owners potentially affected of the proposed change and solicit their opinion. The Area Forester/Zone FMO may facilitate this process. The individual requesting the change must provide to the MAC group representative a written rationale with supporting data for the change as well as the opinions of affected land manager/owners. The written rationale and supporting data will be included with the MAC group decision record.

- The changes are communicated in writing to land manager/owner(s) and suppression organizations through their MAC group representatives and to the general public through media releases.

WILDLAND FIRE SITUATION ANALYSIS

The Wildland Fire Situation Analysis (WFSA) is a systematic and documented decision process employed to determine the most appropriate suppression strategy for a particular situation. A WFSA is prepared when a fire: (1) escapes initial attack, (2) threatens to escape a fire management option into a higher management option, (3) warrants suppression actions but was not initial attacked 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.

A WFSA is jointly prepared by the land manager/owner(s) and suppression organization. The land manager/owner(s) approves the WFSA and any revisions with concurrence of the suppression organization. It is incumbent upon both the land manager/owner(s) and the suppression organization ensures that knowledgeable and qualified representatives are available to assist with preparing and reviewing the WFSA.

A WFSA identifies several alternative suppression strategies/actions within the constraints of the selected management option, which may range from commitment of resources until a fire is extinguished to routine surveillance. The alternatives are analyzed in terms of probability of success, environmental consequences, social and political considerations, consequences of failure and cost. The selected suppression alternative must clearly identify the suppression objectives. The assigned Incident Commander and the land manager/owner(s) must validate the WFSA to insure that the selected alternative is still achievable. When the selected alternative or fire/resource management objectives are not met, the WFSA must be re-written to determine new suppression strategy/action.

Escaped wildland fires may be placed under the management control of an appropriate level Incident Commander. Transfer of authority to the Incident Commander must be documented in a Limited Delegation of Authority. The need to place a land manager/owner's representative at the Incident Command Post (ICP) or the suppression organization's headquarters will be at either the discretion of the affected agency or owner or at the request of the suppression organization. An environmental and/or cultural resource management specialist may be assigned to the Incident Management Team to provide on-site assessment of potential resource impacts. Each agency will furnish expertise as needed.

LIMITED DELEGATION OF AUTHORITY

The Limited Delegation of Authority transfers authority for suppression actions to the Incident Management Team (IMT). An IMT may assume the authority to manage suppression actions only after receiving the Limited Delegation of Authority.

The Limited Delegation of Authority is part of the briefing package provided to the incoming IMT by the organization that initiated the suppression action on the fire and/or the land manager/owner(s). The authorization may include: (1) suppression standards or guidelines, (2) air operation guidelines, (3) personnel work/rest guidelines, (4) monetary guidelines, (5) extraordinary fire situation, strategies and critical values and indicators to assist with identifying and responding to extreme fire conditions or events, (6) incident status reporting, rehabilitation standards, and release of incident management, and (7) initial attack authority for new fire starts within a designated radius of the fire.

SURVEILLANCE PROCEDURES

The plan specifies that fires in Limited management areas, and in Modified management areas after the conversion to Limited management option receive routine surveillance. Surveillance is defined as the "systematic process of collecting, recording or mapping the fuels, topography, weather, fire behavior, and location of values to be protected to provide suppression agencies or land manager/owner(s) the information necessary to make the appropriate suppression action decisions on a wildland fire." Surveillance is generally conducted from aerial observations. The information also provides a chronological administrative history of the fire and suppression decisions.

Monitoring is defined as the "systematic process of collecting, recording and mapping of fuels, topography, weather, fire behavior, and fire effects data to provide a basis for evaluating and adjusting wildland fire management programs." Monitoring generally requires both on-the-ground and aerial observations. Although monitoring is usually associated with prescribed fire, land manager/owner(s) may elect to use agency personnel to collect fire effects monitoring data to assess the ecological impacts of the wildland fire.

Basic surveillance procedures and responsibilities are described under the Limited management option section.

MAP ATLAS

The map atlas is the official record of management boundaries, values to be protected or enhanced, and sensitive resource areas to be avoided during suppression actions. The atlas assists suppression organizations and land manager/owner(s) during suppression strategy development and suppression actions. The map atlas is comprised of 1:63,360 scale maps for the planning area (1:250,000 scale maps are used when 1:63,360 scale maps are not available).

The recorded information includes, but is not limited to: (1) fire management boundaries, (2) Native allotments, (3) natural and cultural resources to be protected or receive special consideration during suppression activities, (4) human developments, (5) threatened or endangered species, (6) transportation/ utility facilities and corridors, (7) sensitive areas or hazards to avoid during suppression actions, and (8) evaluation dates for Modified management option areas.   The land manager/owner(s) are responsible for providing the fire suppression organizations with up-to-date, accurate information on natural and cultural resources, land status changes, and changes in human-use patterns and developments. The map atlas is reviewed and updated annually.

FIRE MANAGEMENT OPTION REVISIONS

The land manager/owner(s) determines the fire management option for the lands under their jurisdiction or ownership. An essential attribute of the fire planning effort in Alaska is providing the land manager/owner(s) with the flexibility to change the fire management option for lands they manage/own as warranted due to changes in land use, protection needs, laws, mandates or policies. The suppression organizations are encouraged to suggest option changes to land manager/owners based upon suppression concerns.

To accommodate changes in the map atlas and distribution of maps, land manager/owner(s) are encouraged to make changes in their selected fire management option boundaries between September 30 and March 1. All changes should be recorded on the map atlas by April 1. Fire management options boundaries should not be changed during the fire season. However, if a change of the selected management option is requested and can be accommodated by all affected land manager/owner(s) and the suppression organization it may be accepted and recorded on the Map Atlas outside the aforementioned time period.

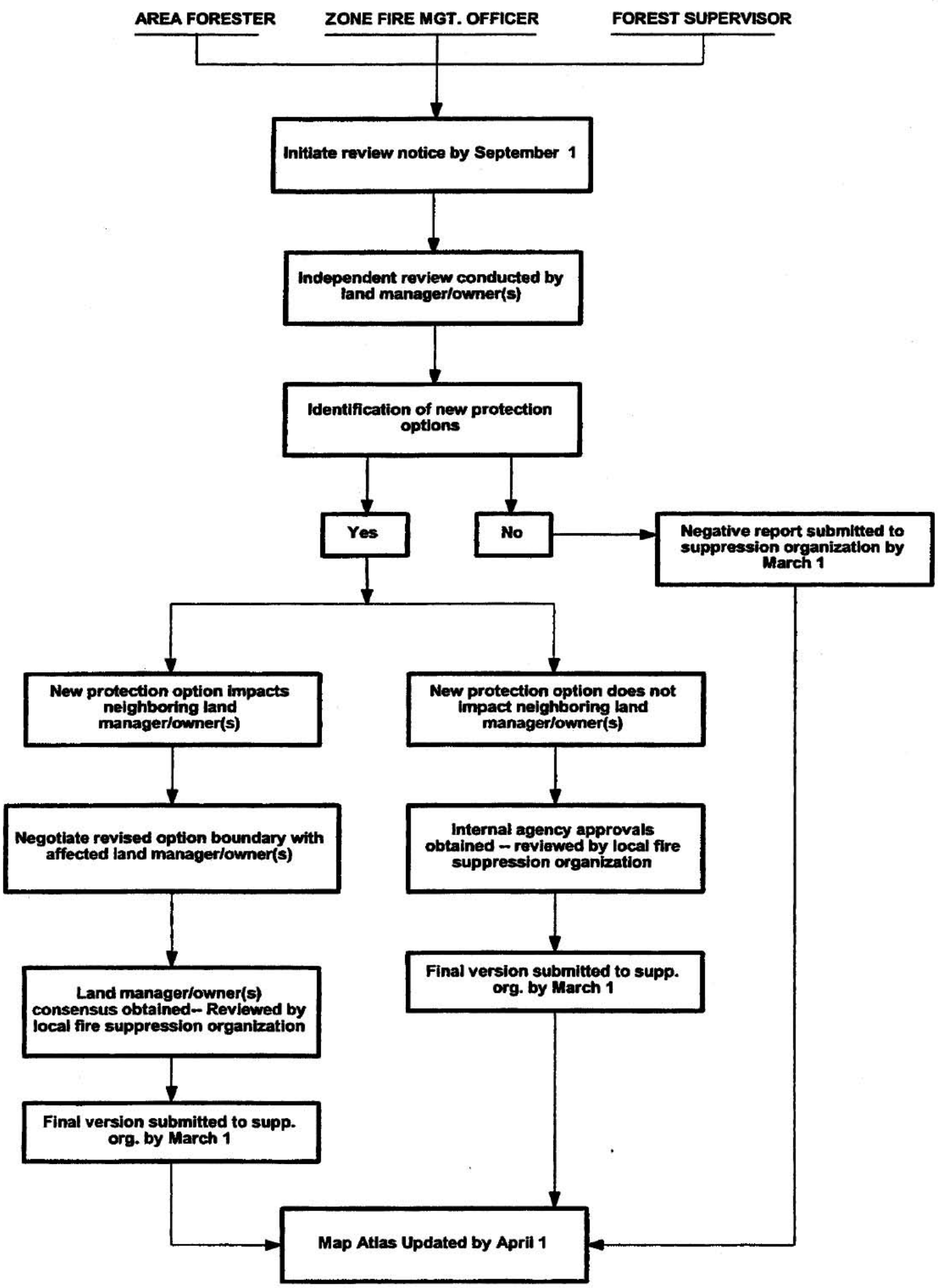
Any changes proposed by a land manager/owner will be provided to all adjacent and affected land manager/owner(s) and resource management agencies. Consensus on a proposed fire management option boundary change should be attempted to minimize creating boundaries that reflect administrative units or boundaries that are not operationally or ecologically feasible. The proposed management option boundary change will also be evaluated by the suppression organization to determine if the change is operationally feasible. The AICC should serve eventually as the central repository for map atlas information.

ANNUAL FIRE SUPPRESSION PROGRAM REVIEW

At the end of each fire season an interagency review of the fire plan implementation and fire suppression operations is held with fire suppression personnel and land manager/owner(s). Land manager/owner(s) and fire suppression personnel are given the opportunity to identify plan implementation problems and operational concerns.

Land manager/owner(s) should evaluate how the suppression organizations responded to the selected fire management options. Instances where actions other than the selected fire management option were initiated will be re-evaluated to determine if the selected fire management option is appropriate. If the land manager/owner(s) determine that an option change is necessary, they will request the change to the local fire suppression organization through the fire management option revision process.

Figure 8
FIRE MANAGEMENT OPTION SUGGESTED REVIEW PROCESS AND TIMEFRAMES



FIRE SUPPRESSION CONSTRAINTS

The following is a compilation of general constraints on the use of fire suppression tools and tactics identified by land manager/owner(s). They are provided to the suppression organizations as general guidelines during suppression activities. Land manager/owners should be contacted for specific details. Additional constraints on the use of suppression tools are at the discretion of the land manager/owner(s) and are documented in a WFSA, Limited Delegation of Authority, or in local agency-specific fire management plans.

1. To the extent possible, minimum impact suppression tactics (MIST) should be used. Fireline will be constructed in a manner that minimizes erosion and will follow natural contours wherever possible. Indirect attack will be used to the extent practical. A fireline rehabilitation plan, as approved by the land manager/owner, must be completed before the final demobilization occurs.

2. The use of tracked or off-road vehicles (for example, bulldozers or all-terrain vehicles) and fireline explosives requires written authorization by the land manager/owner(s) on a case-by-case basis prior to use.

3. Application of aerial fire retardant near lakes, wetlands, streams, rivers, and sources of human water consumption or areas adjacent to water sources should be avoided.

4. Base camps, spike camps, helispots and other support areas should be located in natural clearings if possible. The construction of helispots should be minimized. Any opening created for support areas will be cut with an irregular perimeter. Such areas will be kept clean so as not to attract animals and will be cleaned up before departure of the last suppression personnel.

5. Support areas such as camps, staging areas, and helibases will not be located on Native allotments or any resources used on or removed from a Native allotment (e.g., firewood) without an approved agreement. The local tribal organization or the BIA may prepare the agreement.

6. Flight patterns and suppression activities will be restricted around designated Avoid areas such as peregrine falcon nesting areas, threatened or endangered species, or sensitive sites identified by land manager/owner(s).

7. Suppression activities must not be conducted on identified non-structural cultural resource sites, including sites being excavated.

ALASKA INTERAGENCY WILDLAND FIRE MANAGEMENT PLAN OVERSIGHT

The AWFCG is responsible for the management, amendment and revision of the Alaska Interagency Wildland Fire Management Plan. The AWFCG will review the AIWFMP annually and determine if amendment or revision is appropriate. Proposed changes to the AIWFMP will be submitted to AWFCG in writing with a rationale for the proposed change(s). Proposed changes should be submitted through the agency or owner AWFCG representative. It is the responsibility of the agency or owner representative to communicate the status or AWFCG decision concerning the proposed change(s). Amendments to the AIWFMP will be reviewed by the AWFCG representatives with recommended changes submitted for approval by the Agency/Land Owner Administrators who are represented on the AWFCG.

AIR QUALITY/SMOKE MANAGEMENT

The Alaska Department of Environmental Conservation (ADEC) is the regulatory agency responsible for air quality and smoke management on both state and federal lands in Alaska. Prescribed burns, other than burning to combat a wildland fire, requires written approval from the department. ADEC is also responsible for declaring air episodes and issuing air quality advisories, as appropriate, during periods of poor air quality of inadequate dispersion conditions. The Alaska Interagency Coordination Center (AICC) is notified of any advisories or declarations.

ADEC is represented on the Alaska Wildland Fire Coordinating Group. During periods of wildland fire activity the Multi-Agency Coordinating (MAC) group addresses air quality and smoke management issues. Press releases with recommended actions that individuals can take to protect their health will be issued by ADEC, in coordination with the MAC group.

Concerns about public health related to air quality and visibility are considered in actions taken within all fire management option areas. Incident Commanders, suppression organizations and land manager/owner(s) of ongoing fires consider smoke and its affects in selection and implementation of suppression strategies including, if necessary, the evacuation of individuals if health concerns arise. Air quality and visibility impacts are also considered during the preparation of the Wildland Fire Situation Analysis and the selection of the appropriate suppression strategy. During periods of extensive fire activity the MAC group in conjunction with ADEC may determine that new fire starts will be suppressed due to smoke and air quality concerns regardless of fire management options.

Smoke and other air quality impacts must be considered when making fire management decisions. Fires emit small particles, organic vapors, carbon monoxide, carbon dioxide, and water vapor. The quantity and type of combustion products is dependent on the amount and type of fuel burned, the amount of air (oxygen) around the fuel, and the combustion temperature. Fires with insufficient oxygen produce relatively large amounts of particles, organic vapors, and carbon monoxide. "Cool" burning fires also produce relatively large amounts of these pollutants.

As these compounds are emitted, they disperse in the surrounding air and are carried off by the wind. The concentration of these products in surrounding areas is basically dependent on the quantity emitted, wind direction, wind speed, ambient temperatures, and inversion layers. A low inversion layer keeps combustion products close to the ground, rather than allowing them to be carried to the upper atmosphere. The pollutants will continue to accumulate under the inversion, until the inversion lifts.

Some of the products emitted from a forest/brush fire can cause health problems. The most apparent problem is related to short-term exposure to respirable particles (smoke). People with lung diseases (e.g., asthma or bronchitis) are especially sensitive to smoke. ADEC receives several health-related complaints each fire season. Some individuals have been hospitalized with smoke-induced problems. In some parts of the United States large fires have caused the carbon monoxide concentration in nearby towns to reach unhealthy levels. Some of the combustion products are probable or known carcinogens. While long-term effects have not been documented, repeated or continuous exposure to combustion products may contribute to the development of chronic diseases. The effect of smoke on human health is a function of the concentration of pollutants and the duration and number of exposures. Obviously, firefighters are the individuals most susceptible to acute and chronic health problems due to their extensive exposure to smoke.

The smoke produced by burning vegetative fuels may also temporarily interfere with air and surface travel. Visibility along roads can be reduced to hundreds of feet in the vicinity of a fire. Aircraft operations can be affected if smoke reduces visibility to less than six miles.

Data from the Alaska interior indicate that smoke conditions severe enough to impact aircraft operations is typically limited to a few occasions annually (Barney, R.J. and E.R. Berglund, 1974). Occurrences of "heavy smoke" range from an average of six days per year at Tanana to two days per year at McGrath. When heavy smoke is present, visibility exceeds the minimum visual flight rules (VFR) 60 percent of the time for aircraft within a control zone airspace. For aircraft outside of a control zone airspace, visibility exceeds VFR minimums 85 percent of the time.

PRESCRIBED FIRE

Prescribed fire is defined as: "Any fire ignited by management actions to meet specific objectives." A written, approved prescribed fire plan must exist, and NEPA requirements (agency dependent) must be met, prior to ignition. Prescribed fires in Alaska are used for a variety of purposes including: (1) fuel reduction to protect structures and developments, (2) fuel reduction to strengthen fire management area boundaries, (3) resource management, and (4) reintroduction of fire into areas were fire has been excluded or to simulate natural fire frequency. Although the use of prescribed fire has not been widespread, interest is increasing and an interagency prescribed fire working group has been formed.

Policies and procedures for prescribed fires are agency specific. Interagency sharing of expertise, resources, and personnel for prescribed fire is encouraged.

Locations where the Alaska Interagency Wildland Fire Management Plan and Area Specific Interagency Fire Management Plans are Available for Review

Alaska Resource Library & University of Alaska, Fairbanks
Information Services Elmer E. Rasmuson Library
3150 C Street, Suite 100 310 Tanana Drive
Anchorage, AK 99513-7589 Fairbanks, AK 99775

Alaska Fire Service Bureau of Land Management
P.O. Box 35005 Alaska State Office
Ft. Wainwright, AK 99703 222 W. 7th Avenue, #13
Anchorage, AK 99513-7599

Bureau of Indian Affairs National Park Service
Fire Management, Education & Ranger Activities
1675 C Street, Suite 223 2525 Gambell, Room 306
Anchorage, AK 99501-5198 Anchorage, AK 95503

Department of Natural Resources State & Private Forestry
Division of Forestry USDA Forest Service
550 W. 7th Avenue, Suite 1450 3301 C Street, Suite 1058
Anchorage, AK 99503 Anchorage, AK 99503-3956

Department of Natural Resources US Fish & Wildlife Service
Division of Forestry Fire Management
Fairbanks Area Office 1011 Tudor Road
3700 Airport Way Anchorage, AK 99503
Fairbanks, AK 99709-4699

INTERAGENCY MAP ATLAS LEGEND

The map atlas legend symbols were standardized to insure that the same symbols were used for all mapping. The symbols are used to identify five broad categories of information and specific suppression standards for sensitive features. The symbols were chosen to be compatible with the digitizing/computer graphics system.

FIRE MANAGEMENT OPTION BOUNDARY LINES

Large capital letter symbols are used to designate each of the four management options: Critical (C), Full (F), Modified (M), and Limited (L). These should be placed along the appropriate side of the boundary lines frequently enough to insure that the dispatchers and users of the plan remain oriented correctly.

C F M L

EVALUATION DATES FOR MODIFIED AREAS

The initial evaluation dates for Modified management areas will be noted on the map atlas.

ALL STRUCTURES (including historically significant structures)

A small point designator symbol (✡) is to be placed on the structure site. A small letter qualifier symbol is to be placed next to the point designator to specify what level of suppression the structure requires.

C CRITICAL
F FULL
N NOT SENSITIVE (given the same protection as surrounding lands)

CULTURAL/HISTORIC/ARCHEOLOGICAL RESOURCES (NOT INCLUDING STRUCTURES)

The symbol (☾) is the best point designator for these resources. Use the small letter qualifiers next to the point symbol to define activity level.

C CRITICAL
F FULL
A AVOID

THREATENED AND ENDANGERED SPECIES

The symbol () is the point designator for these resources**.**

F FULL
A AVOID

PROTECTION OF CULTURAL RESOURCE VALUES FROM WILDLAND FIRE

The interagency wildland fire planning process recognized management requirements for cultural and historic resources pursuant to CFR 36 Sec. 800(a) for non site-specific areas, and 800.8(a)(3) for programs designed to further preservation and enhancement of National Register or eligible properties.

Implementation of final decisions will result in a higher level of protection for cultural resources than is currently provided. Specific objectives to be accomplished are:

1. Cultural values needing protection will be identified and mapped.

2. Cultural resources will be given a relatively high value rating as compared to other resource concerns.

<u>Background</u>

Fire is recognized as a normal feature of the natural history in many areas. The evolutionary development of plants and animals has occurred in a natural system where fire was a part of the environment. Human occupation of any area was also subjected to the natural fire regime as well as the increase in fire occurrence due to human activity. In Alaska, the natural national fire regime is characterized by having a return interval of 50 to 200 years, depending on the cover type and location under consideration.

The natural fire cycle has implications for cultural resources: Sites in excess of 200 years old are likely to have been burned over, and some site locations may have been burned repeatedly. Structural elements made of flammable materials have in all probability been lost. Conversely, non-flammable materials have likely been burned, but not damaged, since scientifically valid data have been excavated in recent years.

<u>Site Protection</u>

For fire protection purposes, cultural resources are divided into two classes; structural and non-structural sites:

> <u>Structural Sites</u> are those values, which stand above the ground and are made of flammable materials. Non-Structural <u>Sites</u> are values on or under the ground and are typically non-flammable.

Structural sites are vulnerable to damage from fire, but because they are relatively obvious, they are less likely to be endangered by suppression activity. Non-structural sites are not likely to be harmed by fire, but are vulnerable to fire suppression activities such as construction of control lines, temporary fire camps, and other activities. All fire crews will be briefed as to their responsibility for cultural resources. Illegal collecting by fire crews will not be tolerated.

Cultural resources will be protected and mapped according to the following criteria:

- Critical protection is given to structural resources designated as National Historic Landmarks. Only protection of life or occupied homes may have higher priority.

- Full protection is given to structures on, or eligible for inclusion on the National Register of Historic Places.

- Not sensitive is for abandoned structures that are not eligible for inclusion on the National Register of Historic Places. Protection is given to the same level as surrounding lands.

- Full protection is given non-structural sites on the National Register. Suppression activity must be off the site. This includes any site currently being excavated.

- The National Park Service (NPS) may wish to protect cultural resource sites on a park's List of Classified Structures or Cultural Sites Inventory. Sites on this list may be given the same level of protection as sites designated on the National Register of Historic Places.

Maps will be based on existing data and will be updated each winter to accommodate new information.

DECISION CRITERIA RECORD

Fire Number: Fire Name:

Land Manager/Owner: Fire Management Option:

Adjoining Land Manager/Owner(s): Adjacent Fire Management Option(s):

Current Fire Size: Location (Legal Description):

Map Quad:/Meridian: Lat/Long (if available):

Decision Criteria:

Public Safety at Risk	Yes	No
Firefighter Safety at Risk	Yes	No
Threatening Private Property	Yes	No
Improvements at Risk	Yes	No
Threat to Natural/Cultural Resources	Yes	No
Initial Attack Resources Not Available	Yes	No
Unacceptable Factor(s) to Land Manager/Owner(s)	Yes	No
Other Unacceptable Factors	Yes	No

Weather
Current:

Past:

Predicted:

Fire Behavior
Current:

Past:

Predicted:

Resistance to Control/Extinguish:

TOPOGRAPHY/NATURAL BARRIERS:

Fuels:

Other Contributing Factors: (Fire Danger Ratings, Greenness, etc.):

Fire Representative Summary Statement:

OBJECTIVES:

Strategy:

Estimate Duration of Actions:

SIGNATURE: ____________________________________ DATE: ______________

FIRE REPRESENTATIVE

LAND MANAGER SUMMARY STATEMENT AND AUTHORIZATION**:**
Objectives:

Constraints:

AUTHORIZATION:_______________________________________ DATE:______________
Land Manager/Owner(s) Representatives

Glossary of Alaska Wildland Fire Terms

ANSCA: Alaska Native Claims Settlement Act; Public Law 92-203, the 1971 act authorizing land conveyances to Alaska Natives.

ANILCA: Alaska National Interest Lands Conservation Act. Public Law 96-487, the 1980 bill which established national parks, monuments, and wildlife refuges, and other national conservation units in Alaska.

APPROPRIATE MANAGEMENT RESPONSE: Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

CONTINGENCY PLAN: Predetermined alternative course of action and its consequences. The plan provides for smooth transition of the control effort when new direction is required.

CONTROL OF A FIRE: The completion of control lines around a fire, any spot fires, and interior islands to be left unburned; burning out any unburned areas adjacent to the fire side of the control lines; and cooling down all hot spots that constitute immediate threats to the control lines until these can reasonably be expected to hold under foreseeable conditions.

CONVERSION DATE: That day after which most fires in the Modified Protection Option will be treated as being in a Limited Protection Option area. Conversions dates are not uniform and may change from one geographic area to another.

COOPERATIVE AGREEMENT: A written document which identifies who, what, when, where, why, and how certain actions will be done by each individual or agency involved. This is signed by the designated land manager(s).

CULTURAL RESOURCES: Prehistoric and historic remnants and physical and oral evidence of human activities.

DEFICIENCY LANDS: Lands designated for selection by village and regional corporations when there is insufficient land for selection in their core townships or regions.

DESIGNATED PHYSICAL DEVELOPMENT: Physical structures, improvements or specific sites that the land manager/owner selects and lists as needing the highest priority fire protection.

DIRECT ATTACK: Fireline is built at the edge of the fire or the edge and interior of the fire are worked on directly.

ECOSYSTEM: (1) In Tansley's original concept, any complex of living organisms with their environment that we may isolate mentally for purposes of study. (2) Totality of an environment plus its included organisms, or habitat and community as an interacting unit. (3) A community, including all the component organisms, together with the environment, forming an interactive system. The fundamental unit in ecology. Ecosystems exist in both space and time but their exact outlines are somewhat arbitrary because each is interconnected with other ecosystems as components of larger systems.

ESCAPED FIRE: A fire that has escaped initial attack or was beyond the capabilities of available initial attack forces to contain the fire when those forces arrived at the fire.

FIRE BEHAVIOR: Manner in which a fire reacts to fuel, weather, and topography; common terms used to describe fire behavior include smoldering, creeping, running, spotting, torching, and crowning.

FIRE BREAK: A natural or constructed barrier utilized to stop or check fires that may occur, or to provide a control line from which to work.

FIRE DEPENDENT ECOSYSTEM: An ecosystem can be called fire-dependent if periodic changes in the system due to fire are essential to the functioning of the natural system. In such systems fire is a significant environmental factor that initiates and terminates key vegetation successions, controls the age structure and species composition of the vegetation, produces the vegetative mosaic on the landscape, affects insects and plant diseases, influences nutrient cycles and energy flows, regulates the productivity of the system, and determines the habitats for wildlife.

FIRE EFFECTS: Physical, biological, and ecological impacts of fire on the environment.

FIRE MANAGEMENT OPTIONS: A range of alternatives which defines the extent of fire activity and management acceptable or desirable on a given land area.

FIRE REGIME: The type, intensity, size and frequency of fires typical for a specified land area. The fire regime determines the scale of fire effects and the way fire influences an ecosystem.

HEADQUARTERS SITE: A parcel of land not to exceed five acres, which must be used in conjunction with a business. Applicant does not have to occupy for any definite period of time.

INITIAL ATTACK: The first suppression actions, excluding monitoring, taken on a fire taken consistent with firefighter and public safety, and values to be protected.

INTERIM CONVEYED LANDS: Lands approved for conveyance to the Native corporations and a document of interim conveyance issued. This document is used for conveyance until survey has been accomplished and a patent issued. After lands have been interim conveyed (IC'd) they are administered and managed by the Natives.

LAND MANAGER/OWNER: The responsible Line Officer for the Federal agencies or designated individual in Federal, State, and private organizations who is authorized to make decisions concerning the management of specified land areas.

MONITORING: The systematic process of collecting, recording and mapping of fuels, topography, weather, fire behavior, and fire effects data to provide a basis for evaluating and adjusting prescribed fire programs." Monitoring generally requires both on-the-ground and aerial observations.

NATIVE ALLOTMENTS: Prior to the passage of the Alaska Native Claims Settlement Act, any Indian, Aleut, or Eskimo of full or mixed blood who resides in and is a Native of Alaska, who is head of a family or twenty-one years of age can be allotted land not to exceed 160 acres of non-mineral land. The selected land can consist of up to four parcels of land. The allotted land shall be deemed the homestead of the allottee and their heirs in perpetuity, and shall be inalienable and nontaxable until otherwise provided by Congress. Allotment applications on record, if not appealed or in conflict with other land selections, were administratively approved by ANILCA. The BIA is responsible for administering the land, trust responsibility, for pending, approved or after it is conveyed to the Native allottee and so long as it remains in restricted status.

NATIVE SELECTED LANDS: Lands withdrawn for Native selection and selected by Native village or regional corporations.

NATURAL FIRE REGIME: A natural fire regime is the total pattern of fires in vegetation, over time, characteristic of a natural region or ecosystem, variations in ignition, fire intensity and behavior, fire size (area of burns), recurrence (or return) intervals, and ecological effects.

OVER SELECTED LANDS: Lands selected by the Native corporations and State in excess of their entitlement.

PATENTED LANDS: Lands for which the Native corporations, State of Alaska, or individuals have received the final document of ownership, subject to reservations by the U.S. Government.

PATENTED MINING CLAIMS: A mining claim that has had a validity check and been approved for a patent, and a patent has been issued. This patent conveys surface rights as well as subsurface, subject to valid existing rights.

PRESCRIBED FIRE: Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition.

PRIVATE PATENTED LANDS: Lands that have been conveyed to private individuals or organizations. These lands are owned in "Fee Simple." They have a patent, which assures ownership.

PROJECT FIRE: A fire normally of size and/or complexity that it requires a large organization and possibly several days or weeks to control or confine the fire or the portion of the fire designated for control or confinement.

REGIONAL CORPORATION: An Alaska Native Regional Corporation, established under the laws of the State of Alaska in accordance with the provisions of ANCSA. The State of Alaska has been divided into 12 Native Regional Corporations with a thirteenth formed for Alaska Natives who live outside of Alaska. Regional Corporations receive all subsurface rights of lands acquired by Village Corporations within their region. They also receive the surface and subsurface rights of lands conveyed to the region.

RESOURCE OBJECTIVE: A desirable management decision of a course of action, which provides targets for program accomplishment.

SERAL: (1) Refers to sere. (2) Nonclimax, i.e., a species or a community demonstrably susceptible to replacement by another species or community, usually within a few decades or a few centuries at most.

SERE: A sequence of plant communities that follow one another in an ecological succession on the same habitat from a pioneer stage to, and terminate in, a particular kind of stable (climax) association.

STATE SELECTED: Land selected by the State for possible future conveyance.

STRATEGIC ACTION PLAN: A plan, which identifies and takes into consideration all information about a fire, how the various resources are affected, and specific agency and/or management concerns, and develops a recommended course of action for control of the fire.

STRATEGY: Overall plan of attack for fighting a fire which gives regard to the most cost-efficient use of personnel and equipment in consideration of values threatened, fire behavior, legal constraints, and objectives established for management of natural resources.

SUPPRESSION: The work of confining, containing, controlling or monitoring a fire or portions of a fire beginning with its discovery.

SUSTAINED ATTACK: Continuing suppression action on a fire until control is achieved.

SURVEILLANCE: The systematic process of collecting, recording or mapping the fuels, topography, weather; fire behavior and location of values to be protected to provide suppression agencies or land manager/owner(s) the information necessary to make the appropriate suppression action decisions on wildland fires.

TACTIC: The selection of suppression methods and the coordination of all forces committed to a fire to accommodate a designated strategy.

T & M SITE: A parcel of land up to 80 acres in size conveyed under the trade and manufacturing site regulations. Applicant must have a going business when land is conveyed.

TRIBAL ORGANIZATION: An Alaskan Tribe/Village, Tribal Consortium, or other group formed by Tribes/Villages that have either by a compact or 638 contract under the Indian Self-Determination and Education Act has assumed the delivery of Bureau of Indian Affairs services to Natives, including Native allotments.

TRUST LANDS: Is land (or an interest in land) which is held between the United States as legal owner and the

Native individual(s) as equitable owner. The legal owner holds the legal title to the property but only for the benefit of the equitable owner. The equitable owner (Native allottee) has the full right to use and occupy the property and do anything with it except to sell or lease it, grant rights-of way, or sell the natural resources off it.

TUNDRA: (1) From the Finnish "tunturi," meaning a treeless plain and describing the landscape beyond the cold limits of tree growth. (2) A cold climate landscape having vegetation without trees. A complex of conditions that is ultimately related to regional climate causes the absence of trees. This regional aspect distinguishes tundra from treeless bogs and similar local areas without trees due to edaphic extremes in areas that otherwise support a forest cover. (3) The landscape beyond the temperature limits of tree growth, both to the north and west of treeline in Alaska and at elevations above treeline on mountains. (4) The so-called "barren ground" north of the circumpolar coniferous forests. (5) Treeless areas where dwarf shrubs and low herbaceous plants predominate, often with many lichens and mosses, on a permanently frozen subsoil.

TUSSOCK TUNDRA: A tundra landscape (beyond the limits of tree growth) with a herbaceous vegetation of tussock forming plants, particularly Eriophorum spp.

UNPATENTED MINING CLAIM: A parcel of land upon which a mining claim has been filed but no document of fee simple ownership has been issued. Applicant has only rights to subsurface estate and limited rights to surface estate.

VILLAGE CORPORATION: An Alaskan Native Village Corporation, organized under the laws of the State of Alaska as a business for profit or nonprofit corporation to hold, invest, manage and/or distribute lands, property, funds and other rights and assets for and on behalf of a native village in accordance with the terms of ANCSA. Village Corporations receive ownership of the surface estate on the land conveyed to them. The Village Corporation entitlement varies from three to seven townships, depending on their population as of 1970.

WILDLAND FIRE: Any non-structure fire, other than prescribed fire, that occurs in the wildland.

WILDLAND FIRE MANAGEMENT PROGRAM: The full range of activities and functions necessary for planning, preparedness, emergency suppression operations, emergency rehabilitation, and prescribed fire operations, including non-activity fuels management to reduce risks to public safety and to restore and sustain ecosystem health.

WILDLAND FIRE SITUATION ANALYSIS: A decision-making process that evaluates alternative management strategies against selected safety, environmental, social, economical, political, and resource management objectives as selection criteria.

WILDFIRE: An unwanted wildland fire.

Appendix G
Enabling Legislation.

The following statutes authorize the Service to engage in wildland fire management and provide the means for managing wildland fires on and/or adjacent to refuge lands:

1. Protection Act of September 20, 1922 (42 Stat. 857; 16 U.S.C. 594). Authorizes the Secretary of the Interior to protect from fire, lands under his/her jurisdiction and to cooperate with other Federal agencies, States or owners of timber.

2. Federal Property and Administration Services Act of 1949 (40 U.S.C. 471 et seq.). Provides a system for the procurement, supply, utilization and disposal of property and services.

3. Economy Act of June 30, 1932 (47 Stat. 417; 31U.S.C. 1535). Authorizes Federal agencies to enter into contracts and agreements for services with each other.

4. Reciprocal Fire Protection Act of May 27, 1955 as amended by the Wildfire Suppression Act of 1989 (69 Stat. 66, 67; 42 U.S.C. 1856) (102 Stat. 1615). Authorizes reciprocal fire protection agreements with any fire organization for mutual aid with or without reimbursement and allows for emergency assistance in the vicinity of agency facilities in extinguishing fire when no agreement exists.

5. Wilderness Act of 1964, and as may be amended by ANILCA (see section 702 (7)). Provides direction for the use of fire in wilderness areas.

6. National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997 and the Refuge Recreation Act of 1962 (80 Stat. 927) (16 U.S.C. 68dd-68ee) (16 U.S.C. 460k-460k4). Governs the administration and use of the National Wildlife Refuge System.

7. National Environmental Policy Act of 1969. Provides the procedures for assessing environmental effects of specific actions.

8. Alaska Native Claims Settlement Act of December 18, 1971 (88 Stat. 668; 43 U.S.C. 1601). Alaska Native's lands are to continue to receive forest fire protection from the United States at no cost until they become economically self-sufficient.

9. Disaster Relief Act of May 22, 1974 (88 Stat. 143; 42 U.S.C. 5121). Authorizes Federal agencies to assist state and local governments during emergency or major disaster by direction of the President.

10. Federal Fire Prevention and Control Act of October 29, 1974 et seq. (88 Stat. 1535; 15 U.S.C. 2201). Provides for reimbursement to state and local fire services for costs of firefighting on Federal property.

11. Federal Grants and Cooperative Act of 1977 (Pub. L. 95-244, as amended by Pub. L. 97-258, September 13, 1982, 96 Stat. 1003; U.S.C. 6301-6308). Eliminates unnecessary administrative requirements of Government awards by characterizing the relationship between executive agencies and contractors, States and local

governments and other recipients in acquiring property and services in providing U.S. Government assistance.

12. Alaska National Interest Lands Conservation Act of December 2, 1980 (94 Stat. 2371, 43 Stat. U.S.C. 1602-1784). Designates certain public lands in Alaska as units of the National Park, National Wildlife Refuge, Wild and Scenic Rivers, National Wilderness Preservation, and National Forest systems resulting in general expansion of all systems. Any contracts or agreements with the jurisdictions for fire management services listed above that were previously executed will remain valid.

13. Supplemental Appropriation Act of September 10, 1982 (96 Stat. 837). Authorizes the Secretary of the Interior and Secretary of Agriculture to enter into contracts with State and local government entities, including local fire districts, for procurement of services in pre-suppression, detection, and suppression of fires on any unit within their jurisdiction.

14. Wildfire Suppression Assistance Act of 1989, (Pub. L. 100-428, as amended by Pub. L. 101-11, April 7, 1989). Authorizes reciprocal fire protection agreements with any fire organization for mutual aid with or without reimbursement and allows for emergency assistance in vicinity of agency facilities in extinguishing fires when no agreement exists.

15. National Wildlife Refuge System Improvement Act of October 9, 1997. Directs refuges to maintain the biological integrity, diversity and environmental health of the Refuge System.

16. Healthy Forests Restoration Act, December 3, 2003. Focuses on reducing the risk of catastrophic fire.

Appendix H
Key Points of the National Fire Plan, 2001 Federal Fire Policy, A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment 10-Year Comprehensive Strategy and Implementation Plan, and U.S. Fish and Wildlife Service – National Wildlife Refuge System Wildland Fire Management Program Strategic Plan 2006-2010.

Key Points of the National Fire Plan (*"Managing the Impacts of Wildfires on Communities and the Environment" A Report to the President In Response to the Wildfires of 2000 September 8, 2000*)

1. Firefighting. Continue fighting fires and be adequately prepared.

2. Rehabilitation and Restoration. Restore landscapes and rebuild communities damaged by wildfires.

3. Hazardous Fuel Reduction. Invest in projects to reduce fire risk.

4. Community Assistance. Work directly with communities to ensure adequate protection.

5. Accountability. Be accountable and establish adequate oversight, coordination, program development, and monitoring for performance.

2001 Federal Fire Policy Guiding Principles (*Review and Update of the 1995 Federal Wildland Fire Management Policy January 2001*)

1. Firefighter and public safety is the first priority in every fire management activity.

2. The role of wildland fire as an essential ecological process and natural change agent will be incorporated into the planning process.

3. Fire management plans, programs, and activities support land and resource management plans and their implementation.

4. Sound risk management is a foundation for all fire management activities.

5. Fire management programs and activities are economically viable, based upon values to be protected, costs, and land and resource management objectives.

6. Fire management plans and activities are based upon the best available science.

7. Fire management plans and activities incorporate public health and environmental quality considerations.

8. Federal, State, tribal, local, interagency, and international coordination and cooperation are essential.

9. Standardization of policies and procedures among federal agencies is an ongoing objective.

2001 Federal Wildland Fire Management Policy:

1. SAFETY – Firefighter and public safety is the first priority.

2. FIRE MANAGEMENT AND ECOSYSTEM SUSTAINABILITY – The full range of fire management activities will be used to help achieve ecosystem sustainability, including its interrelated ecological, economic, and social components.

3. RESPONSE TO WILDLAND FIRE – Fire, as a critical natural process, will be integrated into land use and resource management plans and activities on a landscape scale, and across agency boundaries.

4. USE OF WILDLAND FIRE – Wildland fire will be used to protect, maintain, and enhance resources and, as nearly possible, be allowed to function in its natural ecological role.

5. REHABILITATION AND RESTORATION – Rehabilitation and restoration efforts will be undertaken to protect and sustain ecosystems, public health, and safety, and to help communities protect infrastructure.

6. PROTECTION PRIORITIES – The protection of human life is the single, overriding priority.

7. WILDLAND URBAN INTERFACE – The operational roles of federal agencies as partners in the Wildland Urban Interface are wildland firefighting, hazardous fuels reduction, cooperative prevention and education, and technical assistance.

8. PLANNING – Every area with burnable vegetation must have an approved Fire Management Plan.

9. SCIENCE – Fire Management Plans and programs will be based on a foundation of sound science.

10. PREPAREDNESS – Agencies will ensure their capability to provide safe, cost-effective fire management programs in support of land and resource management plans through appropriate planning, staffing, training, equipment, and management oversight.

11. SUPPRESSION – Fires are suppressed at minimum cost, considering firefighter and public safety, benefits, and values to be protected, consistent with resource objectives.

12. PREVENTION – Agencies will work together and with their partners and other affected groups and individuals to prevent unauthorized ignition of wildland fires.

13. STANDARDIZATIION – Agencies will use compatible planning processes, funding mechanisms, training and qualification requirements, operational procedures, values-to-be-protected methodologies, and public education programs for all fire management activities.

14. INTERAGENCY COOPERATION AND COORDINATION – Fire management planning, preparedness, prevention, suppression, fire use, restoration and rehabilitation, monitoring, research, and education will be conducted on an interagency basis with the involvement of cooperators and partners.

15. COMMUNICATION AND EDUCATION – Agencies will enhance knowledge and understanding of wildland fire management policies and practices through internal and external communication and education programs.

16. AGENCY ADMINISTRATOR AND EMPLOYEE ROLES – Agency administrators will ensure that their employees are trained, certified, and made available to participate in the wildland fire program locally, regionally, and nationally as the situation demands.

17. EVALUATION – Agencies will develop and implement a systematic method of evaluation to determine effectiveness of projects through implementation of the 2001 Federal Fire Policy.

A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment 10-Year Comprehensive Strategy and Implementation Plan May 2002

Primary Goals:

1. Improve Prevention and Suppression

2. Reduce Hazardous Fuels

3. Restore Fire Adapted Ecosystems

4. Promote Community Assistance

Guiding Principles:

1. Priority setting that emphasizes the protection of communities and other high- priority watersheds at-risk.

2. Collaboration among governments and broadly representative stakeholders.

3. Accountability through performance measures and monitoring for results.

U.S. Fish and Wildlife Service - National Wildlife Refuge System Wildland Fire Management Program Strategic Plan 2006-2010

***Strategy 1*: Improve Fire Prevention & Appropriate Management of Wildland Fires**

Long Term Goals:

- Eliminate loss of life, reduce injuries to firefighter and the public, and reduce damage to communities and the environment from severe, unplanned and unwanted wildland fires.

- Improve federal, state, and local firefighting resources capability and readiness to protect communities and the environment from wildland fires.

- Reduce large fire suppression costs.

- Reduce suppression activities where they are unnecessary.

***Strategy 2*: Reduce Hazardous Fuels and Restore, Rehabilitate, and Maintain Fire-Adapted Ecosystems**

Long Term Goals:

- Treat hazardous fuels, using appropriate tools, to reduce the risk of unplanned and unwanted wildland fire to communities and to the environment.

- Restore, rehabilitate, and maintain natural vegetation, to promote the goals of refuge Comprehensive Conservation Plans (CCP) and Habitat Management Plans (HCP).

- Maintain natural fire regimes as much as possible by using a "hands off" approach and managing fuels to protect values at risk, while allowing fire to assume its natural role.

***Strategy 3*: Promote Community Assistance**

Long Term Goals:

- Increase capability of communities at risk to prevent losses from wildland fire originating on FWS lands.

- Support biomass utilization where possible.

***Strategy 4*: Improve Human Capital and Work Force Management**

Long Term Goal:

- Develop and maintain a workforce capable of meeting the highest standards of professional and technical expertise in the implementation of the Service's wildland fire program.

***Strategy 5*: Improve Awareness and Outreach**

Long Term Goal:

- Increase the understanding by members of the Congress and their staff, decision makers in DOI and the Office of Management and Budget, NGOs, community partners, and Service managers and employees of the key role fire plays in accomplishing the mission of both the NWRS and the Service.

- Increase public awareness and understanding of natural fire processes and fire use practices sufficient to support informed decisions about its appropriate use.

- Educate neighbors/communities regarding the challenges in living in fire-prone environments, and their responsibility.

Decision Criteria Checklist

Decision Element	**Yes**	**No**
Is there a threat to life, property, or public and firefighter safety that cannot be mitigated?		
Are potential effects on cultural and natural resources outside the range of acceptable effects?		
Are relative risk indicators and/or risk assessment results unacceptable to the appropriate agency administrator?		
Is there other proximate fire activity that limits or precludes successful management of this fire?		
Are there other agency administrator issues that preclude wildland fire use?		

The Decision Criteria Checklist is a process to assess whether or not the situation warrants continued wildland fire use implementation. A "Yes" response to any element on the checklist indicates that the appropriate management response should be suppression-oriented.

Approved Response Action (check appropriate box)		**Signature/Position**	**Date**
Other Appropriate Management Response			
Wildland Fire Use Response			

Justification for Suppression Response:

Appendix J
Wildland Fire Situation Analysis (WFSA).

Wildland Fire Situation Analysis (WFSA)

The Wildland Fire Situation Analysis process is used to determine and document the suppression strategy from the full range of responses available for suppression operations. Suppression strategies are designed to meet the policy objectives of suppression.

The WFSA is a decision making process in which the Agency Administrator or representative describes the situation, compares multiple Strategic wildland fire management alternatives, evaluates the expected effects of the alternatives, establishes objectives and constraints for the management of the fife, selects the preferred alternative, and documents the decision. The format and level of detail required depends on the specific incident and its complexity. The key is to document the decision made. A WFSA and Delegation of Authority will be completed whenever a wildfire escapes initial attack.

The Agency Administrator or their representative, along with the Fire 2 Management Officer (FMO) or Incident Commander will prepare the WFSA. The format and level of detail required depends on the specific incident and its complexity. For signatory authority and cost limits see the chart below. An electronic copy of the WFSA can be found at http://www.fs.fed.us/fire/wfsa/. A description of the WFSA Elements with guidance for the completion can be 7 found in Appendix EE**.**

Funding approval levels for multiple jurisdictional incidents are determined a based on each agency's funding commitment and not upon the total funding.

Signature authorities for WFSA are as follows:

	BIA	BLM	FWS	NPS	FS
Local Approval Level	$2,000,000 Agency Supervisor	$2,000,000 Field/District Manager	$2,000,000 Refuge Manager Project Leader	$2,000,000 Park Superintendent	$2,000,000 District Ranger $2,000,000- $10,000,000 Forest Supervisor
Regional/ State Certification Level	$2,000,000- $5,000,000 Regional Director	$2,000,000 - $5,000,000 State Director	$2,000,000- $5,000,000 Regional Director	$2,000,000- $5,000,000 Regional Director	$10,000,000- $50,000,000 Regional Forester
National Certification Level	>$5,000,000 Director	>$5,000,000 Director	>$5,000,000 Director	>$5,000,000 Director	>$50,000,000 Chief

Source: Chapter 10 of Interagency Standards for Fire and Aviation Operations.

Appendix K
Federal Interagency Wildland Firefighter Medical Qualification Standards Introduction.

FEDERAL INTERAGENCY WILDLAND FIREFIGHTER MEDICAL QUALIFICATION STANDARDS INTRODUCTION

Introduction

The Federal Fire and Aviation Leadership Council authorized an interagency team to address a common perception that the present physical examination processes for employees who participate in arduous wildland fire fighting duties are not adequate.

The team underwent basic firefighter training, gathered information on the present procedures involved with physical examinations, reviewed relevant studies, interviewed fire managers and firefighters (both in an office setting and on the fire line) and discussed their findings.

It was the consensus of the team that the current physical examination process is inadequate for the intended purpose of reasonably assuring a level of employee health necessary so that the employee will not be at unnecessary risk, or put others at risk, in performing arduous duties associated with firefighting. There were very real questions concerning whether the physician was given enough information to make a medically sound judgment of whether the individual being examined could safely perform the duties required by these positions. There was also the question of what relevant health factors should be assessed and what was the most effective and economic method of assessment.

Current Practices

The current practices used by the five wildland firefighting agencies vary widely, and none of these practices were viewed as acceptable neither from a good medical practice standpoint, nor from a potential legal standpoint considering changes in federal disability employment regulations brought about by the Rehabilitation Act of 1973 (Public Law 93-112).

At present, Department of the Interior land management agencies use a variety of government forms and provide varying levels of information to examining physicians in connection with firefighter physicals for present and prospective employees.

Information and forms provided by these agencies include:

<u>BUREAU OF INDIAN AFFAIRS</u>

Standard Form No. 78, Certificate of Medical Examination

- Appendix A-#6 <u>STATEMENT OF PHYSICAL ABILITY FOR ARDUOUS/HEAVY PHYSICAL WORK</u>

    - 53 BIAM(manual) SUPPLEMENT 8, FOREST AND RANGE MANAGEMENT, Fire Management Operations
    -

<u>FISH AND WILDLIFE SERVICE</u>

- Standard Form No. 78, Certificate of Medical Examination (only for non-arduous)

- Form 1400-108, Physical Requirements for Firefighters and Smoke jumper Positions (only for non-arduous)

BUREAU OF LAND MANAGEMENT

- Standard Form No. 78, Certificate of Medical Examination

- Form 1400-108, Physical Requirements for Firefighters and Smoke jumper Positions

    - SPECIFIC INSTRUCTIONS TO PHYSICIAN
    -

NATIONAL PARK SERVICE

- Standard Form No. 78, Certificate of Medical Examination

- Physician Response Memo

- PERSONAL HEALTH HISTORY QUESTIONNAIRE

- PHYSICAL EXAMINATION POLICY AND PROCEDURES

- Instruction letter to physician

    - PRE-APPOINTMENT PHYSICAL EXAM REIMBURSEMENT VOUCHER
    -

Once an examination is completed, the common practice is for the examination results to be forwarded to the Servicing Personnel Office of the employing agency. The Servicing Personnel Office reviews the Standard Form 78 to determine whether the examining physician has marked, in the conclusions block, either "No limiting conditions for this job" or "Limiting conditions as follows:" If "No limiting conditions for this job" is marked, the individual is either hired, or, in the case of a present federal employee, is allowed to participate in arduous duties. If "Limiting conditions as follows:" is marked, the Servicing Personnel Office meets with agency management to determine whether a reasonable accommodation can be made.

U. S. FOREST SERVICE

The U. S. Forest Service currently has not initiated a medical review/medical clearance program for firefighters.

Perceived problems with the current practices include:

• Lack of consistency among agency programs even though wildland firefighters from different agencies frequently perform the same duties side by side.

• Lack of a formal documented waiver/accommodation process for firefighters who do not meet medical standards.

• Lack of a comprehensive medical history as part of the examination process.

• Examination form(s) which are inconsistent with needed elements of the examination.

Federal Interagency Medical Qualification Standards Program

Highlights

The medical qualification program presents several significant departures from current agency practice. These changes include:

Personnel Required to Administer the Program

Servicing Personnel Office(r) (SPO) - The servicing personnel office(r) is responsible for providing appropriate medical forms to GS/WG seasonal temporary position and permanent position applicants.

Fire Management Office(r) (FMO) – The fire management office(r) is responsible for providing appropriate medical forms to incumbent personnel and AD/EFF firefighters.

Central Medical Consultant (CMC) - A central medical consultant is needed to provide medical interpretation of the findings of medical examinations, medical histories, provide quality assurance/quality control on medical documents, and provide medical clearance determinations on the baseline, periodic, and exit examinations. This CMC should be a licensed medical care provider, with experience in occupational health and wildland firefighting. Training may be required in recognition of the medical conditions that may represent a substantial risk of harm in the performance of arduous wildland firefighting duties.

Medical Review Officer (MRO) - The Interagency Wildland Firefighter Medical Qualification Program includes the formal designation of a Medical Review Officer who can interpret adverse medical findings using actual knowledge of the condition under which wildland firefighters duties are performed. The designation of an MRO may be done on an agency or interagency basis, depending upon specific needs. The MRO must be familiar with wildland firefighter operations in order to render expert opinions relating to medical fitness. While the examining physician may see one or a few firefighters and can reasonably render a fitness determination when there are no potentially disqualifying medical conditions, the MRO will see and render a consistent medical recommendation on all firefighters who have any medical condition that may (or may not) be disqualifying. The examining person will be licensed to conduct physical examinations and familiar with general physical examination procedures while the MRO will be a board certified or board eligible occupational medicine physician with intimate knowledge of the conditions of employment.

Program Manager - The Interagency Wildland Firefighter Medical Qualification Standards program includes the formal designation of an overall Program Manager who will provide tracking and continuity to the second level review process. This individual will track and review incoming medical files for completeness, and control the flow of medical files to the MRO. This individual should have a background in wildland firefighting and expertise in safety. Ideally the Program Manager will be a member of the Interagency Medical Review Board. This position is a full time responsibility.

Interagency Medical Review Board - The Interagency Wildland Firefighter Medical

Qualification Standards program includes the formal designation of a overall Interagency Medical Review Board (IMRB) that will provide a variety of professional expertise to the second level review process. The Board members will ideally come from a variety of backgrounds including occupational safety, occupational medicine, wildland firefighting safety, management, union, human resources, etc. The board will take medical review findings from the MRO and determine, with input from the SPO and local management, whether any waiver or accommodation is pertinent to the individual case. The IMRB will consider the specific details of each second level review on a case by case basis, providing continuity to the overall program.

Timing (See next page for a quick reference chart)

Incumbents or Applicants for permanent positions Less Than 45 Years Old

A medical history and physical examination are to be conducted and the "Medical History, Examination, and Clearance Form" completed **every five years**. In those years in which an exam is not scheduled, an "Annual Medical History and Clearance Form" is to be completed by the firefighter. Every year, therefore, the appropriate form is to be completed and reviewed prior to scheduling an arduous duty performance test (currently the 'pack test'.)

Incumbents or Applicants 45 Years Old or Greater

A medical history and physical examination are to be conducted and the "Medical History, Examination, and Clearance Form" completed **every three years**. In those years in which an exam is not scheduled, an "Annual Medical History and Clearance Form" is to be completed by the firefighter. Every year, therefore, the appropriate form is to be completed and reviewed prior to scheduling an arduous duty performance test (currently the "pack test").

There are factors that may make a conventional medical examination impractical. The lack of adequate medical services, the distance from the employee residence to appropriate medical facilities, time sensitive hiring processes (especially during periods of "fire emergencies"), all create situations where the agencies may need to gather medical information within a very limited timeframe. In these situations, the "Annual Medical History and Clearance Form" may be used prior to scheduling an arduous duty performance test. Agencies may individually or collectively agree upon the terms and conditions of the use of this method. The Medical Standards Team cannot recommend the "Annual Medical History and Clearance Form" as a substitute for a scheduled medical examination/interim medical history program, but recognizing the logistics of hiring numerous firefighters in compressed timeframes and under difficult logistical circumstances, we feel that this form is the closest to a comparable substitute that we can provide.

MEDICAL STANDARDS EVALUATION PROCESS
QUICK REFERENCE CHART

MEDICAL STANDARDS EVALUATION PROCESS **The following chart is presented to summarize the requirements for firefighters who perform in arduous firefighter situations.**	Incumbent/ Applicant (permanent positions) < 45 years of age	Incumbent/ Applicant (permanent positions) = 45 years of age	Temporary positions < 45 years of age	Temporary positions = 45 years
Medical Clearance/Surveillance Examination (*Baseline*)	**Yes - initial**	**Yes - initial**	**No**	**No**
Medical Clearance/Surveillance Examination (*Periodic*)	**Every 5 yrs**	**Every 3 yrs**	**No**	**Every 3 yrs**
Annual Medical History and Screening **given on years that no examination is scheduled)** (	**Yes**	**Yes**	**Yes**	**Yes**
Medical Clearance/Surveillance Examination *(Exit)*	**Yes - for incumbents only**	**Yes for incumbents only**	**No**	**No**

Medical Standards

Medical standards were developed and validated by on-site visits to wildland and prescribed fire operations. The written and validated medical standards, including the medical examination elements, are shown in the medical standards section. These standards include the statement of medical fitness for the physiological element as well as a list of potentially disqualifying factors for use by the examining physician/CMC/MRO. Please note that the medical standard is a technical document designed for use by a medical provider and is subject to a case-by-case individualized assessment. The sample conditions listed in the individual standards should not be considered as automatic disqualifications but rather as typical conditions that may be of concern to the medical professional for safety or efficient job performance reasons.

Medical Examination and Forms

A consistent set of medical examination criteria, a medical examination form, and an annual medical history and clearance form were developed to provide uniform tools for agencies to use in the administration of the medical program. This allows for the comprehensive collection of medical data important to the determination of medical fitness for firefighter duties.

Baseline Exam: The baseline (or initial) exam is focused on the medical requirements to perform arduous firefighter duties and is more comprehensive than the periodic exams to allow for the collection of adequate data.

Periodic Exam: A focused periodic medical examination is to be conducted every five years on firefighters until they reach the 45 years of age. At age 45, the periodic medical examination is to be conducted every 3 years.

Exit Exam: The exit exam is performed when an incumbent terminates federal service as an arduous duty wildland firefighter.

Baseline/Periodic/Exit Medical Examination Form: The “Federal Interagency Medical History, Examination and Clearance” form is used, with some differences, for baseline, periodic, and exit medical examinations. The shaded area of the medical examination form is filled out by the firefighter prior to, or at the time of, the examination. The examining physician completes the medical information sections, standards review, and clearance sheet during the course of the medical examination. After receipt of the blood and other test data, the examining physician forwards the completed medical examination form to the agency designated location for review.

Examination forms (Baseline/Periodic) revealing abnormal or suspect medical conditions will be forwarded to the MRO for further review and a medical fitness determination.

Annual Medical History and Clearance Form: An obligatory annual medical history questionnaire is required of firefighters in those years when an actual medical examination is not scheduled. This “Federal Interagency Annual Medical History and

Clearance” form will be reviewed by a physician or an allied medical care provider (e.g. registered nurse, nurse practitioner, or physician’s assistant). The form is then submitted to the agency designated location for review and storage.

Qualification Review Process

The medical documents are reviewed in order for management to make a medical qualification decision. The medical qualification decision process is the same for all arduous duty wildland firefighters. However, there are factors that may make a conventional medical examination impractical (i.e. lack of availability of medical services, the distance from the employee residence to appropriate medical facilities, time-sensitive hiring processes, etc.).

Baseline Examination

Applicants for permanent positions and incumbent arduous duty wildland firefighters, will receive a medical examination and clearance by an agency funded health care professional familiar with physical examination procedures and licensed to conduct a physical examination. This examination is mandatory. The examination will be completed and reviewed before the employee can perform arduous wildland firefighting duties. In the event that arduous wildland firefighting is a job requirement (e.g. essential job function), and the individual is a new hire, then the medical examination and clearance must be completed and reviewed after a formal job offer is tendered, but before the individual is hired. When the results of the examination are received, there is an initial decision point resulting in a "GO - NO GO".

> **Initial "GO" Decision -** A "GO" decision means the individual is medically qualified, and they proceed to the next step in the process, usually the agency administered "work capacity test" and then into mandatory training and ultimately into unrestricted duty as an arduous duty wildland firefighter.
>
> **Initial "NO GO" Decision** - In those limited situations where an applicant/incumbent has a medical condition that may preclude safe and efficient job performance, a second level of review may be used, depending upon employment status or past experience, to consider the specific aspects of the applicant's medical condition and the need for follow-up information from the applicant's medical care provider(s). The FMO/SPO may utilize the services of the Central Medical Consultant (CMC) to interpret the results of a medical examination where a NO GO determination is initially made. The CMC may request that the applicant/employee provide additional information from their personal physician (at the applicant's/employee's expense) to put the medical condition in perspective with the expected conditions of employment. The CMC will then make a second level review medical determination concerning clearance for arduous wildland firefighting duties and report the findings of this review to the FMO/SPO and Program Manager. For incumbents, if clearance is not granted, the Interagency Medical Review Board (IMRB) process is initiated. This level of review is initiated by the CMC/FMO/SPO coordinating with the Program Manager. The CMC will send the results of the medical examination to the Program Manager. The Program Manager would, in turn, review the materials for completeness and forward the case to the Medical Review Officer (MRO) for review and recommendations. The MRO will prepare a summary of medical findings and recommendations which will be evaluated by the IMRB in determining whether any waiver and/or reasonable accommodation is feasible for the position in question. If no waiver or accommodation can be made that is consistent with safe and efficient job performance, then the individual is not medically qualified to perform as an arduous duty wildland firefighter. In the case of an applicant for a position, temporary or permanent, the agency is under no legal mandate to waive/accommodate the medical qualification standards program. At agency discretion, applicants not meeting the medical qualification standards may be reviewed on a case by case basis. An applicant may submit additional information in an effort to become cleared for duty in the following season, or in a later season during that year.

Periodic Medical Examination

Incumbent arduous duty wildland firefighters will receive a periodic medical examination and clearance by an agency funded health care professional familiar with physical examination procedures and licensed to conduct a physical examination **every five (5) years, until the age of 45, and thereafter every three (3) years.** This examination is mandatory. The examination will be completed and reviewed before the employee can perform arduous wildland firefighting duties. When the results of the examination are reviewed, there is an initial decision point resulting in a "GO - NO GO".

> **Initial "GO" Decision -** A "GO" decision means the individual is medically qualified, and they proceed to the next step in the qualification process, usually the agency administered "work capacity test" and then into unrestricted duty as an arduous duty wildland firefighter.
>
> **Initial "NO GO" Decision** - In those limited situations where an applicant/employee has a medical condition that may preclude safe and efficient job performance, a second level of review will be used to consider the specific aspects of the applicant's medical condition and the need for follow-up information

from the applicant's medical care provider (s). The FMO/SPO may utilize the services of the Central Medical Consultant (CMC) to interpret the results of a medical examination where a NO GO determination is initially made. The CMC will review the examination or history to determine whether the medical condition identified during the examination or disclosed in the medical questionnaire is significant enough to warrant a second level of review. The CMC may request that the applicant/employee provide additional information from their personal physician (at the applicant's/employee's expense) in order put the medical condition in perspective with the expected conditions of employment. The CMC will then make a second level review medical determination concerning clearance for arduous wildland firefighting duties and report the findings of this review to the FMO/SPO and Program Manager. If clearance is not granted, the Interagency Medical Review Board (IMRB) process is initiated. This level of review is initiated by the CMC/FMO/SPO coordinating with the Program Manager. The CMC will send the results of the medical examination to the Program Manager. The Program Manager would, in turn, review the materials for completeness and forward the case to the Medical Review Officer (MRO) for review and recommendations. The MRO will prepare a summary of medical findings and recommendations which will be evaluated by the IMRB in determining whether any waiver and/or reasonable accommodation is feasible for the position in question. If no waiver or accommodation can be made that is consistent with safe and efficient job performance, then the individual is not medically qualified to perform as an arduous duty wildland firefighter.

Annual Medical History and Screening

In those years in which an examination is not scheduled, an "Annual Medical History and Clearance Form" is to be completed by the firefighter. In addition, a specified medical screening is to be performed and recorded by a health care professional. Any licensed or certified health care professional may perform the screening as long as the scope of practice delineated by their license or certification includes the required screening functions. This annual medical history and screen is mandatory. The annual medical history and screen must be completed and reviewed before the employee can perform arduous wildland firefighting duties. At the completion of the medical history review and screening by the local health care professional (LHCP), there is an initial decision point resulting in a "GO - NO GO".

Initial "GO" Decision - A "GO" decision by the LHCP means the individual is medically qualified, and they proceed to the next step in the qualification process, usually the agency administered "work capacity test" and then into unrestricted duty as an arduous wildland firefighter.

Initial "NO GO" Decision - In those limited situations where an applicant/employee has a medical condition that may preclude safe and efficient job performance, depending upon employment status, a second level of review may be used to consider the specific aspects of the applicant's medical condition and the need for follow-up information from the applicant's medical care provider (s).

For **Incumbents**: The FMO will utilize the services of the Central Medical Consultant (CMC) to interpret the results of a medical examination where a NO GO determination is initially made. The CMC will review the examination or history to determine whether the medical condition identified during the examination or disclosed in the medical questionnaire is significant enough to warrant a second level of review. The CMC may request that the applicant/employee provide additional information from their personal physician (at the applicant's/employee's expense) in order put the medical condition in perspective with the expected conditions of employment. The CMC will then make a second level review medical determination concerning clearance for arduous wildland firefighting duties and report the findings of this review to the FMO and Program Manager. If clearance is not granted, the Interagency Medical Review Board (IMRB) process is initiated. This level of review is initiated by the CMC/FMO coordinating with the Program Manager. The CMC will send the results of the medical examination to the Program Manager. The Program Manager would, in turn, review the materials for completeness and forward the case to the Medical Review Officer (MRO) for review and recommendations. The MRO will prepare a summary of medical findings and recommendations which will be evaluated by the IMRB in determining whether any waiver and/or reasonable accommodation is feasible for the position in question. If no waiver or accommodation can be made that is consistent with safe and efficient job performance, then the individual is not medically qualified to perform as an arduous duty wildland firefighter.

For **Applicants**: The applicant is responsible for providing additional medical information from their personal physician to the Central Medical Consultant. If additional medical information is provided, The CMC will review the examination or history to determine whether the medical condition identified during the examination or disclosed in the medical questionnaire is significant enough to warrant a second level of review. The CMC may request that the applicant/employee provide additional information from their personal physician (at the applicant's expense) in order put the medical condition in perspective with the expected conditions of employment. The CMC will then make a second level review medical determination concerning clearance for arduous wildland firefighting duties and report the findings of this review to the FMO and Program Manager.

In the case of an applicant for a position as a temporary employee the agency will probably withdraw the job offer, as the time required to complete the medical review will preclude the applicant from participating in the current year's program. An applicant may submit additional information in an effort to become cleared for duty in the following season, or in a later season during that year.

Administrative procedures - The medical examination program uses, minimally, a two-tiered approach to the medical process. The first tier is the medical examination and clearance; a firefighter receives a medical examination by a qualified medical provider according to a specific preset examination protocol. This examination includes an initial assessment of medical fitness by the examining physician. In cases where the examining physician questions the medical fitness of the firefighter to perform the full range of duties of the position, the case is referred to a CMC and/or MRO for a second tier review. The CMC/MRO then renders a recommendation relating to the medical fitness of the firefighter. All pertinent information is provided to the CMC/MRO to allow meaningful recommendations to be made, including but not limited to: the medical history, the results of the physical exam, a description of critical job duties, potential exposures, and any information about known exposures. In addition, the CMC/MRO should be told of any occupational illnesses which could affect the screening of individual workers. The CMC/MRO may request supplementary information from the individual's personal care physician.

The most important characteristic of the two-tiered medical approach is that the examining physician concentrates on the patient examination and initial assessment of medical fitness, and the CMC/MRO concentrates on the relationship between the medical data provided by the examining physician and the known characteristics of the job.

Waiver/Accommodation Procedures - This program delineates a formal administrative procedure, consistent with the requirements of the Rehabilitation Act of 1973 as amended, for agencies to use when an individual fails to qualify medically for the position of arduous duty wildland firefighter. This procedure includes the consideration of medical waivers and reasonable accommodation. If the examining physician indicates that there is a potential disqualifying medical condition, and the CMC/MRO substantiates this potential disqualification, then the Waiver/Accommodation procedure shall be used in a fair and consistent manner to guide management in the disposition of the case. A flowchart delineating the steps and decision points for the Waiver/Accommodation process is provided on page 13. A narrative discussion of the decision points is also provided beginning on page 14.

Waiver/Accommodation Flowchart Narrative

Decision Point One - Waivers. Can the employee perform the essential functions of their position without accommodation and without endangering the safety or health of themselves or others?

The agency must waive a medical standard if an employee has consistently demonstrated the ability to perform his/her job in a satisfactory manner without an undue risk of harm to themselves or others. If a waiver is recommended by the Interagency Medical Review Board (IMRB) and granted by management, then the employee can return to work without restriction. Waivers are good only until the next examination or when other evidence arises indicating that the condition has changed.

Decision Point Two - Additional Medical Opinions. Is there a disagreement on the nature of the medical condition or diagnosis and its effect on the employee's capability?
If an employee fails to meet the medical qualification requirements, is not granted a waiver, and has a personal (non-occupationally induced) medical condition, an employee may obtain at their option another examination by a physician of choice at the employee's expense. If the medical condition is occupationally related then the medical examination, limited to the area of disqualification, will be paid for by the agency and will be conducted on official time. If there is still a disagreement about the condition, a third physician (acceptable to both the agency and the applicant or employee) will be consulted. Medical information provided by an employee's physician of choice, at the employee's own expense will be appropriately considered by the IMRB as it develops recommendations to management. The employee will be allowed at least 30 days from the notice of failure to meet the physical qualifications, to provide this information to the agency.

Decision Point Three - Disability Determination. Does the medical condition result in an impairment of a major life function (including work)?

The Rehabilitation Act of 1973, as amended, prohibits employment discrimination against people with disabilities, and requires employers to hire (and retain) employees who, with or without the disability, would otherwise be qualified for the job. In doing so, the employer is required to provide "reasonable accommodation" to employees with disabilities. The first determination to be made in considering accommodation of the potentially medically disqualified employee is whether the medical condition is disabling. To make this determination, management must decide, with input from the IMRB, whether the condition results in an impairment of a major life function (including work). In the case of the major life function of working, management must determine if the potentially disabled employee is substantially restricted from working in either a class of jobs or a broad range of jobs in various classes compared to the average person in a comparable situation. If management determines that an individual is not disabled then the agency is under no obligation to accommodate the employee.

Decision Point Four - Qualified Disability Determination. Can the individual perform the essential functions of the job with or without accommodation?

If the potentially disqualified employee is considered disabled in the previous determination, then it is their responsibility to suggest an accommodation(s) to management that will allow the employee to perform the essential functions of their position. If there are no accommodation(s) suggested by the employee then the employee cannot perform the essential functions of their position with or without accommodation and the agency is under no obligation to accommodate the employee. It is important for the agency and employee to initiate a dialog so that all possible avenues of accommodation can be evaluated.

Decision Point Five - Undue Hardship Determination. Would accommodation cause undo hardship for the agency?

If the potentially disqualified employee has suggested an accommodation that would allow them to perform the essential functions of their position, then management must determine whether this accommodation would cause undue hardship to the agency. This undue hardship could be in the form of excess or unaffordable cost, or excessive or unacceptable loss of efficiency. If management determines that an accommodation would cause an undue hardship, then the agency is under no obligation to accommodate the employee.

Decision Point Six - Health and Safety. Would accommodation result in an undue risk of harm to the employee or others?

If the potentially disqualified employee has suggested an accommodation that would allow them to perform the essential functions of their position without undue hardship to the agency, then management must determine whether this accommodation would result in an undue risk of harm to the employee or others. This excessive safety or health risk could be in the form of potential sudden or subtle incapacitation while on the job, potential reaction(s) to medication(s) or other concerns. If management determines that an individual cannot be accommodated without undue risk of harm to themselves or others, then the agency is under no obligation to accommodate the employee.

Decision Point Seven - Other Options. After consideration of all available options for accommodating the medically disqualified employee at their present position, the IMRB may also evaluate other positions, locations, or alternatives identified by management. All of these options will be considered, and those that provide an acceptable outcome in term of medical risk management will be forwarded for management consideration.

Appendix L
Alaska Enhanced Smoke Management Plan Procedures Manual.

Smoke Effects Mitigation and Public Health Protection Proposal

On June 27, 2005, the Alaska Wildland Fire Coordinating Group (AWFCG) approved this Smoke Effects Mitigation and Public Health Protection Proposal for a trial evaluation during the 2005 wildland fire season in Alaska. This proposal will be reviewed at the Interagency Fall Fire Review and revised if necessary for final approval.

Due to the social and economic impacts of smoke during the 2004 Fire Season, the following smoke mitigation thresholds and procedures are proposed for approval by the Alaska Wildland Fire Coordinating Group (AWFCG) and implementation by the member agencies. The measures were developed to promote a proactive assessment and documentation of potential smoke impacts. The main thrust is the ***assessment*** to determine ***if*** actions are necessary. However, wildland fire smoke is inevitable. Public outreach efforts are essential to keep the public informed and provide ample opportunity for individuals to take action based on individual health factors. Land managers, the Alaska Department of Environmental Conservation (ADEC), and suppression providers share the task of providing pro-active and adequate public information on wildfire smoke before, during and after wildfires occur. Examples of how land managers, ADEC, and suppression providers can provide better public information about wildfire smoke include:

1. Incorporating information about health effects of smoke and potential for smoke from wildfires in annual FIREWISE-type newspaper notices.
2. Working with local communities to incorporate information about health effects of smoke and what should be done about it into FIREWISE and other public fire prevention activities. Refer to the website http://www.epi.hss.state.ak.us/wildfire/default.htm for “Wildfire Smoke - a Guide for Public Health Officials” and links to other publications for public education guidelines.
3. Incorporating within communications to the public the role of fire, its importance in Alaska, the inevitability of smoke impacts in the short term, and the long term ecosystem benefits.
4. Using Fire Information Officers to disseminate information on smoke health effects during wildfires.
5. Identifying sensitive smoke receptors before the fire season (i.e. communities, villages, recreational areas, tour industry, public highways, hospitals, schools, groups at higher risk for smoke related problems, etc) and target them for dissemination of special information on how to prepare for and deal with smoke when it occurs.
6. Pre-planning public health mitigation scenarios, ranging from increased public education during the incident to providing respite from smoke during a smoke event.

Besides the need for public information, there is a need to disseminate important smoke-related information among the land management agencies, ADEC, and suppression service providers before, during and after wildfire incidents. This may be facilitated by:

1. Predictive Services incorporating smoke concerns and forecasts as a routine subject into suppression service providers and land managers briefings during wildfire activity to assist with operational and land manager assessments and decisions.
2. Suppression service providers including information on smoke impact potential or smoke conditions on the Fire Notification and Fire surveillance reports given to land managers.
3. Land managers providing ADEC and suppression service providers with information on smoke impacts obtained during their surveillance/monitoring activities, requests for smoke monitoring at specific-locations and land management concerns or decisions that affect smoke management.
4. Suppression and land manager FMOs, Predictive Services personnel and the ADEC meteorologist routinely tracking smoke plume locations and smoke distribution using satellite imagery.
5. ADEC broadcasting smoke advisories to assist Alaska Multi-Agency Coordination (MAC) group, suppression providers and land mangers with decisions related to smoke.

These educational and informational procedures will be implemented on a trial basis by each AWFCG member within their agencies. These smoke mitigation procedures must remain flexible to respond to the changing needs and priorities of land managers, ADEC and suppression service providers. An analysis on the effectiveness of implementing these measures will be included in the annual AWFCG fall fire program review. Proposed changes to the threshold criteria will be documented at that meeting and will be relayed to the AWFCG Smoke Management Committee, who will change the procedures, if necessary. Changes will be approved by the AWFCG and implemented by AWFCG members within their agencies the following fire season. In this way, the threshold criteria will be adopted for a period of one year and will be available for revision on an annual basis.

Once approved, it is the responsibility of each AWFCG member to distribute and provide operational direction within their agencies. The threshold criteria are intended to provide minimum uniform requirements for interagency use; they do not preclude more restrictive agency-specific measures nor should they discourage an assessment of any fire of any size at any time that may have potential impacts on a community. It is not the intent of the following threshold criteria to constrict the use of fire as a management tool or to produce an unreasonable workload; it is the intent to facilitate and document (on forms already in use) an acceptable interagency systematic review of smoke impacts and furnish the public with appropriate air quality information. Examples of the range of actions that may be implemented as a result of an assessment include indirect attack on an ongoing fire to inhibit fire growth to suppression of new starts within a defined geographic area. An assessment may also clearly indicate that no action is necessary.

The following three threshold criteria based on air quality impacts are proposed for final approval for the 2005 fire season for ***assessment, documentation*** and ***management action*** requirements for wildland fires that are allowed to burn under the influence of natural forces and where the cost of suppression may exceed the value of the resources to be protected, the environmental impacts of fire suppression activities may have more negative impacts on the resources than the effects of the fire, or the exclusion of fire may be detrimental to the fire dependent ecosystem i.e. Limited and Modified (post conversion) Fire Management Option areas. Air quality impacts are not immediately addressed for fires occurring in Critical, Full and Modified (pre-conversion) Fire Management Option areas since, under the standard operating procedures, actions to suppress the fires in those areas are implemented by the suppression service providers upon discovery of the fire. If a fire in one of these management option areas is not contained by initial response forces, a WFSA is required; the WFSA includes an analysis of smoke impact and conditions.

Assessments are the responsibility of both the land manager and suppression organizations. ADEC provides the technical expertise for addressing air quality and health related issues. Additional information on air quality is available on the ADEC website at http://www.dec.state.ak.us/air/.

ADEC confirms that visibility is a good indication of air quality. Air quality categories can be estimated using the visibility ranges in the Air Quality Guidelines table on page 5. The US Fish and Wildlife Service, Alaska Fire Service, Fairbanks North Star Borough and ADEC have recently purchased portable air quality monitoring equipment. As air quality problems develop portable air quality monitors may be used to better measure particulate matter (PM2.5). When monitoring equipment readings are available, they will be the used to determine if threshold criteria are met; the AWFCG will determine location priorities for monitoring when the situation warrants.

Threshold Criteria 1 *Minimal Impacts*:
Smoke concerns are generally few. Smoke will only be produced for a short period of time or is barely visible to the public. Smoke amounts are not expected to reach ***"unhealthy"*** levels. Members of the public have expressed few or no concerns about smoke. No impacts or minor impacts to isolated residences, remote roads or other facilities may occur.

Assessment: Upon discovery of a fire, an initial assessment of potential impacts is made by suppression agencies and land managers. When fires are first discovered, suppression agencies document pertinent fire information including potential smoke impacts on the Fire Notification Form. Those forms are forwarded to land managers. Fire activity and potential impacts including those related to smoke for ongoing fires is documented on fire surveillance reports. This information is summarized and submitted by Zone/Area Dispatch Offices to the Alaska Interagency Coordination Center (AICC) and incorporated daily into the AICC Situation Report. Land managers may use other assessment tools such as spot forecasts, satellite imagery, local knowledge, websites, monitoring data, Rare Event Risk Assessment Process (RERAP), etc. to further assess potential impacts. Land Managers will consider the potential consequences of the fire on air quality and the impact of smoke on the public when making fire management decisions. The land manager will also consider the cumulative effects of the fire within the context of other fires burning within the same watershed (hydrologic unit (HUC)). The assessments/decisions are documented on one of the forms listed below.

Management Action and Responsibility: If the Fire Notification Form, the fire surveillance report or land manager's assessment indicates no potential impacts to a community or sensitive area, the fire is managed in accordance with the predetermined fire management option. If the Fire Notification Form, fire surveillance report and/or the land manager's assessment indicate that there are potential impacts to a community or sensitive area, the land manager in consultation with the Suppression FMO will determine the appropriate management response based on the best available information, including Threshold Criteria level. Smoke management issues and potential smoke impacts must be considered if a Decision Criteria Record implements a fire management response different from the predetermined fire management option. If a fire requires a WFSA or the fire is to be managed under a WFIP, potential consequences of the smoke on air quality and the impact of smoke on the public will be considered in developing management alternatives as required in both processes.

Assessments and/or alternatives chosen should be reviewed and validated routinely throughout the duration of the fire to ensure that smoke mitigation actions are implemented on a timely basis, if required.

Documentation: The suppression provider and land manager will document the assessments/decisions on one of the following:

1. Fire Notification Form (new starts);
2. Fire Surveillance Report (ongoing fires);
3. Decision Criteria Record (Alaska Interagency Wildland Fire Management Plan Appendix E);
4. Wildland Fire Implementation Plan (WFIP); or
5. Wildland Fire Situation Analysis (WFSA).

Threshold Criteria 2 ***Localized Impacts:***

Smoke concerns are moderate, although some concerns may require special mitigation. Smoke will be visible to the public over several days. Smoke exposures or amounts at the ***"unhealthy"*** level may cause health or safety concerns over a short period of time. Vistas, roads, and some residences may experience short-term decreases in visibility. Members of the public have expressed concerns about smoke. A few health related complaints may occur. Smoke intrusions may occur into smoke sensitive areas. Mitigation measures or additional smoke modeling may be needed to address potential concerns with smoke impacts. Specific smoke monitoring may be required to determine smoke plume heights and directions.

Assessment: Upon discovery of a fire, an initial assessment of potential impacts is made by suppression agencies and land managers. When fires are first discovered, suppression agencies document pertinent fire information including potential smoke impacts on the Fire Notification Form. Those forms are forwarded to land managers. Fire activity and potential impacts including those related to smoke for ongoing fires is documented on fire surveillance reports. This information is summarized and submitted by Zone/Area Dispatch Offices to the Alaska Interagency Coordination Center (AICC) and incorporated daily into the AICC Situation Report. ***"Unhealthy"*** air levels detected in a community and projected to continue or degrade further will prompt assessments by land managers. Examples of additional reference materials available to estimate the potential impacts from that fire and its affect a community's air quality include spot forecasts, satellite imagery, local knowledge, websites, monitoring data, and RERAP. Land Managers will consider the potential consequences of the fire on air quality and the impact of smoke on the public when making fire management decisions. The land manager will also consider the cumulative effects of the fire within the context of other fires burning within the same HUC. The decisions based on these assessments of mitigation alternatives and impacts are documented on one of the forms listed below. The assessment must be completed and documented within 72 hours from detection of ***"unhealthy"*** conditions.

Management Action and Responsibility: If the Fire Notification Form, Fire surveillance report and/or the land manager's assessment indicates **no potential** impacts to a community, sensitive area, or localized area, the fire is managed in accordance with the predetermined fire management option. If the Fire Notification Form, fire surveillance report and/or the land manager's assessment indicate **potential** impacts to a community, sensitive area, or localized area where ***"unhealthy"*** smoke impacts exist and are projected to continue, the land manager(s) in consultation with the Suppression FMO will determine the appropriate management response based on the best available information, including Threshold Criteria level. Existing localized smoke management issues and potential smoke impacts must be considered if a Decision Criteria Record implements a fire management response different from the predetermined fire management option. If a fire requires a WFSA or the fire is to be managed under a WFIP, potential consequences of the smoke on air quality and the impact of smoke on the public will be considered in developing management alternatives as required in both processes.

Assessments and/or alternatives chosen should be reviewed and validated routinely throughout the duration of the fire to ensure that smoke mitigation actions are implemented on a timely basis, if required.

Documentation: The suppression provider and land manager will document assessments/decisions on one of the following:

1. Fire Notification Form (new starts);
2. Fire Surveillance Report(ongoing fires);
3. Decision Criteria Record (Alaska Interagency Wildland Fire Management Plan Appendix E);
4. Wildland Fire Implementation Plan (WFIP); or
5. Wildland Fire Situation Analysis (WFSA).

<u>Threshold Criteria 3</u> ***<u>Regional Impacts:</u>***
Smoke concerns are high and require special and sometimes difficult mitigation. Smoke will be readily visible to the public and last several days to weeks. Smoke exposures or amounts at the ***"unhealthy"*** level are likely to cause health and safety concerns. Large segments of the public are concerned about smoke. Vistas, roads, and residences may experience longer-term decreases in visibility or significant decreases in visibility over the short-term. Major smoke intrusions may occur into smoke sensitive areas, such as hospitals and major airports, at ***"unhealthy"*** levels and trigger air quality and health concerns. Special coordination with air quality officials is required. Mitigation measures or additional smoke modeling are required to address potential concerns with smoke impacts. Specific smoke monitoring is required to determine smoke plume heights and directions.

Assessment: Upon discovery of a fire, an initial assessment of potential impacts is made by suppression agencies and land managers. When fires are first discovered, suppression agencies document pertinent fire information including potential smoke impacts on the Fire Notification Form. Those forms are forwarded to land managers. Fire activity and potential impacts including those related to smoke for ongoing fires is documented on fire surveillance reports. This information is summarized and submitted by Zone/Area Dispatch Offices to the Alaska Interagency Coordination Center (AICC) and incorporated daily into the AICC Situation Report. When fires with multiple land ownership cause air quality in a community to reach ***"unhealthy"*** levels and it is projected to continue or degrade further, land managers should complete additional assessments documentation within 72 hours from detection of ***"unhealthy"*** conditions. Land managers will follow assessment procedures identified under Threshold 2 and forward those assessments to their AWFCG representative. The AWFCG will evaluate the situation.

Management Action and Responsibility: Convene the AWFCG to evaluate the situation. The AWFCG may implement smoke mitigation actions such as initial attack of fires in a specific geographic area or region regardless of fire management option. AWFCG members are responsible to communicate AWFCG decisions within their agencies. Once air quality improves to ***"unhealthy for sensitive groups"*** for 72 hours or more**,** the AWFCG should re-evaluate decisions and on-going actions to determine if decisions and actions remain valid and should continue or if new parameters are needed.

If the Fire Notification Form, Fire surveillance report and/or the land manager's assessment indicates that the fire is **outside** of any geographic area that the AWFCG has implemented smoke mitigation actions and **<u>no potential</u>** impacts to a community, sensitive areas, or the regional area exist, the fire is managed in accordance with the predetermined fire management option. If Fire Notification Form, Fire surveillance report and/or the land manager's assessment indicates that the fire is **outside** of any geographic area that the AWFCG has implemented specific smoke mitigation actions and indicates **<u>potential</u>** impacts to a community, sensitive area, or regional area where ***"unhealthy"*** smoke impacts exist and are projected to continue, the land manager(s) in consultation with the Suppression FMO will determine the appropriate suppression response based on the best available information, including Threshold Criteria level. Existing smoke mitigation actions, regional smoke management issues and potential smoke impacts must be considered if a Decision Criteria Record implements a fire management response different from the predetermined fire management option. If a fire requires a WFSA or the fire is to be managed under a WFIP, potential consequences of the smoke on air quality and the impact of smoke on the public will be considered in developing management alternatives as required in both processes.

Assessments and/or alternative chosen should be reviewed and validated routinely throughout the duration of the fire to ensure that smoke mitigation actions are implemented on a timely basis, if required.

Documentation: The suppression provider and land manager will document the assessments/decisions on one of the following:

1. Fire Notification Form (new starts);
2. Fire Surveillance Report(ongoing fires);
3. Decision Criteria Record (Alaska Interagency Wildland Fire Management Plan Appendix E);
4. Wildland Fire Implementation Plan (WFIP); or
5. Wildland Fire Situation Analysis (WFSA).

Air Quality Guidelines				
Visibility Range*	**Categories**	**Monitored Particulate Value (PM2.5, 24 hr. average)**	**Health Effects**	**Cautionary Statements**
10 miles and up	**Good**	0-15	None	None
6 miles to 9 miles	**Moderate**	16-40	Possibility of aggravation of heart or lung disease among persons with cardiopulmonary disease and the elderly.	None
3 miles to 5 miles	**Unhealthy For Sensitive Groups**	41-65	Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly.	People with respiratory or heart disease, the elderly and children should limit prolonged exertion.
1.5 to 2.5 miles	**Unhealthy**	66-150	Increased aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; increased respiratory effects in the general population.	People with respiratory or heart disease, the elderly, and children should avoid prolonged exertion; everyone else should limit prolonged exertion.
0.9 to 1.4 miles	**Very Unhealthy**	151-250	Significant aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; significant risk of respiratory effects in the general population.	People with respiratory or heart disease, the elderly, and children should avoid any outdoor activity; everyone else should avoid prolonged exertion.
0.8 miles or less	**Hazardous**	>250	Serious aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; serious risk of respiratory effects in the general population.	Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly, and children should remain indoors.

* Procedures for making personal observations to estimate visibility

1. face away from the sun

2. look at objects/landmarks that are at known distances.
3. estimate the distance at which the known objects totally disappear

//s William B. Cella June 27, 2005
AWFCG Chair Date

FWS Developing a Response to Wildland Fire Supplement

Link to Redbook Chapter 10

F. Extended Attach Operations

4. Wildland Fire Situation Analysis

a. Definition

3) i. WFSA web site for latest WFSA information and program download
ii. A downloadable Wildland Fire Situation Analysis
iii. Sample WFSA

I. Air Quality and Smoke Management

Clean air is a primary natural resource value in all Fish and Wildlife Service units. Fire management activities which result in the discharge of air pollutants (e.g., particulates, carbon monoxide, and other pollutants from fires) 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, as amended (42 USO 7418). These requirements are the same substantive, procedural, and administrative requirements (See *561* FW 2) that apply to a private person or other non-governmental entity. The protection of these resources must be given full consideration in fire management planning and operations.

Coordination with a state or states air regulatory office is required during the development of resource and fire management plans in order to determine procedures for compliance with state air quality regulations. The FWS Air Quality Branch (AQB) should be contacted on the proper procedures for obtaining coordination with the state or states in which the refuge is located, or when notified by the state that an air pollution violation has occurred.

At the time the draft Fire Management Plan is sent to the regional office for review, the regional office will determine if the smoke management portions of the plan will be sent to the AQB for review and comment. A copy of the comments from the AQB will be returned to the region and will be forwarded to the refuge with the regional comments. When the draft Fire Management Plan is in the region for review, the Regional Fire Management Coordinator will ensure that the air quality coordinator reviews the smoke management portion of the plan and the comments from AQB before they are returned to the refuge. A copy of the air quality section(s) of the approved Fire Management Plan will be sent to the AQB.

The Smoke Management Guide for Prescribed and Wildland Fire 2001 Edition (NFES

1279) is the FWS primary technical reference and should be referenced when developing and implementing wildland fire management plans. Other useful geographical and activity specific publications are:

1. Southern Forestry Smoke Management Guidebook. Mobley et.al.., USDA Forest Service GTR SE- 10, December, 1976. A very detailed and comprehensive book but written specifically for the Southern States. It is an excellent reference for principles of smoke management. The abbreviated principles listed below are from this publication.
2. Principles of Smoke Dispersion from Prescribed Fires in Northern Rocky Mountain Forests. W.R. Beaufait and O.P. Cramer, USDA Forest Service, Division of Fire Control, Northern Region, Missoula, Montana, August *5*, 1969 (revised January *15*, 1972). This publication covers the subject well but is confined to the Northern Rocky Mountains.
3. Slash Smoke Management Guidelines. Office of the State Forester, Salem, Oregon, September 11, 1969. An excellent publication, though limited to slash burning and to the State of Oregon.

Appendix M
Wildland Fire Use Management.

Chapter 11
FWS Incident Management Information

Link to Redbook Chapter 11

E. 9. Wildland Fire Use

Implementation guidance is found in the interagency Wildland and Prescribed Fire Management Policy Implementation Procedures Reference Guide.

The determination of whether a FUIM2 may be used to manage a wildland fire use incident must be documented in the Wildland Fire Implementation Plan (WFIP) using the Wildland and Prescribed Fire Complexity Rating Worksheet. A FUM2 may only be used to manage wildland fire use incidents having a ***Low*** or ***Moderate*** overall complexity rating with **NO** individual complexity values of *5* (using the 1, 3, *5* scale) for the following Complexity Elements: Safety; Threats to Boundaries; Fuels and Fire Behavior; Objectives; Management Improvement; or Natural, Cultural, Social values. A National Wildfire Coordinating Group (NWCG) qualified Fire Use Manager (FUMA) can be used to manage all other wildland fire used to accomplish resource benefits. This does not preclude the agency administrator (or delegated individual) from requiring a FUMA to manage any wildland fire use incident regardless of complexity.

Wildland Fire Use
Agencies may apply this strategy in managing wildland fires for resource benefit. An approved Fire Management Plan (FMP) is required. This plan identifies specific resource and fire management objectives, a predefined geographic area, and prescriptive criteria that must be met.

A Wildland Fire Implementation Plan (WFIP) will be completed for all wildland fires that are managed for resource benefit. This is an operational plan for assessing, analyzing, and selecting strategies for wildland fire use. It is progressively developed and documents appropriate management responses for any wildland fire managed for resource benefits. The plan will be completed in compliance with the guidance found in the *Wildland Fire Use, Implementation Procedures Reference Guide, May 2005.*
A WFIP consists of three distinct stages:

- **Stage I** - The initial fire assessment, or size-up, is the preliminary information gathering stage. It compares current information to established prescription criteria found in the FMP. This is an initial decision making tool which assists managers in classifying fires for resource benefit or suppression actions. Components include: Strategic Fire Size-Up, Decision Criteria Checklist, Management Actions, and Periodic Fire Assessment.
- **Stage II** - Defines management actions required in response to a changing fire situation as indicated by monitoring information and the periodic fire assessment from Stage I. This stage is used to manage larger, more active fires with greater potential for geographic extent than Stage I. Components include: Objectives, Fire Situation, Management Actions,

Estimated Costs, and Periodic Fire Assessment.

- **Stage Ill** - Defines management actions required in response to an escalating fire situation, potential long duration, and increased need for management activity, as indicated by the periodic assessment completed in Stage II. Components include: Objectives and Risk Assessment Considerations, Maximum Manageable Area Definition and Maps, Weather Conditions and Drought Prognosis, Long-term Risk Assessment, Threats, Monitoring Actions, Mitigation Actions, Resources Needed to Manage the Fire, Contingency Actions, Information Plan, Estimated Costs, Post-burn Evaluation, Signatures and Date, and Periodic Fire Assessment.

WFIP Completion Timeframes

WFIP Stage	Maximum Completion Timeframe
Stage I	8 hours after confirmed fire detection and Strategic Fire Size-Up.
Stage II	48 hours after need indicated by Planning Needs Assessment.
Stage III	7 days after need indicated by Planning Needs Assessment
Periodic Fire Assessment	As part of all stages and on assigned frequency thereafter.

- ***NPS*** *- Wildland Fire Use Program Oversight. Regional office fire management officers are responsible for appraising and surveying all wildland fire use activities within their region. The regional office fire staff will review implementation plans for fires with a Complex Rating. Direct contact with parks may be necessary in order to stay apprised of complex situations. On rare occasions, circumstances or situations may exist which require the regional director to intervene in the wildland fire use decision process.*
- ***NPS*** *- Review by the regional fire management officer or acting is mandatory for Wildland Fire Implementation Plans with a projected cost of greater than $500,000. Review by the NPS National Fire Management Officer at NIFC, or Acting, is mandatory for Wildland Fire Implementation Plans with a projected cost of greater than $1,000,000.*

Appendix N
Prescribed Fire Plan Format

PRESCRIBED FIRE PLAN

ADMINISTRATIVE UNIT(S):

PROJECT NAME:

PREPARED BY: ____ DATE:____________
Name & Qualification

TECHNICAL REVIEW BY:____________________________ DATE:_______
Name & Qualification

COMPLEXITY RATING:____

APPROVED BY: ____ DATE:_______
Agency Administrator

DOI: The approved Prescribed Fire Plan constitutes the authority to burn. No one has the authority to burn without an approved plan or in a manner not in compliance with the approved plan. Actions taken in compliance with the approved Prescribed Fire Plan will be fully supported. Personnel will be held accountable for actions taken that are not in compliance with elements of the approved plan regarding execution in a safe and cost-effective manner.

AGENCY ADMINISTRATOR GO/NO-GO PRE-IGNITION APPROVAL CHECKLIST

PRESCRIBED FIRE NAME:

Instructions: The Agency Administrator's GO/NO-GO Pre-Ignition Approval is the intermediate planning review process (i.e. between the Prescribed Fire Complexity Rating System Guide and Go/No-Go Checklist) that should be completed before a prescribed fire can be implemented. The Agency Administrator's Go/No-Go Pre-Ignition Approval evaluates whether compliance requirements, Prescribed Burn Plan elements, and internal and external notifications have been completed and expresses the Agency Administrator's intent to implement the Prescribed Burn Plan. If ignition of the prescribed fire is not initiated prior to expiration date determined by the Agency Administrator, a new approval will be required.

YES	NO	KEY ELEMENT QUESTIONS
		Is the Prescribed Fire Plan up to date? *Hints: amendments, seasonality.*
		Have all compliance requirements been completed? *Hints: cultural, threatened and endangered species, smoke management, NEPA.*
		Is risk management in place and the residual risk acceptable? *Hints: Prescribed Fire Complexity Rating Guide completed with rational and mitigation measures identified and documented?*
		Will all elements of the Prescribed Fire Plan be met? *Hints: Preparation work, mitigation, weather, organization, prescription, contingency resources*
		Will all internal and external notifications and media releases be completed? *Hints: Preparedness level restrictions*
		Are key agency staff fully briefed and understand prescribed fire implementation?
		Other:

Recommended by: ____ Date: ___________
FMO/Prescribed Fire Burn Boss

Approved by: ____ Date: ___________
Agency Administrator

Approval expires (date): ____________________________________

PRESCRIBED FIRE GO/NO-GO CHECKLIST

PRESCRIBED FIRE NAME:

	YES	**NO**
A. Has the burn unit experienced unusual drought conditions or contain above normal fuel loadings which were not considered in the prescription development? If NO proceed with checklist., if YES go to item B.		
B. If YES have appropriate changes been made to the Ignition and Holding plan and the Mop Up and Patrol Plans? If YES proceed with checklist below, if NO STOP.		

YES	**NO**	**QUESTIONS**
		Are ALL fire prescription elements met?
		Are ALL smoke management specifications met?
		Has ALL required current and projected fire weather forecast been obtained and are they favorable?
		Are ALL planned operations personnel and equipment on-site, available, and operational?
		Has the availability of ALL contingency resources been checked, and are they available?
		Have ALL personnel been briefed on the project objectives, their assignment, safety hazards, escape routes, and safety zones?
		Have all the pre-burn considerations identified in the Prescribed Fire Plan been completed or addressed?
		Have ALL the required notifications been made?
		Are ALL permits and clearances obtained?
		In your opinion, can the burn be carried out according to the Prescribed Fire Plan and will it meet the planned objective?

If all the questions were answered "YES" proceed with a test fire. Document the current conditions, location, and results

____________________________________ Burn Boss

____________________ Date

COMPLEXITY ANALYSIS SUMMARY			
ELEMENT	**RISK**	**POTENTIAL CONSEQUENCE**	**TECHNICAL DIFFICULTY**
1. Potential for escape			
2. The number and dependence of activities			
3. Off-site Values			
4 On-Site Values			
5. Fire Behavior			
6. Management organization			
7. Public and political interest			
8. Fire Treatment objectives			
9 Constraints			
10 Safety			
11. Ignition procedures/methods			
12. Interagency coordination			
13. Project logistics			
14 Smoke management			

COMPLEXITY RATING SUMMARY	
	OVERALL RATING
RISK	
CONSEQUENCES	
TECHNICAL DIFFICULTY	
SUMMARY COMPLEXITY DETERMINATION	

RATIONALE:

DESCRIPTION OF PRESCRIBED FIRE AREA	PROJECT NAME:	
	BURN UNIT NAME:	

PHYSICAL DESCRIPTION

PROJECT OR BURN UNIT BOUNDARY DESCRIPTION

FUELS DESCRIPTION	
ON-SITE FUELS DATA	ADJACENT FUELS DATA

DESCRIPTION OF UNIQUE FEATURES (hazards, regulations, issues, constraints, etc. Examples may include: fences to protect, power poles, historical/cultural sites, threatened and endangered species or habitat, etc.)

GOALS AND OBJECTIVES	PROJECT NAME:	
	BURN UNIT NAME:	

<table>
<tr><th colspan="2">PURPOSE AND RESOURCE MANAGEMENT GOALS:</th></tr>
<tr><td colspan="2"></td></tr>
<tr><th colspan="2">RESOURCE AND PRESCRIBED FIRE OBJECTIVES</th></tr>
<tr><th>RESOURCE OBJECTIVES:</th><th>PRESCRIBED FIRE OBJECTIVES:</th></tr>
<tr><td></td><td></td></tr>
<tr><td>OBJECTIVES ARE S.M.A.R.T.</td><td>Specific
Measurable
Attainable
Reasonable
Time Related</td></tr>
<tr><th colspan="2">CONSTRAINTS:</th></tr>
<tr><td colspan="2"></td></tr>
</table>

FUNDING	PROJECT NAME:	
	BURN UNIT NAME:	

PRESCRIBED FIRE PHASE:	COST:	FUNDING SOURCE:
TOTAL OF ALL ESTIMATED COSTS:		

PRESCRIPTION: ENVIRONMENTAL PARAMETERS	**PROJECT NAME:**	
	BURN UNIT NAME:	
	PRESCRIPTION COVERAGE: **(Rx type &/or ignition method and season should be covered when multiple Rx included)**	

ENVIRONMENTAL PARAMETERS NEEDED TO PRODUCE THE DESIRED FIRE BEHAVIOR: Fill in applicable environmental parameters (weather, topography, fuels, etc.) for this fuel model. Separate environmental prescriptions may be needed for multiple fuel model conditions, seasonal differences and/or types of ignition (black lining, underburning, broadcast aerial ignition, etc.*	**Fuels Within the Project or Burn Unit Boundary**		**Fuels Outside of The Project or Burn Unit Boundary**	
	Low Fire Intensity	**High Fire Intensity**	**Adjacent**	**Max. Spot Distance**
Environmental parameters discussion, or description of empirical evidence utilized:				

*Separate prescriptions pages should be added for multiple prescriptions and result in multiple complexity ratings and burn organizations.

PRESCRIPTION:	**PROJECT NAME:**	
	BURN UNIT NAME:	

<table>
<tr><td>FIRE
BEHAVIOR PARAMETERS OUTPUTS</td><td colspan="2">PRESCRIPTION COVERAGE:
(Rx type &/or ignition method and season should be covered when multiple Rx included)</td><td colspan="2"></td></tr>
<tr><td rowspan="2">DESCRIPTION OF PRESCRIBED FIRE BEHAVIOR CHARACTERISTICS NEEDED TO MEET THE RESOURCE MANAGEMENT OBJECTIVES STATED IN THE OBJECTIVES SECTION: Fill-in all applicable fire behavior parameters (flame lengths, rate of spread, scorch height, ERC, etc.) for this fuel model. Separate environmental prescriptions may be needed for multiple fuel model conditions, seasonal differences and/or types of ignition (black lining, underburning, broadcast, aerial ignition, etc.*</td><td colspan="2">Fire Behavior For Fuels Within the Project or Burn Unit Boundary</td><td colspan="2">Fire Behavior For Fuels Outside the Project or Burn Unit Boundary</td></tr>
<tr><td>Low Fire Intensity</td><td>High Fire Intensity</td><td>Adjacent</td><td>Max. Spot Distance</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Fire Behavior outputs may be derived from BEHAVE models, nomograms, or historical/empirical evidence. Include modeling and/or empirical evidence documentation as an appendix or in the fire behavior narrative.</td></tr>
<tr><td colspan="5">Fire Behavior Narrative or description of empirical evidence:</td></tr>
<tr><td colspan="5"></td></tr>
</table>

*Separate prescriptions pages should be added for multiple prescriptions and result in multiple complexity ratings and burn organizations.

<table>
<tr><td rowspan="2">SCHEDULING</td><td>PROJECT NAME:</td><td></td></tr>
<tr><td>BURN UNIT NAME:</td><td></td></tr>
<tr><td colspan="3" align="center">IGNITION TIMEFRAMES:</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3" align="center">PROJECT DURATION:</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3" align="center">CONSTRAINTS:</td></tr>
<tr><td colspan="3"></td></tr>
</table>

PRE-BURN CONSIDERATIONS	**PROJECT NAME:**	
	BURN UNIT NAME:	

ON AND OFF-SITE CONSIDERATIONS
ON SITE: **OFF SITE:**
METHOD AND FREQUENCY FOR OBTAINING WEATHER FORECAST(S):
NOTIFICATIONS:

Who	When*	Phone Number and/or e-mail	Responsibility	Date	Method

PRESCRIBED FIRE BRIEFING CHECKLIST	

- **Burn Organization**
- **Burn Objectives**
- **Description of Burn Area**
- **Expected Weather & Fire Behavior**
- **Communications**
- **Ignition plan**
- **Holding Plan**
- **Contingency Plan**
- **Wildfire Conversion**
- **Safety**

The Prescribed Fire Burn Boss, or designee, will ensure that any new personnel arriving to the prescribed fire receives a briefing prior to assignment.

<table>
<tr><td rowspan="2">ORGANIZATION AND EQUIPMENT</td><td>PROJECT NAME:</td><td></td></tr>
<tr><td>BURN UNIT NAME:</td><td></td></tr>
<tr><td colspan="3">Specify the minimum required implementation organization to meet the capabilities by position, equipment, and the supplies needed for the prescribed fire until declared out. Different organizations may be identified for different stages of implementation (i.e. holding v. mop-up and patrol, different ignition operations, different prescriptions).</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">CHANGES TO ORGANIZATION DURING IMPLEMENTATION:
Any changes to the organization during implementation must be documented. These are changes that may reflect assignments to other personnel not changes to the capabilities, equipment or supplies which would require an amendment.</td></tr>
<tr><td colspan="3"></td></tr>
</table>

COMMUNICATIONS	PROJECT NAME:	
	BURN UNIT NAME:	

Identify and assign command, tactical and air operations frequencies as needed.						
SYSTEM	**RX FREQ.**	**RX TONE**	**TX FREQ.**	**TX TONE**	**ASSIGNMENT**	**REMARKS**

PROJECT PHONE NUMBERS	
PERSONNEL NAME:	**PHONE NUMBER:**

PUBLIC, PERSONNEL SAFETY	PROJECT NAME:	
	BURN UNIT NAME:	

GENERAL PUBLIC AND PERSONNEL SAFETY MESSAGE:

SPECIFIC SAFETY DISCUSSION INCLUDING UNIQUE HAZARDS AND CONCERNS:

EMERGENCY MEDICAL PLAN	PROJECT NAME:	
	BURN UNIT NAME:	

EMERGENCY FACILITIES:

EMERGENCY EVACUATION:

MEDICAL EMERGENCY PROCEDURES:

DIRECTIONS FROM NEAREST MEDICAL FACILITY TO PROJECT VIA GROUND:

<table>
<tr><td rowspan="2">TEST FIRE</td><td>PROJECT NAME:</td><td colspan="4"></td></tr>
<tr><td>BURN UNIT NAME:</td><td colspan="4"></td></tr>
<tr><td colspan="6">PLANNED LOCATION & SPECIFIC INSTRUCTIONS:</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">BURN DAY DOCUMENTATION</td></tr>
<tr><td colspan="2">WEATHER CONDITIONS ONSITE:</td><td colspan="4">RESULTS OF TEST FIRE:</td></tr>
<tr><td colspan="2"></td><td colspan="4"></td></tr>
<tr><td>Does the test fire meet prescription parameters?</td><td>YES</td><td></td><td>NO</td><td></td><td></td></tr>
<tr><td colspan="6">COMMENTS:</td></tr>
<tr><td colspan="6"></td></tr>
</table>

IGNITION PLAN	PROJECT NAME:	
	BURN UNIT NAME:	

NARRATIVE FOR IGNITION PLAN:
METHOD(S)*: TECHNIQUES: SEQUENCES: ANTICIPATED PATTERNS:
If aerial ignition (or other aerial operations) is planned, also cover aviation operations, organization, and safety. If a specific administrative or agency aerial ignition plan exists, attach to the prescribed fire plan

*Multiple prescriptions may require identifying and developing multiple ignition organizations and implementation instructions.

HOLDING PLAN	PROJECT NAME:	
	BURN UNIT NAME:	
GENERAL PROCEDURES NARRATIVE FOR PRESCRIBED FIRE HOLDING:		
CRITICAL HOLDING POINTS AND MITIGATION ACTIONS:		
Critical holding points and safety zones will be identified on the project map		

PRESCRIBED FIRE MOP-UP & PATROL	PROJECT NAME:	
	BURN UNIT NAME:	
GENERAL PROCEDURES NARRATIVE FOR PRESCRIBED FIRE MOP-UP AND PATROL:		
PRESCRIBED FIRE DECLARED OUT BY:		

<table>
<tr><td rowspan="2">CONTINGENCY PLAN</td><td>PROJECT NAME:</td><td></td></tr>
<tr><td>BURN UNIT NAME:</td><td></td></tr>
<tr><td colspan="3">TRIGGER POINTS:
Determine trigger points that indicate when additional holding resources and actions are needed to ensure the prescribed fire stays within prescription.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">ACTIONS NEEDED:
Describe actions to be taken to ensure the prescribed fire stays within prescription.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">MINIMUM RESOURCES AND MAXIMUM RESPONSE TIME(S):
Describe personnel needed to ensure the prescribed fire stays within prescription. Plans may identify different levels of contingency staffing needed for different stages of the burn, ignition through patrol. Verify availability of identified contingency resources on day of implementation.</td></tr>
<tr><td colspan="3"></td></tr>
</table>

If contingency resources availability falls below plan levels for that stage of the burn, actions must be taken to secure operations until identified contingency resources are replaced.

With the ordering and/or deployment of contingency resources, the burn boss will notify the Agency Administrator through the appropriate chain of command.

<table>
<tr><td rowspan="2">WILDFIRE CONVERSION</td><td>PROJECT NAME:</td><td></td></tr>
<tr><td>BURN UNIT NAME:</td><td></td></tr>
<tr><td colspan="3">A prescribed fire must be declared a wildfire by those identified in the plan when that person(s) determines that the contingency actions have failed or are likely to fail and cannot be mitigated within the next burning period by on-site holding forces and any listed contingency resources. In addition, 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 within the next burning period.</td></tr>
<tr><td colspan="3">WILFIRE DECLARED BY:
Who will make the decision that the fire has escaped</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">IC ASSIGNMENT:
Identify who will be the IC</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">NOTIFICATIONS:
Identify the notifications to be made and who will make them.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">EXTENDED ATTACK ACTIONS AND OPPORTUNITIES TO AID IN SUPPRESSION EFFORTS:</td></tr>
<tr><td colspan="3"></td></tr>
</table>

<table>
<tr><td rowspan="2">SMOKE MANAGEMENT AND AIR QUALITY</td><td>PROJECT NAME:</td><td></td></tr>
<tr><td>BURN UNIT NAME:</td><td></td></tr>
<tr><td colspan="3">COMPLIANCE:
Describe how the project will comply with local community, County, State, Tribal, and Federal air quality regulations.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">IMPACTED AREAS:
Identify Class I air sheds, restricted areas, non-attainment areas (designated areas), and population centers that may be impacted.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">SENSITIVE FEATURES AND RECPTORS:</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">MITIGATION STRATIGIES AND TECHNIQUES TO REDUCE IMPACTS (If Applicable):</td></tr>
<tr><td colspan="3"></td></tr>
</table>

MONITORING	PROJECT NAME:	
	BURN UNIT NAME:	

MONITORING: Describe the monitoring that will be required for the prescribed fire. At a minimum specify the weather, fire behavior and fuels information (forecast and observed) and smoke dispersal monitoring required during all phases of the project and the procedures for acquiring it, including who and when.

POST-BURN ACTIVITIES	PROJECT NAME:	
	BURN UNIT NAME:	

POST-BURN REPORT: Prescribed fire reporting will include: burn day conditions, fire behavior, smoke dispersal, and first order fire effects.
OTHER: Describe other post-burn activities that must be completed. This may include: safety mitigation measures, and rehabilitation needs including those as a result of pre-burn activities undertaken.

APPENDICES

A. Maps

B. Technical Review Checklist

C. Complexity Analysis

D. Job Hazard Analysis

E. Fire Behavior Modeling Documentation or Empirical Documentation (unless it is included in the fire behavior narrative in Element 7; Prescription)

VICINITY MAP

PROJECT MAP

Insert the following documents into the plan

- Completed NWCG Complexity Analysis
- Completed Job Hazard Analysis
- Completed Fire Behavior Modeling Documentation or Empirical Documentation.

TECHNICAL REVIEWER CHECKLIST		
PRESCRIBED FIRE PLAN ELEMENTS:	**S /U**	**COMMENTS**
1. Signature page		
2. GO/NO-GO Checklists		
3. Complexity Analysis Summary		
4. Description of the Prescribed Fire Area		
5. Goals and Objectives		
6. Funding		
7. Prescription		
8. Scheduling		
9. Pre-burn Considerations		
10. Briefing		
11. Organization and Equipment		
12. Communication		
13. Public, Personnel Safety and Medical Procedures		
14. Test Fire		
15. Ignition Plan		
16. Holding Plan		
17. Contingency Plan		
18. Wildfire Conversion		
19. Smoke Management and Air Quality		
20. Monitoring		
21. Post-burn Activities		
22. Maps		
23. Complexity Analysis		
24. JHA		
25. Fire Prediction Modeling Runs		
26. Other		

S = Satisfactory

U = Unsatisfactory

See approval form next page:

Recommended for Approval:

____ ________________________

Technical Reviewer Qualification and currency (Y/N) Date

Approval is recommended subject to the completion of all requirements listed in the comments section, or on the Prescribed Fire Plan.

Not Recommended for Approval:

____ ________________________

Technical Reviewer Qualification and currency (Y/N) Date

Reason(s) for non-approval and follow-up required for approval:

Appendix O
Prescribed fire qualifications

Prescribed Fire Burn Boss Type 1 (RXB1)

Required Training:

Advanced Wildland Fire Behavior (S-490)

Prerequisite Experience:

Satisfactory performance as a Prescribed Fire Burn Boss Type 2 plus satisfactory performance as an Incident Commander Type 3 plus satisfactory position performance as a Prescribed Fire Burn Boss Type 1 in representative fuel group(s)

Prescribed Fire Burn Boss Type 2 (RXB2)

Required Training:

Introduction to Wildland Fire Behavior Calculations (S-390)

Prerequisite Experience:

Satisfactory performance as an Ignition Specialist Type 2 + Satisfactory performance as an Incident Commander Type 4 + Satisfactory position performance as a Prescribed Fire Burn Boss Type 2 in representative fuel group(s).

Ignition Specialist Type 1 (RXI1)

Required Training: None

Prerequisite Experience:

Satisfactory performance as an Ignition Specialist Type 2 plus satisfactory position performance as an Ignition Specialist Type 1

Ignition Specialist Type 2 (RXI2)

Required Training: None.

Prerequisite experience:

Satisfactory performance in any Single Resource Boss position + Satisfactory position performance as an Ignition Specialist Type 2.

Fire Effects Monitor

Required Training:

Intermediate Fire Behavior (S-290)

Prerequisite Experience:

Satisfactory experience as a Firefighter Type 2 plus satisfactory position performance as a Fire Effects Monitor

Firefighter (FFT2)

Required Training:

Firefighting Training (S-130) and Introduction to Wildland Fire Behavior (S-190).

Prerequisite Experience: None.

Appendix P
AWFCG Fire Effects Monitoring Protocols (Revised May, 2006)

Note: These protocols are still in draft form and are currently out for peer review. The final protocols will be appended to this plan when they become available.

<u>*********DRAFT***********</u>**
<u>Fire Monitoring Protocol</u>
<u>Alaska Interagency</u>
<u>Fire Effects Task Group (FETG)</u>

INTRODUCTION

The purpose of this document is to provide basic protocol for methods to monitor or inventory Alaska fuels and/or fire effects. Guidelines for monitoring wildland fires, prescribed fires and mechanical treatments were developed in consultation with the Interagency Alaska Fire Effects Task Group (FETG), NPS Fire Monitoring Handbook (FMH 2003), and USFS FIREMON methods (http://fire.org/firemon/).

> *"Monitoring the effects of wildland fire is critical for (1) documenting fire effects, (2) assessing ecosystem damage and benefit, (3) evaluating the success or failure of a burn, and (4) appraising the potential for future treatments. Objectives for monitoring depend on the type of fire. Wildfire monitoring is necessary to evaluate the possible need for rehabilitation (Hardwick et al. 1998), while monitoring after prescribed fires is required to assess the effectiveness of the treatment. Monitoring data can have far-reaching applications in fire management because it provides the scientific basis for planning and implementing future burn treatments. Measuring post-fire ecosystem response also allows us to understand the consequences of fire on important ecosystem components and share this knowledge in a scientifically based language. Monitoring is the critical feedback loop that allows fire management to constantly improve prescriptions and fire plans based on the new knowledge gained from field measurements."* (FIREMON, 2004).

Goals and Objectives

There were three primary goals for developing an interagency protocol for monitoring fire and fuel treatments effects.

- Provide interagency protocols to encourage collaboration, thus increased sample sizes within different vegetation communities for broader landscape inference.

- Provide a simple monitoring protocol designed to meet common needs in monitoring fire and fuels treatment effects.

- Provide protocols that can be implemented in a "rapid response" situation or can be expanded to provide more in-depth information for specific variables of interest.

Ecological monitoring must be designed to meet the objectives of each project and therefore the FETG anticipates that this protocol may have components added or deleted in response to specific project objectives. However, this protocol was designed to address the most common monitoring objectives following fire or fuels treatments. These objectives are to:

- Document changes in vegetation, fuels and soils following disturbance (i.e. fire or treatment) through time.

- Quantify the probability of vegetation successional trajectories following disturbance.

- Provide input data for fire behavior models and land classification.

A tabular summary of the common objectives that are addressed by individual components of this protocol is included in Appendix A.

Monitoring Levels and Variables

Recognizing the need for basic monitoring methods that would work in Alaska fuels, the FETG initially developed recommendations for minimum variables to monitor fire or treatment effects within a framework of three monitoring intensities (Level 1 – 3). A brief description of the three monitoring levels is provided below:

Level 1, Surveillance Monitoring - This level provides a basic overview of the baseline data that is required to be collected for all wildland or prescribed fires, some variables are required for mechanical treatments. Information at this level includes such items as RAWS weather data, general description of the fire environment (i.e. topography and fuel types), and fire location or perimeter. Information collected at this level precludes the necessity for on the ground measurements and can be done from remote sensing or an aerial platform. The FETG has previously provided an interagency technical reference on photo points and a sample data sheet in Excel format, available for download at http://fire.ak.blm.gov under Fire Effects header (file share).

Level 2, Moderate Intensity Monitoring - This level of monitoring documents fire behavior observations (not addressed in this document), fuels, and general effects of wildland fires, prescribed fires or mechanical treatments on vegetation. Information at this level includes characteristics of the fire, such as rate of spread, fire behavior, and burn severity, as well as current weather conditions. Fuel conditions would be assessed by determining the fuels array, composition, and dominant vegetation within the burn area, in addition to using vegetation and fuels maps to predict potential fire spread. Information to assess pre and post fire or treatment effects would include duff depth and moisture measurements, photo points, vegetation cover, and tree parameters. This level of monitoring is recommended for wildland fire use and prescribed fires, but is dependent on the objectives of the burn and the resources of concern. Some of the variables monitored at this level would require on the ground measurements of specific sites.

Level 3, Comprehensive Monitoring (Short or Long-term Fire Effects) – This level would be used to monitor the effects of prescribed or wildland fires in greater depth, it may also be used for mechanical treatments. Level 3 monitoring requires collecting information on fuel reduction, vegetative changes, and soil parameter changes. This level of monitoring may also include wildlife utilization techniques. The number of variables monitored increases and the techniques are more rigorous. Information collected at this level is based upon management objectives and the resources of concern. Variables monitored at this level would require the establishment of permanent plots.

Suggested monitoring variables for Level 1 through 3 are shown in Figure 1. These levels are cumulative, for instance all variables monitored in Level 1would be included in Level 2 monitoring. Level 1 variables are recommended minimums for all fires. The implementation of variables at Level 2 and Level 3 would depend on the objectives of the fire and the resources of concern, and would remain up to the discretion of the FMO, fuels specialists, resource staff, and fire ecologist. The difference between Level 2 and Level 3 monitoring will often be the nature of data gathered for the same variable (qualitative vs. quantitative) or the number of plots, which may determine the statistical significance of findings.

FETG Fire Monitoring Variables

Level 1

- Perimeter
- Fuel types
- Photo points/Lat-Long
- Weather (measured or from RAWS)
- Topographic features (from perimeter map)
- Burn severity maps (>300 acre fires) (optional)

Level 2

- Perimeter
- Fuel types
- Photo points/Lat-Long
- Weather
- Topographic features
- Fire Behavior
- Smoke
- Duff moisture/depth
- Burn severity
- Vegetation class (pre & post)
- Vegetation cover/ composition
- Tree density by species and size class
- Canopy height
- Canopy closure

Level 3

- Perimeter
- Fuel types
- Photo points
- Weather
- Topographic features
- Fire Behavior
- Smoke
- Duff moisture/depth
- Burn severity
- Vegetation class (pre & post)
- Vegetation cover (pt intercept)/species composition
- Tree density by *spp*, size class
- Tree canopy cover
- Tree heights, diameters
- Ladder fuel heights
- Duff moisture/depth
- Active layer depth
- Soil parameters
- Tree ring disks/cores
- Shrub or species specific densities
- Brown's transects
- Additional variables as needed

METHODS OVERVIEW

The following section describes a set of Alaska field-tested methods used in a simple “Level 3” monitoring effort which employs permanent ground plots. Each plot can be laid out and read by an experienced crew in less than 2 hours. Data can be entered easily into either of the National fire effects database programs (NPS FEAT or U.S. Forest Service FIREMON). Each of the National programs offers their own field datasheets which can be used, but the attached custom datasheets will expedite field data collection and already have names of common Alaska species filled in. This reference intentionally limits its scope to Alaska vegetation and field conditions. For simplicity, the myriad of options for modifying and customizing monitoring protocols or plot sizes, levels of monitoring intensity, deciding on the number of plots to use, placement of plots, other variables to include, etc. are not discussed here. It is recommended the user consult many other excellent references on setting up a monitoring study, including Elzinga, et al 1998, FMH, FEAT, and FIREMON user guides.

THE OVERVIEW:

1. PLOT DESCRIPTION (Enter on *SITE AND GENERAL VEGETATION* form)
   - General plot description, direction to plots
   - Lat/Long, datum, error
   - General vegetation type/fuel model
   - Photo information

2. VEGETATION COVER (Point Intercept) (Enter on *VEGETATION COVER-Point Intercept* form)
   - Point intercept 30-m transect (60 points, every 0.5-m along 30-m baseline).
   - Stake with chaining pins or permanently stake both ends with PVC conduit, fiberglass survey stakes or buried rebar stakes.
   - Record all trees, shrubs, herbaceous species, include substrate or groundcover hits at each point.
   - Photograph both ends toward middle (FIREMON convention is a North and East photo only).
   - Read on right, walk on left of baseline.

3. TREE DENSITIES (Enter on *TREE DENSITY TALLY* and *TREE MEASUREMENT* forms)
   - 1-m x 30-m belt transect rectangle for all trees >4.5’ (1.37 m) in height.
   - Tally trees >4.5’ in height by species and diameter size classes: (< 5 cm, 5.1-10 cm, 10.1-15 cm, 15.1-23 cm, >23 cm), and status (Live/Dead). (*TREE DENSITY TALLY* form).
   - Tally small trees (<4.5’ tall) in 3 subplots, 1-m x 1-m located at 3, 15, & 27-m marks. (total “seedling” area of 3.0 m^2 or 0.00037 ac) (*TREE DENSITY TALLY* form).
   - For two trees of each species and size class record diameter (DBH), height, crown base height (CBH), ladder fuel heights, crown radius (see instructions *TREE MEASUREMENT* form)
   - For all trees > 23 cm record species, DBH, height, crown base height (CBH), ladder fuel heights, crown radius (*TREE MEASUREMENT* sheet).

4. PERMAFROST DEPTH & BURN SEVERITY
   - Measure the depth of the active layer every 3 m beginning at 3-m mark, for 10 total points. (Enter on *PERMAFROST/BURN SEVERITY* datasheet).

- Post-burn: Record micro-site specific burn severity index, use FMH convention with 5-class severity codes for substrate and vegetation, every 3 m beginning at 3-m mark, for 10 total points. (Enter on *PERMAFROST/BURN SEVERITY* datasheet).

Additional burn severity options:

- Duff consumption pins (pre-burn) every 3-m, for a total of 10 points, co-located with FMH burn severity index).
- CBI (Composite Burn Index) for overall burn severity score of plots, and for comparison to remote-sensed burn severity (D-NBR normalized burn ratio).

5. DUFF & LITTER DEPTH
    - Measure the depth of the forest floor surface material (live moss, dead moss, upper and lower duff layers) at two places displaced at least 1 m off the transect which appear similar with respect to forest floor characteristics along the transect. (Enter on *DOWN WOODY DEBRIS & DUFF DEPTHS* form)

6. DOWN WOODY FUEL LOADING (optional)
    - Brown's transect along baseline: 2m for 1-hr and 10-hr; 4m for 100-hr, and 30m for 1000-hr fuels. (6.6 ft, 13.1 ft, and 98 ft).
    - If quantitative fuel loading is desired, place additional Brown's transects at 120 deg and 240 deg from origin and mark end w/ pin flag. (enter on *DOWN WOODY DEBRIS & DUFF DEPTHS* form)

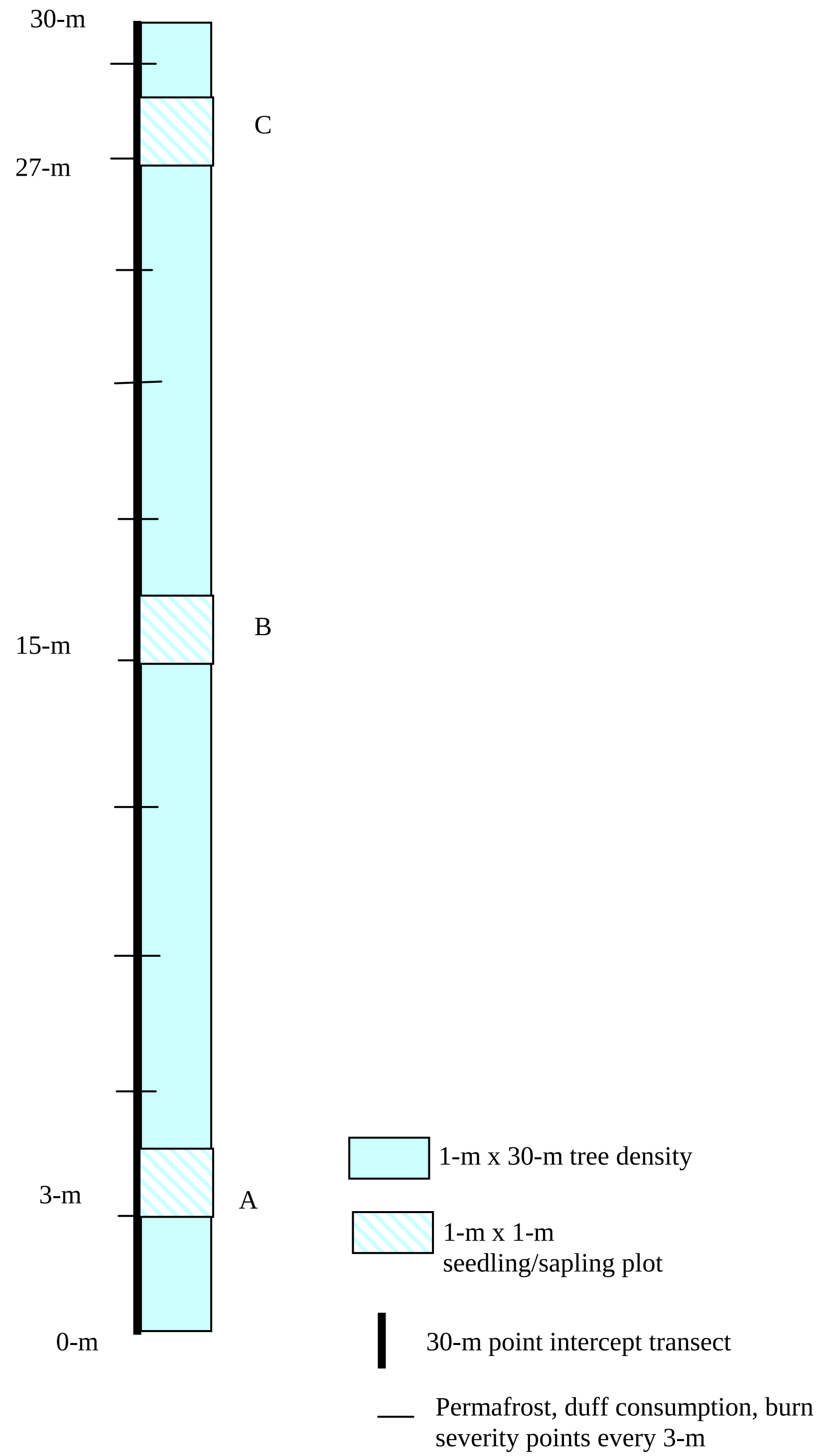
7. SHRUB DENSITY (optional)
    - If quantitative data is desired for woody browse or shrub species, tally individuals (or **stems above ground** for clonal *spp.* such as alder, or when it is not possible to distinguish individual shrubs) in the same 1-m x 30-m belt which was used for trees. In very dense brush, may need to subsample to 0.5 X 30 m belt, or tree seedling plots. (Enter on *SHRUB DENSITY* form).
      - Recommend **not** tallying rose, raspberry, or spirea in shrub transects if doing this for browse info: accurate counts are very difficult.

METHODS DETAILED

Plot Setup

See plot figure 1. A 30-m x 1-m plot will be setup based off the random point coordinate. Determine a random azimuth, using a random number generator or the compass spin method. Setup a 30-m transect by staking the zero end of a 30-m/100-ft with the chaining pins or conduit and pull the end of the tape in a straight line in the direction of the random bearing (be sure to record declination used). Drive spray painted 2.5-ft conduit into each end of the plot as marked on the figure. Tag the zero-end of the transect ("origin") with an aluminum tag displaying the plot number and date. Mark additionally with flagging for easy visual in aerial photo. Avoid walking or trampling on the right side of the transect, where the vegetation measurements will be made. For all plots collect a GPS position at the zero end of the tape. Record the waypoint number or point name and lat/long on the data sheet, as well as noting the error. For all plots collect an averaged (20 pt average or more) GPS position at the zero end of the tape. Record the WP number and lat/long on the data sheet. NAD-83 Datum will be used in the GPS receivers (Standard for DOI agencies).

Figure 1. Plot diagram.



Site and Photo Points

General site information will be collected and recorded for each plot on the Site and General Vegetation form (Appendix B). It is recommended that additional site location descriptions, diagrams of plots, and additional notes on the plot be written up on separate sheet. The definitions of the fields for the Site and General Vegetation Form are given below:

- **Unit** – land unit identifier or write out land unit name - (i.e. Steese White Mtns, Yukon-Charley NP) (NPS - four letter park acronym)
- **Project** – Description of project: PPF (pre/post fire), CBI (burn severity), HZF (for hazard fuels), PP (paired plots).
- **Plot ID** – Identifier for the plot within the project. For pre/post fire plots, use the fire number and sequential numbering 01 through x.
- **Fire Name and Fire Date** – Fire name/number or project location i.e Front Country
- **Fire Date -** Date of fire or fuels treatment (pre-treatment will be blank).
- **Field date** – Sample date
- **Field Crew** – Names of crew members
- **WP number and GPS number** – record the WP number of the collected point and the name or number of the GPS used.
- **Lat/Long** – Using a GPS (Garmin V recommended), collect a lat/long averaging the time of collection for 20 points. Record in Decimal Degrees - i.e. Lat: N 65.634891° Long: W 142.982340°
- **GPS Error -** Record the error EPE and units, this needs to be recorded before you save the waypoint in Garmin handhelds.
- **Datum** – GPS datum used for collecting and navigating to plots, use NAD-83 (this is the same as WGS-84).
- **Transect Azimuth** – record the azimuth of the transect facing from the zero end to the 30-m end.
- **Declination used** – record the declination setting used on your compass, for the initial reading, base your declination on the most recent topographic map. For future reading use the declination used in the original setup.
- **Transect slope** – record the slope looking down the transect
- **Slope** – Percent slope, use clinometer
- **Aspect** – Slope aspect (facing downhill) azimuth in degrees
- **Elevation** – Taken form GPS or maps in feet or meters (record units)

- **Viereck Class** – Using Viereck's (1992) Alaska Vegetation Classification, determine the vegetation class to level IV, or if possible level V for the plot area. Either write it out: Open PICMAR/LEDGRO/HYSPLE or use numeric: I.A.2.f with Labrador tea.
- **Soil** – Estimate of soil drainage: wet, moist, dry.
- **Disturbance** – General note of disturbances, record date estimate if known. This is for the plot and general vicinity.
- **Evidence of fire**
- **Photo number, time and camera** – record the photo number in the digital camera or keep a photo log if standard camera, record the time of the photos (for digital cameras) and the camera used.

A minimum of two photos will be taken for each plot, aerial photos should be taken of the plot. The photos will be taken from each end of the vegetation sampling transect looking towards the plot center. Label a dry-erase board with the sample date, park-project-location-plot ID (i.e. YUCH-PPF-A324-02), transect azimuth (direction facing) and designate as 0-m ---> 30-m and vice-versa. Hold the board to the edge of the photo view within the first 1.5 - 2 m of the transect with the camera set at a fixed height of 5 ft above the ground. Record the photo number of the plot on the site data sheet.

Vegetation and Ground Cover

Ocular Vegetation Sampling- Ocular estimates of vegetation and ground cover are recorded on the Site and General Vegetation form for dominant vegetation and ground cover within the 30-m transect. The cover classes are defined as: 1-9%, 10-24%, 25-59%, 60-74%, and ≥75%. Estimate the cover of each species or ground cover and check the appropriate column. Due to overlapping and canopy cover, the total cover can equal more than 100%. Additional species can be added on the second page or by crossing out pre-written species. Estimate the height by height class in meters for all trees and shrubs. Species are listed by layer as described below:

- *TREE LAYERS* - List all the species that occur within the plot and estimate the percent cover. Willows or alders of tree size are not considered trees. Check the box showing the average height of the canopy, estimate average tree diameter, ladder fuel heights and live crown heights. If a single species forms two distinct sub-layers, list it twice. Use scientific names where possible to indicate species, use first three letters of the genus and the species.
- *SHRUB LAYERS* - Shrubs are defined as woody plants with multiple stems. For each shrub species check the appropriate cover class and height class. If there are newly established shrubs, identify if plants are new seedlings or re-sprouts, otherwise leave the column blank.

- *HERBACEOUS and GROUND LAYER* - Within the herbaceous (non-woody) layer, estimate the % herbaceous cover provided by graminoids (grasses, sedges, rushes), forbs (flowering) plants, ferns, and horsetails. Estimate the % ground cover provided by mosses and hepatics (liverworts), lichens, litter (dead leaves or needle litter), and bare ground or talus. If there are newly established herbs, identify if plants are new seedlings or re-sprouts, otherwise leave the column blank.

Vegetation/Ground Cover - Point-Intercept Sampling- Along the 30-m transect, the point intercept method will be used to determine plant and ground cover. Every 50 cm along the 30-m transect, all plant species and forest floor surface cover (mosses, lichens, litter) that are intercepted at that point will be recorded. Start at the 0.5 m mark and sample along the right side of the transect. Using a ¼" diameter pole (6 ft fiberglass bike flag), gently lower the pole so that the rod is plumb to the ground (on slopes this will not be perpendicular to the ground). At each point intercept record the species that touch one side of the pole from top to bottom, for example if black spruce was the tallest vegetation at that point hit it would be recorded first, similarly ground cover will always be last. Record the species code on the Point Intercept Data Sheet. Use the NRCS four letter code for vascular plants, bryopytes (mosses) and lichens. In general the first two letters are the genus (i.e. Salix) and the last two are the species (i.e glauca) is SAGL. Use the USDA plants database for most current species codes (http://plants.usda.gov/). Numerics are frequently used to differentiate species with similar codes, if you can't remember the exact code write out the species on the bottom of the sheet and the acronym used for that species. If there are unknown species that are common, collect for identification and record an identifiable acronym and note on the data sheet. For dead standing trees record the species and include D after the species code. For dead branches on a live tree, record the tree as though it were alive. From this data we will calculate the species composition and percent cover by species or substrate.

Forest Measurements

Tally all trees taller than 1.4-m (4.5 ft) that occur within an a 1-m belt transect on the right side of the point intercept transect by species and diameter size classes (< 5 cm, 5.1 - 10 cm, 10.1 - 15 cm, 15.1 – 23 cm, > 22.5 cm DBH) (as defined by the Forest Service Natural Fuels Photo Series, 2001). Use a linear metric measuring tape or the folding ruler to determine if trees are within 1-m of the transect line (30 m^2). All live "seedling" trees less than 4.5 ft tall will be tallied by species on 3 subplots (1-m x 1-m) at the 3, 18, and 27-m mark along the base transect (total seedling area of 3.0 m^2 or 0.00037 ac).

Detailed tree measurements will be recorded all trees larger than 23 cm (9 inch) dbh AND for two smaller live trees (> 4.5 feet tall) of each species and each size class recorded within the tree density plot. In order to randomly select the trees <23 cm to be measured, select trees that are closest to the mid-point of the tree density belt (15-m point). The following measurements will be taken: DBH (diameter at breast height), tree height, height to live crown, height to live and dead ladder fuels, and crown radius. Data will be used to determine summary data such as, density, basal area, crown bulk density, and stand height. Example data sheets for measurements are in Appendix B and examples of tree measurements are in Appendix C. Definitions of the parameters measured are given below:

- **Species -** record the species of the tree using six letter acronyms (first three letters of genus and first three letters of species). All willows and alders will be classified as shrubs.
- **DBH -** measure the diameter of the tree in centimeters at 4.5 ft or 1.37m above the ground, using the metric logger's tape.
- **Tree height -** Measure the tree height in 1/10ths of meters (0.1 m) with a clinometer. Measure 10 – 30 m away from the tree, depending on tree height. Using the percent side of the clinometer, the tree height in meters equals: =(distance from tree in meters) x (% to top of tree **-** % to base of tree). Note that if the base % is negative this will be added to the total height (Math: minus a negative is positive). See Appendix C.3.
- **Crown base height –** measure the height to main live crown – the height in meters (0.1 m) from the forest floor to the obvious live crown. Use a clinometer or measure with tape or pole (See Appendix C.2).
- **Height to live ladder fuel** – the height (cm) from the forest floor to the lowest point of a live branch on the tree. Measure with a tape or pole.
- **Height to dead ladder fuel** – the height (cm) from the forest floor to the lowest point of a dead branch on the tree.
- **Crown radius -**measure the crown radius to the average widest branch or drip-line of the crown, measure to the nearest centimeter.

Permafrost, Burn Severity, & Duff/Woody Fuel Loading

Active Layer Depths - Ten active layer points are located along the baseline at 3-m intervals (Fig. 1), except last point is placed at 29-m. At each point measure the depth of the active layer with the bike flag rod and tape measure. Measure the depth in cm to the point of permafrost or bedrock. If it is possible to determine that depth is to rock, note this on the datasheet.

Burn Severity & Duff Consumption *(optional)* - If duff consumption is being measured pre-fire, place burn pins (15-20" welding rods) firmly in the ground, flush with forest floor height. If pin is not flush with the forest floor, record the height above the surface or cut the welding rod flush with the forest floor. Up to 1 yr postfire: determine depth of burn in cm from the marked burn pin and measure depth of active layer in cm at each point. At each point determine burn severity code (BSC) as described in FMH 2003 for the substrate at each point, see Appendix C3 for codes. Burn severity for the plot can be determined using the Composite Burn Index methodology (See FIREMON 2004).

Forest Floor Duff Depths and Moisture – Measuring the depth of the duff and litter layers is standard, removing plugs for oven drying and fuel moisture determination may be added if the data is required for the project. Measure the depth of the forest floor surface material (live moss, dead moss, upper and lower duff layers) at two sites at least 1 m off the transect which appear similar with respect to forest floor characteristics. Do not disturb the vegetation along the transect itself. Carefully cut down through the forest floor to mineral soil or permafrost (for fuel moisture determinations, remove ~ 4-inch-square forest floor plugs) using a compass saw, trowel and/or shovel. Measure the depth of each layer down to mineral soil (live moss, lichen, dead moss, upper duff, lower duff) with a ruler to the nearest 0.5 cm (See Wilmore 2001, duff moisture collection methods). If permafrost or other obstructions are encountered, measure the layers available and indicate the cause and depth of obstruction. Record N/A if a layer is not present. For duff moisture sampling (optional), record the depths and collect the samples in nalgene sampling jars, and record bottle number. More detailed information on duff layers, moisture sampling and data sheets for destructive fuel sampling are available (Wilmore 2000, Jandt et al. 2005).

Down woody fuels (Optional) - Down woody fuel load can be measured along the 30-m transect line using the planar intersect method outlined by Brown (1974). Woody debris is defined as follows: 1 hr fuels (0 to 1/4” diam), 10 hr fuels (1/4 to 1” diam), 100 hr fuels (1 to 3” diam) and 1000 hr sound (>3” diam), 1000 hr rotten (> 3” diam). Tally the woody fuels by size class along the point intercept transect baseline: 2m for 1-hr and 10-hr; 4m for 100-hr, and 30m for 1000-hr fuels. (6.6 ft, 13.1 ft, and 98 ft respectively). If quantitative fuel loading is desired, place additional Brown’s transects at 120 deg and 240 deg from origin and mark end w/ pin flag.

Shrub Density (optional)

If quantitative data is desired for woody browse or shrub species, tally individuals (or **stems above ground** for clonal *spp.* such as alder, or when it is not possible to distinguish individual shrubs) in the same 1-m x 30-m belt which was used for trees. If desired, tally the shrubs by life form (mature, resprout, seedling). In very dense brush, may need to subsample to 0.5-m x 30-m belt, or tree seedling plots. (Enter on *SHRUB DENSITY*).

- Recommend **not** tallying rose, raspberry, or spirea in shrub transects if doing this for browse info: accurate counts are very difficult.

Field Gear List

General	Item	Pre/Post Plots
Plot	30 meter tape	1
Plot	Bike flag	1
Plot	chaining pins	2
Plot	Clinometer	1
Plot	Clipboard	2
Plot	Compass	2
Plot	Diameter calipers	1
Plot	Diameter logger's tape, metric	1
Plot	Diameter tape (small), metric	2
Plot	Field vest	1/person
Plot	Folding ruler 1 meter	2
Plot	handlens	2
Plot	Horseshoe nail	1
Plot	Paintsticks	2
Plot	Rebar/plot marking stake	2 per plot
Plot	steel tags w/wire	2 per plot
Plot	welding rods (duff consumption)	10 per plot
Plot	white board/dry erase pen	1
duff	4" quilting square	1
duff	compass saw	1
duff	duff containers	40
duff	Green duff mat	1
duff	Pruners	1
duff	Ruler, centimeter	1
duff	special duff plug shovel	1
Tech	Digital Camera	1
Tech	GPS w/appropriate map coverage downloaded	1
Tech	PDA w/FEAT Database	1
logistic	Radio w/appropriate freqs	1
logistic	Copies of original forms for each plot.	1 set for each year
logistic	Form organizer for plot project w/ data sheets	1
logistic	Maps of plot locations	1
logistic	Satellite Phone	1
logistic	Shotgun w/ammo	1
Personal	Food, Clothing, Shelter	yes

FIRE EFFECTS APPENDIX A

PROTOCOL-SPECIFIC OBJECTIVES

This Appendix provides a summary of the common objectives for each of the protocol components used in this FETG monitoring protocol.

<table>
<tr><th></th><th>OBJECTIVES</th><th>METHOD</th></tr>
<tr><td rowspan="4">1</td><td>VEGETATION & GROUND COVER</td><td rowspan="4">Point intercept transect</td></tr>
<tr><td>Document the percent cover and species composition of common species at any given time period.</td></tr>
<tr><td>PROVIDE VEGETATION SPECIES INFORMATION FOR LAND COVER MAPPING AND FIRE BEHAVIOR MODELING.</td></tr>
<tr><td>Document changes in species composition and percent cover through time following fire to provide predictions of successional trajectories</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td rowspan="4">2</td><td>TREE DENSITY</td><td></td></tr>
<tr><td>Determine the estimated tree density by species and diameter size class.</td><td rowspan="3">Tree Density Belt Transect</td></tr>
<tr><td>Document tree mortality, colonization, seeding of project area. If re-sampling occurs, then changes through time can be recorded.</td></tr>
<tr><td>Derive inputs for fire behavior modeling (crown base height and ladder fuels) and treatment effectiveness documentation.</td></tr>
</table>

	OBJECTIVES	METHOD
3	**PERMAFROST DEPTH**	Point Intercept (10-points)
	Document the active layer depth and its variability at the plot site.	
	DOCUMENT CHANGES IN THE ACTIVE DEPTH LAYER FOLLOWING FIRE OR DISTURBANCE.	
4	**BURN SEVERITY**	
	Describe the overall burn severity of the sampling plot including its variability within each plot.	Transect (10-points)
	Use an accepted burn index to calculate a mean proportion of burn severity for the plot for both vegetation and substrate.	Burn Severity Index
5	**DUFF AND LITTER DEPTH**	
	Provide general indices of duff and litter depth to use in fire behavior and fuel models	Forest Floor Samples (duff plugs)
6	**DOWN WOODY FUEL LOADING**	
	Document fuel loading (tons/acre) for fire and fuel modeling, risk assessments, and treatment effectiveness monitoring.	Down and woody fuels (Brown's) transect

	OBJECTIVES	METHOD
7	**SHRUB DENSITY**	Shrub Density Belt Transect
	Document shrub density by species to estimate shrub survival, mortality and establishment within the plot area. Data can also be used to estimate forage availability, degree of site conversion, and potential ladder fuels for fire behavior models.	
	ESTIMATE SHRUB DENSITIES THROUGH TIME FOLLOWING DISTURBANCE TO PREDICT SUCCESSIONAL TRAJECTORIES.	

FIRE EFFECTS APPENDIX B:

DATA SHEETS

Site and General Description

UNIT: ______ PROJECT: _____ PLOT ID: ________ PRE OR POST ___ YRS FIRE NUMBER _______ FIRE DATE: _______

FIELD DATE: ____________ FIELD CREW: _______________________ FIRE NAME:___________________________

TRANSECT AZIMUTH: _________ TRANSECT SLOPE: ________ DECLINATION USED: _____________

SLOPE: _________% ASPECT: _______ ELEVATION: ________ FT VIERECK CLASS: ________________________

SOIL (CIRCLE): WET MOIST DRY DISTURBANCE (CIRCLE): FIRE WIND INSECT OTHER: _______________

Evidence of fire: Yes or No Fire Indicators: Burn Snags Burned Stumps Fire Scars Charcoal (circle all that apply)

Photos: Camera used: _______________

Photo numbers: ________ Description: _______________ Time of photos: _________

PHOTO NUMBERS: ________ DESCRIPTION: _______________ TIME OF PHOTOS: _________

PHOTO NUMBERS: ________ DESCRIPTION: _______________ TIME OF PHOTOS: _________

PHOTO NUMBERS: ________ DESCRIPTION: _______________ TIME OF PHOTOS: _________

LAT/LONGS - MARK THE ENDS OF THE PLOT:

GPS TYPE: __________GPS IDENTIFICATION: ___________ GPS DATUM: __________

DESCRIPTION: _____ WP NO: _____ LATITUDE: N____________ LONGITUDE: W_________ GPS ERROR: ___(M/FT)

DESCRIPTION: _____ WP NO: _____ LATITUDE: N____________ LONGITUDE: W_________ GPS ERROR: ___(M/FT)

DESCRIPTION: _____ WP NO: _____ LATITUDE: N____________ LONGITUDE: W_________ GPS ERROR: ___(M/FT)

DESCRIPTION: _____ WP NO: _____ LATITUDE: N____________ LONGITUDE: W_________ GPS ERROR: ___(M/FT)

Plot Layout and Notes: Provide notes and map on relocating or LZ, burn information and other plot notes as needed below.

Plot Notes:

A. SITE AND GENERAL VEGETATION (A)

UNIT: ______________ PROJECT: ______________ PLOT ID: ________ PRE OR POST _____ YRS

FIRE NUMBER __________________

FIRE DATE: ____________________

FIELD DATE: ____________ FIELD CREW: _________________________

FIRE NAME:___________________________

WP NO: _____ LATITUDE: N____________ LONGITUDE: W_____________

GPS ERROR: _______DATUM: ________

TRANSECT AZIMUTH: _________ TRANSECT SLOPE: ________ DECLINATION USED: _____________

SLOPE: _________% ASPECT: _______ ELEVATION: ________ FT

VIERECK CLASS: ___________________________

SOIL (CIRCLE): WET MOIST DRY

DISTURBANCE (CIRCLE): FIRE WIND INSECT OTHER: ________________

Evidence of fire: Yes or No

Fire Indicators: Burn Snags Burned Stumps Fire Scars Charcoal (circle all that apply)

Photo numbers: __________________________________

Time of photos: ____

Camera used: ____

SPECIES Tree Layer	Common Name	Cover Class 1-9%	10-24%	25-59%	60-74%	≥75%	Height Class 0-3 m	3-5 m	5-9 m	9-21 m	> 21 m	Ht to live crown (cm)	Ht to Ladder Fuel (cm)	Avg DBH (cm)
PIGL	White spruce													
PIMA	Black spruce													
LALA	Larch													
POTR5	Aspen													
POBA2	Balsam poplar													
BEPA	Paper birch													
		1-9%	10-24%	25-59%	60-74%	≥75%	<0.2 m	0.2-1.5 m	> 1.5 m	Seedling	Re-sprout			
ALNUS	Alder species													
BENA	Dwarf/resin birch													
EMNI	Crow berry													
LEPA11	Labrador tea													
ROAC	Prickly Rose													
SALIX	Willow species													
SHCA	Soap Berry													
VAUL	Blue berry													
VAVI	Lowbush cranberry													
RIBES	Currant species													
Herbaceous & Ground Cover		1-9%	10-24%	25-59%	60-74%	≥75%	Seedling	Re-sprout						
ARRU	Bear berry													
LIBO3	Twin flower													
MEPA	Blue bells													
EQUIS	Horsetail													
EPAN2	Fireweed													
GRASS*	Unidentified grass													
CACA4	Northern blue-joint													
CAREX	Sedge													
LYCOP2	Club Moss													
ERVA4	Cottongrass/ tussock													
COCA13	Dwarf Dogwood													
GELI2	Timber berry													
FMOSS	Unidentified feather													

	moss											

SITE AND GENERAL VEGETATION (B)

Unit: ________ Project: ________ Plot ID: __________ Pre or Post ___ yrs Field Date: _______________

SPECIES Tree Layer	**Common Name**	**Cover Class** 1-9%	10-24%	25-59%	60-74%	≥75%	**Height Class** 0-3 m	3-5 m	5-9 m	9-21 m	> 21 m	**Ht to live crown**	**Ht to Ladder Fuel**	**Avg DBH (cm)**
		1-9%	**10-24%**	**25-59%**	**60-74%**	**≥75%**	**<0.2 m**	**0.2-1.5 m**	**> 1.5 m**	**Seedling**	**Re-sprout**			
Herbaceous & Ground Cover		**1-9%**	**10-24%**	**25-59%**	**60-74%**	**≥75%**	**Seedling**	**Re-sprout**						
CLADI3	Reindeer lichen													
LICHEN*	Unidentified lichen													
HYSP70	Stair-step moss													
SPHAG2	Sphagnum moss													
MOSS*	Unidentified moss													
PEAP60	Freckle pelt lichen													

Vegetation Point Intercept

Land Unit: ____________ Plot ID _____________ Pre or Post ____ yrs Fire/Treatment: ______________

Date: __________ Field Crew: ______________________________

Record substrate and species codes of trees, shrubs, forbs and groundcover intercepted at each 50 cm interval, record plants tallest to lowest.

PNT	Meters	*Tallest* SPP 1	SPP 2	SPP 3	SPP 4	SPP 5	SPP 6
1	0.5						
2	1						
3	1.5						
4	2						
5	2.5						
6	3						
7	3.5						
8	4						
9	4.5						
10	5						
11	5.5						
12	6						
13	6.5						
14	7						
15	7.5						
16	8						
17	8.5						
18	9						
19	9.5						
20	10						
21	10.5						
22	11						
23	11.5						
24	12						
25	12.5						
26	13						
27	13.5						
28	14						
29	14.5						
30	15						
31	15.5						
32	16						
33	16.5						
34	17						
35	17.5						

PNT	Meters	*Tallest* SPP 1	SPP 2	SPP 3	SPP 4	SPP 5	SPP 6
36	18						
37	18.5						
38	19						
39	19.5						
40	20						
41	20.5						
42	21						
43	21.5						
44	22						
45	22.5						
46	23						
47	23.5						
48	24						
49	24.5						
50	25						
51	25.5						
52	26						
53	26.5						
54	27						
55	27.5						
56	28						
57	28.5						
58	29						
59	29.5						
60	30						

Common codes:

Trees

Code	*Name*
PIGL	Picea glauca – White spruce
PIMA	Picea mariana – Black spruce
BEPA	Betula papyrifera – Paper birch
POTR	Populus tremuloides – Aspen
POBA	Populus balsamifera – Balsam poplar

Shrubs

Code	*Name*
BENA	Betula nana - Resin birch & Dwarf birch
ALNUS	Alnus spp – Alder , SALIX – willow
LEPA11	Ledum palustre – Labrador tea
VAUL	Vaccinium uluginosum – blue berry
VAVI	Vaccinium vitis-idaea – lowbush cranberry

Ground

Code	*Name*
FMOSS	Feather moss
HYSP70	Hylocomium splendens – Stair step moss
SPHAG2	Sphagnum spp (moss)
LTR	Litter
WD	Woody debris
DUFF	Organic duff
SOIL	Mineral soil

Forbs/Grasses

Code	*Name*
CHAN	Chamerion angustifolium – Tall Fireweed (EPAN2)
POAL	Polygonum alpinum – Wild rhubarb
MEPA	Mertensia paniculata - Tall blue bells
LIBO3	Linnaea borealis – Twin flower
EQUIS	Equisetum spp – Horsetail
CACA4	Calamagrostis canadensis – blue joint grass

Tree Density Tally

Land Unit: _________ Project: ___________ Plot ID: ____________ Pre or Post ____ yrs Date __ _______ Field Crew: __________________

Tally the number of trees taller than 4.5' (1.37-m) by diameter size class and species within the 1-m x 30-m belt transect plot area. Dead trees with less than 45 degree angle with the ground are not tallied (counted as fuel). For small "layering" trees, pull trees upright to determine if height is > 4.5'.
Tally the "seedling/saplings" - *live* trees less than 4.5' tall by species and resprout/seedling/mature in the three 1-m x 1-m subplots at 3m, 15m and 27m along the transect.

Tree (cm at DBH)	**≤ 5 cm**	**5.1 - 10 cm**	**10.1 – 15 cm**	**15.1 - 23 cm**	**>23 cm**	**Sapling /Seedlings <4.5 ft 3-m**	**Sapling /Seedlings <4.5 ft 15-m**	**Sapling /Seedlings <4.5 ft 27-m**
Picea mariana LIVE						R S M		
DEAD								
Picea glauca LIVE						R S M		
DEAD								
Larix laricina LIVE						R S M		
DEAD								
Betula papyrifera LIVE						R S M		
DEAD								
Populus balsamifera LIVE						R S M		
DEAD								
Populus tremuloides LIVE						R S M		
DEAD								

Tree Measurement Data Sheet

Land Unit: ____________ Project: _______________ Plot ID: ___________________

PRE OR POST ____ YRS FIELD DATE: __________ FIELD CREW:

____

Record the following information for two live trees (> 4.5 feet tall) of each species for each size class recorded within the tree density plot. Select the trees to be measured, by those closest to the mid-point of the tree density belt (15-m point). Measure the heights in 1/10ths of meters (i.e 15.3 m) and DBH in 1/10ths of centimeters (i.e. 5.3 cm). Note in comments tree damage, insects or disease.

Tree No.	Tree Species	DBH (cm)	Height (m)	Crown Radius (m)	Ht to Dead Ladder Fuel (cm)	Ht to Live Ladder Fuel (cm)	Main Crown Base Ht (cm)	Comments

Tree Density and Measurements (optional form version)

Land Unit: _____________ Project: ________________ Plot ID: ____________________

Pre or Post ____ yrs

Fire Name/Number: ______________ Fire Date: ____________ Field Date: ___________

Field Crew: _________________________

Tally the number of trees taller than 4.5' (1.37-m) by species, live/dead, and diameter size class (< 5cm, 5-10 cm, 10-15 cm, 15-23 cm, > 23 cm) within the 1-m x 30-m belt transect plot area. Tally the "seedlings" - *live* trees less than 4.5' tall by species and re-sprout/seedling/mature (S/R/M) in the three 1-m x 1-m subplots (A, B, C) along the transect. Record the following information for two live trees (> 4.5 feet tall) of each species for each size class recorded within the tree density plot. Select the trees to be measured, by those closest to the mid-point of the tree density belt (15-m point). Measure the heights in 1/10ths of meters (i. e .15.3 m) and DBH in 1/10ths of centimeters (i.e. 5.3 cm), crown base height (m), ladder fuel. Note in comments tree damage, insects or disease. **Diameter size classes: < 5cm, 5-10 cm, 10-15 cm, 15-23 cm, > 23 cm**

Tree 1	Tree 2

Active Layer/Duff Consumption

Park Unit: ____________ Project: _______________ Plot ID: ___________________

PRE OR POST ____ YRS FIRE NAME/NUMBER: _____________ FIRE DATE: ___________

FIELD DATE: __________ FIELD CREW: ____________________________

Point	Distance	Active Layer Depth cm	Comments
1	3-m		
2	6-m		
3	9-m		
4	12-m		
5	15-m		
6	18-m		
7	21-m		
8	24-m		
9	27-m		
10	29-m		

Burn Severity/Duff Consumption (See Appendix B3 for Burn Severity Codes)

Date: ____________

		Post-Fire		Pre-fire	Post-fire	
Point	Distance	Burn Severity Code (Substrate)	Burn Severity Code (Vegetation)	Burn Pin above surface (cm) (A)	Burn Pin Exposed (cm) (B)	Burn Depth cm (B-A)
1	3-m					
2	6-m					
3	9-m					
4	12-m					
5	15-m					
6	18-m					

7	21-m					
8	24-m					
9	27-m					
10	29-m					

Down Woody Debris & Duff Depths

Unit: ____________ Project: _______________ Plot ID: __________________

Pre or Post ____ yrs Field Date: __________ Field Crew:___________________________

Record the number of intercepts of woody fuels along the 50 ft transect by size class: 0 - 1/4" and 1/4"- 1" from 0 to 6 ft along transect, 1" - 3" diameter from 0 to 12 ft along transect, and > 3" diameter from 0 to 100 ft along transect. Record the diameter of fuels >3" diameter. Measure litter and duff depths at each end of the transect. Or use meters: 2-m (6.6 ft), 4-m (13.1 ft), 30-m (98 ft).

	# of intercepts			Record Diameter (inches) > 3" diam		Litter and Duff Depths (cm)			
Transect	0 – 0.25" 1 hr	0.25 - 1" 10 hr	1 - 3" 100 hr	3"+ solid 1000 hr S	3"+ rotten 1000 hr R	Sample site 1	Depth cm	Sample site 2	Depth cm
						Litter		Litter	
Dir. ____						Lichen		Lichen	
Slope ___						Live Moss		Live Moss	
						Dead Moss		Dead Moss	
						Upper Duff		Upper Duff	
	Total:	Total:	Total:			Lower Duff		Lower Duff	

Transect	0 – 0.25" 1 hr	0.25 - 1" 10 hr	1 - 3" 100 hr	3"+ solid 1000 hr S	3"+ rotten 1000 hr R	Sample site 3	Depth cm	Sample site 4	Depth cm
						Litter		Litter	
Dir. ____						Lichen		Lichen	
Slope ___						Live Moss		Live Moss	
						Dead Moss		Dead Moss	
						Upper Duff		Upper Duff	
	Total:	Total:	Total:			Lower Duff		Lower Duff	

Definitions & Tally Rules

Downed woody material are dead twigs, branches, stems and boles of trees and shrubs that have fallen and lie on or above the ground.

>Measure woody material first to avoid disturbing it and biasing your estimates.
>Do not count dead woody stems and branches still attached to standing shrubs and trees (see below)
>If more than 45 degrees and dead, but still attached at the bole it is still counted
>Do not tally any particle having a central axi that coincides perfectly with the sampling plane.
>If the sampling plane intersects a curved piece more than once tally each intersection
>For rotten logs that have fallen apart try to estimate its original diameter
>Tally uprooted stumps and roots not encased in dirt. Do not tally undisturbed stumps

Shrub Density Data Sheet

Park Unit: _____________ Project: ________________ Plot ID: _____________ Pre or Post ____ yrs

Field Date: ___________ Field Crew: ______________________________

The 30 meter belt transect is 1 meter wide. For <u>each</u> plant (see protocol for details) of the preferred species, within the 30-m x 1-m belt transect, record the number of shrubs by life status. Record average height class (optional).

	Shrub Species	***Avg. Height (m)***	***Mature***	***Resprout***	***Seedling***

APPENDIX C – Cheat Sheets

C.1. Tree Crown Measurements

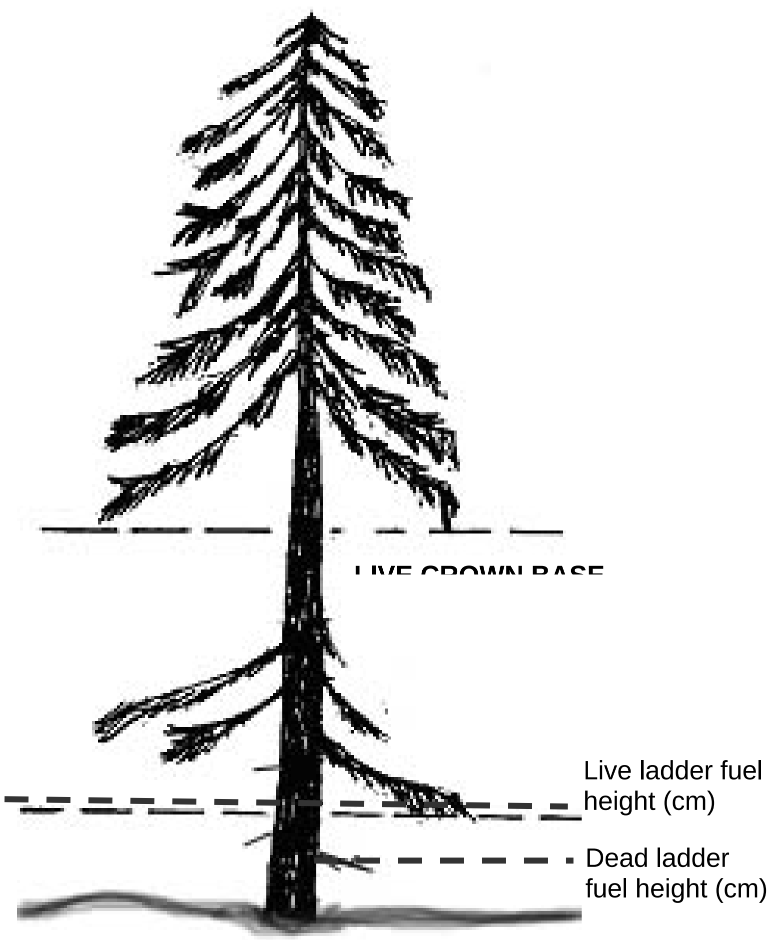


Fig. B.2 Tree crown and ladder fuel measurements. Figure modified from USFS FMH Manual, 2002.

B.2. Tree Height Measurements

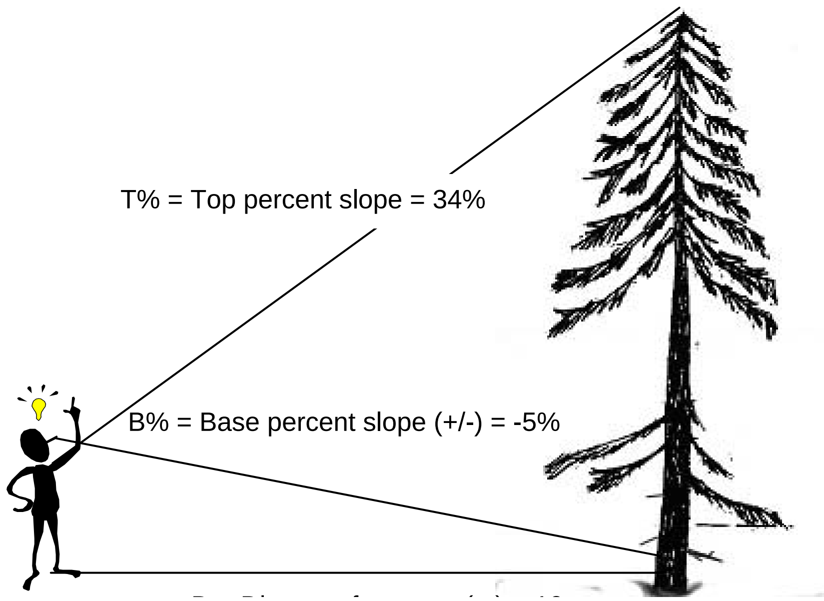


Figure C.3 Tree height equals: Height (m) = D x (T% - B%). If the base percent is negative (reading eye-level to tree or on slope above tree DBH), then add B%, if base percent is positive (on slope below tree DBH) then subtract B%.   Ht = 20m x (0.34 + 0.05) = 7.8 m

Remember to use percent side of clinometer (right side scale or look for percentage sign at top or bottom of scale) and to move the clinometer up and down, not your head if possible. *Hint:* 10-m and 20-m distances makes easier math, but you must go back far enough to accommodate tree heights.

C. 3. Burn severity code matrix –modified from NPS Fire Monitoring Handbook (2003)

Forest and ShrubTypes	
Substrate (S)	Vegetation (V)
Not burned	Not burned
Litter partially blackened; duff nearly unchanged; wood/leaf structures unchanged	Foliage scorched and attached to supporting twigs (red needles may have dropped and be found at base of trunks)
Litter charred to partially consumed; upper duff layer may be partially consumed but not altered over the entire depth; surface appears black; small woody debris is partially burned.	Foliage and smaller twigs partially to completely consumed; branches mostly intact; less than 40% of the shrub canopy is commonly consumed
Litter mostly to entirely consumed, leaving coarse, light colored ash; duff deeply charred to lower duff or upper/lower duff interface, but underlying mineral soil is not exposed; small woody debris is mostly consumed.	Foliage, twigs, and small stems consumed; some branches (>.5-2.5 cm in diameter) (0.25-1.0 in) still present; 40-80% of the shrub canopy is commonly consumed.

Litter and duff completely consumed, or within 1 cm of mineral soil, sometimes leaving fine white ash; mineral soil may be visibly altered, sometimes reddish. *Marchantia* and fire mosses may be present.	All plant parts less than 2.5 cm (1 in) in diameter are consumed, only leaving deeply charred major stems or trunks.
Inorganic preburn	None present preburn

Appendix Q
Biophysical Setting Descriptions.

The following information should be updated by the end of 2006 calendar year. For updated information refer to the website http://frcc.gov/pnvgSummaries.html

DRAFT
Fire Regime Condition Class (FRCC) Interagency Guidebook Reference Conditions

Author/Modeler(s): Evie Witten
Lead Author Phone: (907) 276-3133 (#107) **E-mail:** akfrcc@alaska.net
First Draft Date: March 3, 2004 **Most Recent Edit:** August 5, 2004
Status: In development **PNV Code:**

Potential Natural Vegetation (PNV) Name: Upland White Spruce Interior

Fire regime group: IV

Geographic Area: Interior and western Alaska

Physical Stetting Description:
Upland White Spruce Interior PNV sites are widespread and common throughout interior and parts of western Alaska on relatively warm (south, west, and east aspects), well-drained upland terrain, especially south-facing loess-covered slopes adjacent to rivers (Viereck et al 1986). These are the most productive forest sites in the Alaska taiga. Upland White Spruce sites also occur near timberline to elevations of approximately 750 m (Viereck et al 1986) where stands tend to be open (< 60% canopy cover) and white and black spruce may be mixed (Viereck et al 1992). Typical soils include Cryaquepts, Cryochrepts and Cryofluvents, and range from somewhat acid to almost basic (Viereck et al 1992). Permafrost is usually absent.

Biophysical Classification:
The Upland White Spruce Interior PNV type occurs in the following ecoregions described by Nowacki et al (2001):
- Intermontane Boreal
- Nulato Hills section of the Bering Taiga
- Bering Tundra

The following level IV community types described by Viereck et al (1992) are included in the Upland White Spruce Interior PNV group:

IA1j – Closed White Spruce Forest
IA2e – Open White Spruce Forest
IA3c – White Spruce Woodland
IB1d – Closed Paper Birch forest (white spruce understory & sites)
IB1e – Closed Quaking Aspen Forest (white spruce sites)
IB1f – Closed Paper Birch-Quaking Aspen Forest (white spruce sites)
IB2a – Open Paper Birch Forest (interior AK sites)
IB2b – Open Quaking Aspen Forest
IB3a – Paper Birch Woodland (successional status unknown)
IC1a – Closed Spruce-Paper Birch Forest (white spruce sites)
IC1b – Closed White Spruce-Paper Birch-Balsam Poplar (Black Cottonwood)
IC1d – Closed Quaking Aspen-Spruce Forest (white spruce sites)
IC2a – Open Spruce-Paper Birch Forest (white spruce sites)

Identification of Key Characteristics of the PNV and Confuser PNVs:
Site indicator species include white spruce (*Picea glauca*), paper birch (*Betula papyrifera*), quaking aspen (*Populus tremuloides*), soapberry (*Shepherdia canadensis), Arctostaphylos uva-ursi*, and prickly rose *(Rosa acicularis*)

(Dyrness et al 1983). High bush cranberry (*Viburnum edule),* twinflower *(Linnaea borealis),* and field horsetail (*Equisetum*) are also good indicators of warm, well-drained sites (Foote 1983). Ericaceous species (i.e. *Vaccinium uliginosum*, *V. vitis-idaea)* are frequently found on both white spruce and black spruce sites, and thus are not ideal site indicators.

This PNV is similar to the Riparian White Spruce Interior PNV, which occurs on river terraces throughout the same region and where flooding is a more important disturbance and fire is less frequent. In places this PNV can be confused with the Black Spruce Interior PNV because black and white spruce often mix, especially on sites with transitional moisture and thermal conditions. The Upland White Spruce Interior and Black Spruce Interior PNVs also have many understory species in common.

Natural Fire Regime Description:
The Upland White Spruce Interior Fire regime is characterized by crown fires & severe surface fires. Fires tend to be large – 50,000 hectares or larger. During most fire years a small number of large fires account for most of the total area burned (Gabriel and Tande 1983). Ecologically significant fires usually occur during the exceptional fire years and cover 200,000 + hectares (Viereck 1983). Usually some of the organic layer remains (Viereck 1983). Mean fire return interval estimates include:

- 100-200 yrs (Yarie 1981).
- 113 yrs (Yarie 1983) (Porcupine River area)
- 50-70 years (Foote 1983) (for white & black spruce/*Betula gladulosa* woodlands at treeline)
- 50-150 yrs (Duchesne and Hawkes 2000)
- 113-238 yrs (Rowe 1972) (for Kluane National Park)
- 100-150 years (Heinselman 1981) (for spruce lichen woodlands of western boreal region)
- 150 yrs (80-200 year range) (personal communication experts' workshop March 2004)

Good white spruce seed crops occur approximately every third (Duchesne and Hawkes 2000) to twelfth year (Viereck 1973). The effective dispersal distance is approximately two tree heights (45-60 m) (Viereck 1973). Post fire regeneration of white spruce increases when fires occur late summer of a good seed year. It is not common for pure white spruce stands to re-establish following fire as a combination of abundant seed and proper seed bed conditions are required for white spruce regeneration (Foote 1983). If seed trees are eliminated over large areas, aspen will likely colonize site and slow the re-establishment of white spruce (Duchesne and Hawkes 2000).

Fire severity is an important factor in determining post burn successional pathways in the Alaska taiga (Foote 1983). Except in the case of a severe burn, post fire succession in boreal forests tends to return to the pre-disturbance forest cover type, however the rate of change and species composition may vary (Foote 1983, Payette 1992, Boucher 2003). Post fire regeneration is characteristically rapid and dominated by revegetation via rhizomes and root and stump sprouts of species that survive the fire (Schaefer 1993, Viereck 1975, Van Cleve and Viereck 1981). Where the organic layer is mostly consumed by fire vegetative reproduction is much reduced and sites are captured more by light-seeded 'invader' species (Heinselman 1981).

Other Natural Disturbance Description:
Fire is the dominant natural disturbances in this PNV; however, insect outbreaks also play an important role.

Wind throw gap disturbances are also important in stand development within the Upland White Spruce PNV.

Natural Landscape Vegetation-Fuel Class Composition:
The natural vegetation structure is a mosaic of the seral stages described below. White spruce is the climax indicator species.

Natural Scale of Landscape Vegetation-Fuel Class Composition and Fire Regime:
This PNV exists within landscape mosaics composed of the Black Spruce Interior PNV (on relatively colder and wetter forest sites), the Riparian White Spruce (on river terraces), the Non-Forested Wetland PNV, and at the attitudinal and latitudinal limits of the PNV, shrub and tundra types. White Spruce Interior sites are typically patchy and exist on south-, west-, and east-facing slopes and well-drained upland terrain.

Uncharacteristic Vegetation-Fuel Classes and Disturbance:

PNV Model Classes and Descriptions:

Class	**Modeled Percent of Landscape**	**Description**
A: 0 -10 years Post disturbance regeneration: herbs, shrub regeneration, seedlings	7%	Vegetative reproduction of shrubs (e.g., *Rosa acicularis Viburnum edule, Salix spp*) and hardwoods from shoots and suckers. Light-seeded herbs establish. White spruce seedlings rarely present (Foote 1983) unless seed trees remained after fire and they produced a good seed crop. Quaking aspen and paper birch may be present in densities of 30,000 stems/ha at 1-2 m in height
B: 10-30 years Mid-development: tall shrub-sapling	12%	Dense tall shrubs and/or saplings in the overstory, and herbs, tree seedlings, and litter below. Mosses and lichens exist but are not an important component. Trees may include hardwoods and spruce.
C: 30-200 years Mid- to late – development hardwood or conifer/hardwood, open or closed	41%	Young trees become dominant in the overstory, with a > 25% hardwood component. *Rosa acicularis*, *Viburnum edule,* and *Linnaea borealis* are commonly in the understory. Lichens and feather mosses become established. Overstory trees may be present at densities of approximately 2,300 stems/acre (Foote 1983).
D: 30-300 years Mid- to late-development, open spruce	14%	Open spruce stands with tree canopy closure of < 60%. Hardwoods, if present, occupy < 25% of the tree canopy. In older stands, hardwoods may no longer be present in the overstory, however occasional hardwoods may remain. The understory may include various combinations of tall shrubs, low shrubs, herbs, mosses and lichens.
E: 30-300 years Late-development, closed spruce	26%	Site is dominated by mature white spruce with > 60% canopy closure. Hardwoods, if present, occupy < 25% of the tree canopy. In older stands, hardwoods may no longer be present in the overstory, however occasional hardwoods may remain. The understory may include various combinations of tall shrubs, low shrubs, herbs, mosses and lichens.
Total:	100%	

Modeled Fire Frequency and Severity:

	Mean Probability	Mean Fire Frequency (years) (inverse of probability)	Description
Replacement fire	0.44	230	Based on literature and expert input
Mosaic fire	0.14	715	Based on literature and expert input
All Fire	0.58	170 years	Based on literature and expert input
Other disturbances			

Modeled Fire Severity Composition:

	Percent All Fires	Description
Replacement fire	75%	Based on literature and expert input
Non-replacement fire	25%	Based on literature and expert input
All Fire	100%	

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Fire Regime Condition Class (FRCC) Interagency Guidebook Reference Conditions

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First Draft Date: March 3, 2004 **Most Recent Edit:** August 5, 2004
Status: In development **PNV Code:**

Potential Natural Vegetation (PNV) Name: Black Spruce Interior

Fire regime group: IV

Geographic Area: Interior and western Alaska

Physical Stetting Description:
Black Spruce Interior PNV sites are widespread and common throughout interior and parts of western Alaska on cold, mostly poorly-drained terrain. Soils range from poorly drained Cryaquepts, to Cryochrepts to well-drained alluvial gravels. Permafrost is usually present at depths ranging from 30 cm to over 1 meter, but may be absent from stands growing on coarse alluvium or on shallow soils over bedrock (Viereck et al 1992). Upland black spruce sites occupy north-facing slopes and ridge tops. Lowland black spruce sites occupy old river terraces, small valley bottoms, lake margins and lower north-facing slopes (Viereck and Little 1972). Open treeline forests occur up to approximately 750 meters in elevation (Viereck et al 1986).

Biophysical Classification:
The Black Spruce Interior PNV type occurs in the following ecoregions described by Nowacki et al (2001):
- Intermontane Boreal
- Bering Taiga
- Arctic Tundra - Brooks Range Foothills (P1)
- Alaska Range Transition - Alaska Range (B3)

The following community types described by Viereck et al (1992) are included in the Black Spruce Interior PNV group:
IA1k – Closed Black Spruce Forest (black spruce sites)
IA2f – Open Black Spruce Forest (black spruce sites)
IA3d – Black Spruce Woodland (black spruce sites)
IA3e – Black Spruce-White Spruce Woodland
IB1d – Closed Paper Birch forest (black spruce understory & sites)
IB1e – Closed Quaking Aspen Forest (severely burned black spruce sites)
IB1f – Closed Paper Birch-Quaking Aspen Forest (black spruce sites)
IC1a – Closed Spruce-Paper Birch Forest (black spruce sites)
IC1c – Closed Spruce-Paper Birch-Quaking Aspen Forest
IC1d – Closed Quaking Aspen-Spruce Forest (black spruce sites)
IC2a – Open Spruce-Paper Birch Forest (black spruce sites)
IC2b – Open Quaking Aspen-Spruce Forest (sere in black spruce/white spruce mixed type)

Identification of Key Characteristics of the PNV and Confuser PNVs:
Common species include black spruce (*Picea mariana*) and mosses (*Sphagnum* spp., *Hylocomium splendens, Pleurozium schreberi*) or lichens (*Cladina* and *Cladonia* spp). Low shrubs usually limited to black spruce sites and treeline sites include Labrador tea (*Ledum groenlandicum* and *L decumbens*), Bog cranberry *(Vaccinium oxycoccus*), bog blueberry *(V. uliginosum*), and Mountain cranberry *(V. vitis-idaea)* (Dyrness et al 1983). Woodland horsetail (*Equisetum sylvaticum)* and cloudberry *(Rubus chamaemorus*) are commonly found in black spruce and mixed white and black spruce stands (Dyrness et al 1983). *Eriophorum* spp. and bigelow sedge *(Carex bigelowii)* are also common on black spruce sites.

This PNV is similar to the Black Spruce South-central PNV which occurs south of the Alaska Range and has a longer fire return interval and slightly different successional pathways. In some locations this PNV can be confused with the White Spruce PNV because black and white spruce often mix, especially on sites with transitional moisture and thermal conditions.

Natural Fire Regime Description:
Most fires in Black Spruce Interior PNV are either crown or ground fires of enough intensity to kill overstory trees. Usually some of the organic layer remains. (Viereck 1983). Fires tend to be large – 50,000 hectares or larger. Ecologically significant fires usually occur during the exceptional fire years and cover 200,000 + hectares (Viereck 1983). During most fire years a small number of large fires account for most of the total area burned (Gabriel and Tande 1983). Mean fire return interval estimates include:

- 25-40 years (Yarie 1983) (range estimate for interior Alaska)
- 36 years (Yarie 1983) (for the Porcupine River area)
- 50-100 years (Heinselman 1978, Viereck 1983) (for interior Alaska),
- 130 years (Heinselman 1981) (open spruce-lichen – Alaska taiga)
- 100 years (Heinselman 1981) (closed black spruce – Alaska taiga)
- 80-90 years (Rowe et al 1974) (for the MacKenzie Valley)
- 50-70 years (Viereck et al 1986) (for interior Alaska)
- 70-100 years (Christiansen 1988) (for spruce-lichen woodland)
- 80 yrs (40-120 year range) (personal communication; FRCC experts' workshop March 2004)

Fire in thermokarst areas causes melting of permafrost and deepening of the soil active layer. Fire on soil with ice wedges may produce ditches 2-3 cm deep that remain active 40-50 years after the fire (Viereck 1973). Post fire regeneration is characteristically rapid and dominated by revegetation via rhizomes, root and stump sprouts of species that survive the fire (Schaefer 1993, Viereck 1975, Van Cleve and Viereck 1981). Regeneration of black spruce tends to occur over one to two decades after a fire event (Black & Bliss, 1980; Sirois & Payette, 1989 (Black and Bliss 1980, Sirois and Payette 1989)). Where the organic layer is mostly consumed by fire, vegetative reproduction is much reduced and sites are captured more by light-seeded 'invader' species (Heinselman 1981).

Other Natural Disturbance Description:
The thaw pond cycle (disturbance leads to thawing of permafrost and ponding) and paludification (Sphagnum layer buildup and saturation) are important disturbances on black spruce sites (Viereck et al 1986, Foote 1983, Viereck 1975).

Natural Landscape Vegetation-Fuel Class Composition:
The natural vegetation structure is a mosaic of the seral stages described below, with open spruce forests being the dominant late-development type. Black spruce is the climax indicator species.

Natural Scale of Landscape Vegetation-Fuel Class Composition and Fire Regime:
Typical landscapes in this PNV exist in a mosaic with relatively warmer and drier white spruce and riparian white spruce sites, non-forested wetlands and at the attitudinal and latitudinal limits of the PNV, shrub and tundra types.

Uncharacteristic Vegetation-Fuel Classes and Disturbance:
If natural fires are suppressed over time, more contiguous blocks of class E would develop across the landscape. Insect (ips) disturbance and disease would probably also increase, particularly in closed stands on colder sites where the moss layer is thick and soils more nutrient deprived.

PNV Model Classes and Descriptions:

Class	**Modeled Percent of Landscape**	**Description**
A: 0-30 years Early Seral moss, herb, shrub and sapling	26%	Moss, herbs, seedlings of trees and shrubs establish 3 months to 3 years post fire (Foote 1983). Shrubs and saplings 1.4 to 7 m tall typically begin capturing sites 4-5 years post fire. Tall shrub and sapling layer characterized by 60-100% canopy closure. Tree saplings may include spruce, hardwoods or both.
B: 30-90 years Mid-development, closed or open spruce	25%	Black spruce overtops shrubs and gains dominance. Tree density may be < or > 60% depending on site conditions.
C: 30-90 years Mid-development, open or closed hardwoods or mixed hardwood/spruce	21%	Hardwoods or hardwoods and spruce overtop shrubs and gain dominance. Early in this age class trees are at least 2.5 cm d.b.h. and 4-8 m tall (Foote 1983). Spruce may occur as an understory, subdominant, and co-dominant component. Tree density may be < or > 60% depending on site conditions. Beneath trees shrubs, herbs and mosses exist. As the stage advances spruce and moss become more important.
D: 90-300 years Late-development, open spruce	20%	Spruce gains dominance over hardwoods (if previously present). Tree canopy cover is < 60% and maybe < 25% (woodland) depending on site conditions. Occasional hardwoods may remain. The understory may include various combinations of tall shrubs, low shrubs, herbs, mosses and lichens. If fire is absent for long periods paludification may occur.
E: 90-300 years Late-development, closed spruce	8%	Site is dominated by mature black spruce with > 60% canopy closure. The understory may include various combinations of tall shrubs, low shrubs, herbs, mosses and lichens.
Total:	100%	

Modeled Fire Frequency and Severity:

	Mean Probability	Mean Fire Frequency (years) (inverse of probability)	Description
Replacement fire	1.23	80	Based on literature and expert input
Mosaic fire	0.23	435	Based on literature and expert input
All Fire	1.56	65	Based on literature and expert input
Other disturbances			

Modeled Fire Severity Composition:

	Percent All Fires	Description
Replacement fire	75	Based on literature and expert input
Non-replacement fire	25	Based on literature and expert input
All Fire	100	

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Fire Regime Condition Class (FRCC) Interagency Guidebook Reference Conditions

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Status: In development **PNV Code:**

Potential Natural Vegetation (PNV) Name: Riparian Spruce Hardwood

Fire regime group: III

Geographic Area: Interior, western and south-central Alaska

Physical Stetting Description:
Riparian Spruce Hardwood PNV sites are widespread and common on young alluvial deposits and terraces adjacent to major rivers in interior, western and south-central Alaska. Frequent river channel migration and associated flooding and fluvial processes constitute the major disturbance in this PNV type (Viereck et al 1986, Walker et al 1986). The type is characterized by young successional stages dominated by willow and alder and extensive stands of balsam poplar and/or white spruce. This band may be several km wide along larger rivers and 100 m or less along small streams and at higher elevations (Viereck et al 1986). Soils are alluvial, well drained and poorly developed. Permafrost is usually absent.

Biophysical Classification:
The Riparian Spruce Hardwood PNV type occurs in the following ecoregions described by Nowacki et al (2001):
- Intermontane Boreal
- Alaska Range Transition
- Bering Taiga

The following forested community types described by Viereck et al (1992) are included in the various successional stages of the Riparian Spruce Hardwood PNV:

IA1j – Closed White Spruce Forest
IA2e – Open White Spruce Forest
IB1b – Closed Black Cottonwood Forest (SC, SW and Interior AK)
IB1c – Closed Balsam Poplar Forest (floodplain)
IB1g – Closed Quaking Aspen-Balsam Poplar Forest
IB2c – Open Balsam Poplar (Black cottonwood) Forest (floodplain sites)
IB3b – Balsam Poplar woodland (floodplain sites)
IC1a – Closed Spruce-Paper Birch Forest (white spruce sites)
IC1b – Closed White Spruce-Paper Birch-Balsam Poplar (Black cottonwood)
IC1e – Closed Balsam Poplar-White Spruce Forest
IC2c – Open Paper Birch – Balsam Poplar-Spruce Forest

Identification of Key Characteristics of the PNV and Confuser PNVs:
Site indicator species include white spruce (*Picea glauca*) or Lutz spruce (*P. glauca lutzii*) (on the Kenai Peninsula), balsam poplar (*Populus balsamifera*), willow (*Salix spp*.), and Alder (*Alnus spp*.) (Dyrness et al 1983, Van Cleve and Viereck 1981). meadow horsetail *(Equisetum pratense)* is commonly present in early successional stages and in the understory in older seres (Van Cleve et al 1980). Prickly rose *(Rosa acicularis*), highbush cranberry *(Viburnum edule*), and mountain cranberry *(Vaccinium vitis-idaea*) characterize the understory of older seres (Van Cleve and Viereck 1981).

This PNV is similar to the Upland White Spruce Interior and Upland Spruce Hardwood South-central PNVs, which occur on uplands in interior and south-central Alaska, respectively. On older river terraces this PNV may be confused with the Black Spruce Interior and Black Spruce South-central PNVs because black and white spruce often mix, especially on sites with transitional moisture and thermal conditions.

Natural Fire Regime Description:
Estimates of mean fire return intervals include:
- 200+ years (200-300 year range) (Viereck 1973, Barney 1971)
- 300 years (Rowe et al 1974) (for alluvial white spruce MacKenzie River Valley)
- 300 years (Heinselman 1981)
- 300 years (Duchesne and Hawkes 2000)
- 300 years (personal communication experts' workshop March 2004)

Small, relatively infrequent, mixed severity fires characterize this PNV due to the sites' proximity to rivers, which act as fire breaks (Viereck 1973, Barney 1971, Foote 1983). High moisture content of the vegetation, high percentage of deciduous species, and high relative humidity also contribute to making fires less frequent in the Riparian Spruce Hardwood PNV than in typically adjacent PNVs. In interior Alaska the oldest white spruce stands (350+ yrs) are commonly found on islands of floodplains where they are protected from fire (Viereck 1973).

Other Natural Disturbance Description:
Stochastic flood events are the primary disturbance in the Riparian Spruce Hardwood PNV group. Floods are most frequent close to active river channels, and annual flooding associated with spring ice break-up, midsummer glacial melt and severe storms can maintain young vegetation communities perpetually along river margins. The channels of Alaska's large rivers move across the broad floodplains over the course of multiple decades to centuries. Relative to flooding, fire plays a minor role in driving succession and ecosystem processes in this PNV.

Natural Landscape Vegetation-Fuel Class Composition:
The natural vegetation structure is a mosaic of the seral stages described in the table below. White or Lutz spruce is the climax indicator species (Viereck et al 1986). These sites may transition to black spruce PNV sites if the river channel migrates away over time, allowing a moss layer to build up, permafrost to develop, and the soil to become relatively colder (Viereck 1975, Foote 1983, Viereck et al 1986, Walker et al 1986).

Natural Scale of Landscape Vegetation-Fuel Class Composition and Fire Regime:
The distribution of this PNV on the landscape is typically linear, flanking rivers and cutting through a mosaic of relatively colder and wetter black spruce sites on older river terraces. Swaths of the Riparian Spruce Hardwood PNV may be several km wide along larger rivers and 100 m or less along small streams and at higher elevations (Viereck et al 1986).

PNV Model Classes and Descriptions:

Class	**Modeled Percent of Landscape**	**Description** (After: Viereck et al 1986, Walker et al 1986, Van Cleve & Viereck 1981, Van Cleve et al 1980, Viereck 1975, Viereck 1970)
A: 0 -5 years Post disturbance regeneration: herbs, shrub regeneration, seedlings	5%	Silt is deposited on the inside of river meanders following flood events. Flooding deposits seeds which germinate and take root. *Equisetum spp.* and *Salix spp.* colonize in the first year. Within 5 years *Salix spp* and balsam poplar seedlings are abundant. Plant cover is 1-2% first year. Shrub cover increases up to 40% by the fifth year, with a diverse herbaceous layer underneath. Occasionally white (or Lutz) spruce will germinate in large numbers on mineral soil after flooding, resulting in a dense, even-aged stand (succession is to Class E, otherwise to Class B).
B: 5-30 years		Tall shrubs (*Salix spp.*, *Alnus spp.*) and saplings with a closed canopy (>60%). Saplings may consist of balsam poplar with

Mid-development: closed shrub-sapling	18%	white (or lutz) spruce in the understory (succession to Class C), or saplings may consist of pure, even-aged spruce (succession to Class E). Saplings overtop shrubs at 20-40 years, when shade-intolerant pioneer shrub species decline and shade-tolerant shrubs (*Rosa acicularis(prickly rose), Viburnum edule (high bush cranberry)*) become more common and have a canopy cover of 10%.
C: 300 –150 years Mid-development closed balsam poplar	41%	Balsam poplar is the dominant overstory species. White spruce is commonly in the understory. Shade-tolerant shrub species persist in the understory. If spruce is present, at approximately 100-150 years the transition from balsam poplar to white spruce dominance begins (succession to Class D). If white spruce is not present poplar persists, the stand ages and individual trees are lost to wind, disease or rot. Shrub cover commonly increases as the overstory canopy declines.
D: 125-400 years Late-development open white spruce	25%	Spruce gains dominance over poplar and a mixed age, open stand develops. If enough young spruce establishes as poplar declines, the canopy closes again (succession to Class E). Alternatively, the stand may remain open with shrubs in the understory.
E: 30-400 years Mid -late-development, open or closed white or Lutz spruce	11%	This class contains closed stands of white (or lutz) spruce. These stands may be even-aged (resulting from spruce establishment on mineral soil after a flood event (succession from Class A) or mixed age (succession from Class D). If succession is from Class D, occasional mature balsam poplar may persist in the overstory. As the spruce canopy closes feather moss becomes dominant on the forest floor, reaching 80% cover. *Rosa acicularis, Viburnum edule*, and *Alnus spp*. may be scattered in the stand. A low shrub and herb layer may also occupy the forest floor.
Total:	100%	

Modeled Fire Frequency and Severity:

	Mean Probability	Mean Fire Frequency (years) (inverse of probability)	Description
Replacement fire	.02	5,000	Based on literature and expert input
Mosaic fire	.32	315	Based on literature and expert input
All Fire	.34	300	Based on literature and expert input
Flood events	1.36	73	

Modeled Fire Severity Composition:

	Percent All Fires	Description
Replacement fire	90%	Based on literature and expert input
Non-replacement fire	10%	Based on literature and expert input
All Fire	100%	

Uncharacteristic Vegetation-Fuel Classes and Disturbance:

Uncharacteristic vegetation-fuel classes and disturbances result in different percentages of seral classes than those listed below for the Riparian Spruce Hardwood model.

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Fire Regime Condition Class (FRCC) Interagency Guidebook Reference Conditions

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First Draft Date: March 3, 2004 **Most Recent Edit:** August 5, 2004
Status: In development **PNV Code:**

Potential Natural Vegetation (PNV) Name: Persistent Shrub South

Fire regime group: III – infrequent, mixed severity regime

Geographic Area: Southeast Alaska, coastal forests region of south-central Alaska, Bristol Bay region of southwest Alaska.

Physical Stetting Description:
The Persistent Shrub South PNV encompasses several different plant communities on a variety of sties; the common element is that the shrub communities are persistent over time and do not appear to be a sere of another PNV. The Persistent Shrub South PNV occurs on a variety of sites ranging from peat deposits in maritime climates, topogenous bogs, blanket bogs, wet stream bottoms, lowland depressions, marshy stream banks, poorly drained forest openings (Viereck et al 1992), and active avalanche shoots. A peat layer may be absent, thin or relatively thick (1-2 m). Permafrost is generally absent, although has been reported at a depth of 60 cm on the Bering Sea side of the Alaska Peninsula (Racine 1978). Slowly moving, standing water may be present on some sites (e.g., shrub swamp sites).

Biophysical Classification:
Persistent Shrub South PNV occurs in the following ecoregions described by Nowacki et al (2001):

- Bering Taiga – Bristol Bay Lowlands (P6), Yukon-Kuskokwim Delta (P8)
- Aleutian Meadows – Alaska Peninsula (M7)
- Coastal Rainforests – All subregions

The following community types described by Viereck et al (1992) are included Persistent Shrub South PNV group:

IIB1a – Closed Tall Willow Shrub (topoedaphic climax on sheltered upland slopes only)
IIB1b – Closed Tall Alder Shrub (topoedaphic climax on avalanche tracks, steep alpine slopes and tundra uplands only)
IIB2b – Open Tall Alder Shrub (topoedaphic climax at treeline only)
IIC2e – Open Low Ericaceous Shrub Bog
IIB1f – Closed Tall Shrub Swamp (Southeast Alaska sites)

IIC1d – Closed Low Ericaceous Shrub
IIIA1b – Dry Fescue (sere in coastal shrub communities in south-central Alaska)

Identification of Key Characteristics of the PNV and Confuser PNVs:
The vegetation communities included in this PNV are diverse (see cross-walk to Viereck et al (1992) community types above). These same community types occur on different sites (e.g., on floodplains and on burned areas within a forested area) as part of a successional sequence of a different PNV. Therefore, the key to identifying the Persistent Shrub South PNV is to match the community type with the site where it occurs according to the physical setting description and the list of community types described by Viereck et al (1992) above.

Common shrub species on sites dominated by ericads include *Kalmia polifolia*, *Empetrum nigrum, Vaccinium uliginosum*, *V. vitis-idaea*, *Andromeda polifolia*, *V. oxycoccos*, *Ledum decumbens,* and *Cladothamnus pyrolaeflorus* (copperbush). On these sites common understory species include sedges such as *Eriophorum angustifolium*, *Trichophorum caespitosum*, *Carex pluriflora*, and *C.Paucifloria*. Other commonly important herbs include *Rubus Chamaemorus*, *Drosera* spp., and *Gentiana douglasiana* (in Southeast Alaska only). On Persistent Shrub South PNV sites supporting the closed tall shrub swamp vegetation type, common tall shrub species include *Alnus tenuifolia*, *A. sinuata*, *Salix planifolia* and *S. lanata.* On these sites common herbs *include Calamagrostis canadensis*, *Equisetum* spp., *Cornus canadensis*, *Trientalis europaea*, *Potentilla palustris,* and *Carex* spp.. *Shagnum* spp. are usually present and often dominant in the moss layer. In active avalanche shoots *Alnus* spp. are dominant. Trees are absent or scarce.

Shrubs are usually 20-50 cm tall with 25-75% shrub cover, but may be 1.5 m or more tall (e.g., closed tall shrub swamp) (Viereck et al 1992).

The Persistent Shrub South PNV resembles the Persistent Shrub North PNV, which is similarly diverse and defined by the presence of persistent shrubs, but occurs in interior, western and arctic Alaska. The ericaceous plant communities included in this PNV may also bear resemblance to the Dwarf Shrub Tundra PNV, which occurs throughout Alaska but usually occupies well-drained sites and supports shrubs < 20 cm (vs. poorly drained sites and shrub > 20 cm in the Persistent Shrub South PNV).

Natural Fire Regime Description:
Very little information is available about fire history in persistent shrub communities in Alaska. All of the other PNVs in the region (Southeast Alaska, coastal forests region of south-central Alaska, Bristol Bay region of southwest Alaska) are long interval systems due to the moist climate. Mean fire return interval in these PNVs are estimated to be:

- Coastal Boreal Transition Forest PNV (625 year MFI),
- Coastal Forests PNV, (1500 year MFI)
- Kenai Mountain Hemlock PNV (910 year MFI).

Based on the climate and fire histories of adjacent PNVs, mean fire return interval (MFI) for the Persistent Shrub South was estimated at 900 years for this model.

Other Natural Disturbance Description:
Other natural disturbances may include wind, flooding and avalanche, depending on the site.

Natural Landscape Vegetation-Fuel Class Composition:
The natural vegetation structure is a mosaic of the seral stages described in the table below.

Natural Scale of Landscape Vegetation-Fuel Class Composition and Fire Regime:
The Persistent Shrub South PNV exists within a landscape mosaic composed primarily of forested and wetland PNVs. Most of the other PNVs occurring in the region are characterized by large, primarily replacement fires.

Uncharacteristic Vegetation-Fuel Classes and Disturbance:

Uncharacteristic sites have disproportionate percentages of seral classes on the landscape relative to those listed below.

PNV Model Classes and Descriptions:

Class	**Modeled Percent of Landscape**	**Description**
A: Post-disturbance herbaceous 0-5 years	1%	Grasses, sedges and/or forbs dominate the site. Shrubs sprout from rootstock
B: Mature shrub 5-1,000 years	99%	Shrubs overtop herbaceous layer and become dominant. A low shrub and/or herbaceous layer usually persists. Shrub cover is 25-75%.
Total:	100%	

Modeled Fire Frequency and Severity:

	Mean Probability	Mean Fire Frequency (years) (inverse of probability)	Description
Replacement fire	.08	1,250	Based on literature and expert input
Mosaic fire	.02	5,000	Based on literature and expert input
All Fire	.11	910	Based on literature and expert input
Wind/Weather/Stress	.2	500	

Modeled Fire Severity Composition:

	Percent All Fires	Description
Replacement fire	70%	Based on literature and expert input
Non-replacement fire	30%	Based on literature and expert input
All Fire	100%	

- The 125 year MFI suggested by the March 2004 experts’ group does not make sense given the geographic range.

References

Nowacki, G., Spencer, P., Brock, T., Fleming, M., and Jorgenson, R. 2001. Narrative Descriptions for the Ecoregions of Alaska and Neighboring Territories. National Park Service. Place of publication unknown. 17 p.

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Fire Regime Condition Class (FRCC) Interagency Guidebook Reference Conditions

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First Draft Date: March 3, 2004 **Most Recent Edit:** August 5, 2004
Status: In development **PNV Code:**

Potential Natural Vegetation (PNV) Name: Persistent Shrub South

Fire regime group: III – infrequent, mixed severity regime

Geographic Area: Southeast Alaska, coastal forests region of south-central Alaska, Bristol Bay region of southwest Alaska.

Physical Stetting Description:
The Persistent Shrub South PNV encompasses several different plant communities on a variety of sties; the common element is that the shrub communities are persistent over time and do not appear to be a sere of another PNV. The Persistent Shrub South PNV occurs on a variety of sites ranging from peat deposits in maritime climates, topogenous bogs, blanket bogs, wet stream bottoms, lowland depressions, marshy stream banks, poorly drained forest openings (Viereck et al 1992), and active avalanche shoots. A peat layer may be absent, thin or relatively thick (1-2 m). Permafrost is generally absent, although has been reported at a depth of 60 cm on the Bering Sea side of the Alaska Peninsula (Racine 1978). Slowly moving, standing water may be present on some sites (e.g., shrub swamp sites).

Biophysical Classification:
Persistent Shrub South PNV occurs in the following ecoregions described by Nowacki et al (2001):

- Bering Taiga – Bristol Bay Lowlands (P6), Yukon-Kuskokwim Delta (P8)
- Aleutian Meadows – Alaska Peninsula (M7)
- Coastal Rainforests – All subregions

The following community types described by Viereck et al (1992) are included Persistent Shrub South PNV group:

IIB1a – Closed Tall Willow Shrub (topoedaphic climax on sheltered upland slopes only)
IIB1b – Closed Tall Alder Shrub (topoedaphic climax on avalanche tracks, steep alpine slopes and tundra uplands only)
IIB2b – Open Tall Alder Shrub (topoedaphic climax at treeline only)
IIC2e – Open Low Ericaceous Shrub Bog
IIB1f – Closed Tall Shrub Swamp (Southeast Alaska sites)
IIC1d – Closed Low Ericaceous Shrub
IIIA1b – Dry Fescue (sere in coastal shrub communities in south-central Alaska)

Identification of Key Characteristics of the PNV and Confuser PNVs:
The vegetation communities included in this PNV are diverse (see cross-walk to Viereck et al (1992) community types above). These same community types occur on different sites (e.g., on floodplains and on burned areas within a forested area) as part of a successional sequence of a different PNV. Therefore, the key to identifying the Persistent Shrub South PNV is to match the community type with the site where it occurs according to the physical setting description and the list of community types described by Viereck et al (1992) above.

Common shrub species on sites dominated by ericads include *Kalmia polifolia*, *Empetrum nigrum, Vaccinium* *uliginosum*, *V. vitis-idaea*, *Andromeda polifolia*, *V. oxycoccos*, *Ledum decumbens*, and *Cladothamnus pyrolaeflorus* (copperbush). On these sites common understory species include sedges such as *Eriophorum angustifolium*, *Trichophorum caespitosum*, *Carex pluriflora*, and *C.Paucifloria*. Other commonly important herbs include *Rubus Chamaemorus*, *Drosera* spp., and *Gentiana douglasiana* (in Southeast Alaska only). On Persistent Shrub South PNV sites supporting the closed tall shrub swamp vegetation type, common tall shrub species include *Alnus tenuifolia*, *A. sinuata*, *Salix planifolia* and *S. lanata*. On these sites common herbs *include Calamagrostis canadensis*, *Equisetum* spp., *Cornus canadensis*, *Trientalis europaea*, *Potentilla palustris*, and *Carex* spp.. *Shagnum* spp. are usually present and often dominant in the moss layer. In active avalanche shoots *Alnus* spp. are dominant. Trees are absent or scarce.

Shrubs are usually 20-50 cm tall with 25-75% shrub cover, but may be 1.5 m or more tall (e.g., closed tall shrub swamp) (Viereck et al 1992).

The Persistent Shrub South PNV resembles the Persistent Shrub North PNV, which is similarly diverse and defined by the presence of persistent shrubs, but occurs in interior, western and arctic Alaska. The ericaceous plant communities included in this PNV may also bear resemblance to the Dwarf Shrub Tundra PNV, which occurs throughout Alaska but usually occupies well-drained sites and supports shrubs < 20 cm (vs. poorly drained sites and shrub > 20 cm in the Persistent Shrub South PNV).

Natural Fire Regime Description:
Very little information is available about fire history in persistent shrub communities in Alaska. All of the other PNVs in the region (Southeast Alaska, coastal forests region of south-central Alaska, Bristol Bay region of southwest Alaska) are long interval systems due to the moist climate. Mean fire return interval in these PNVs are estimated to be:

- Coastal Boreal Transition Forest PNV (625 year MFI),
- Coastal Forests PNV, (1500 year MFI)
- Kenai Mountain Hemlock PNV (910 year MFI).

Based on the climate and fire histories of adjacent PNVs, mean fire return interval (MFI) for the Persistent Shrub South was estimated at 900 years for this model.

Other Natural Disturbance Description:
Other natural disturbances may include wind, flooding and avalanche, depending on the site.

Natural Landscape Vegetation-Fuel Class Composition:
The natural vegetation structure is a mosaic of the seral stages described in the table below.

Natural Scale of Landscape Vegetation-Fuel Class Composition and Fire Regime:
The Persistent Shrub South PNV exists within a landscape mosaic composed primarily of forested and wetland PNVs. Most of the other PNVs occurring in the region are characterized by large, primarily replacement fires.

Uncharacteristic Vegetation-Fuel Classes and Disturbance:
Uncharacteristic sites have disproportionate percentages of seral classes on the landscape relative to those listed below.

PNV Model Classes and Descriptions:

Class	**Modeled Percent of Landscape**	**Description**
A: Post-disturbance herbaceous	1%	Grasses, sedges and/or forbs dominate the site. Shrubs sprout from rootstock

0-5 years		
B: Mature shrub 5-1,000 years	99%	Shrubs overtop herbaceous layer and become dominant. A low shrub and/or herbaceous layer usually persists. Shrub cover is 25-75%.
Total:	100%	

Modeled Fire Frequency and Severity:

	Mean Probability	Mean Fire Frequency (years) (inverse of probability)	Description
Replacement fire	.08	1,250	Based on literature and expert input
Mosaic fire	.02	5,000	Based on literature and expert input
All Fire	.11	910	Based on literature and expert input
Wind/Weather/Stress	.2	500	

Modeled Fire Severity Composition:

	Percent All Fires	Description
Replacement fire	70%	Based on literature and expert input
Non-replacement fire	30%	Based on literature and expert input
All Fire	100%	

- The 125 year MFI suggested by the March 2004 experts' group does not make sense given the geographic range.

References

Nowacki, G., Spencer, P., Brock, T., Fleming, M., and Jorgenson, R. 2001. Narrative Descriptions for the Ecoregions of Alaska and Neighboring Territories. National Park Service. Place of publication unknown. 17 p.

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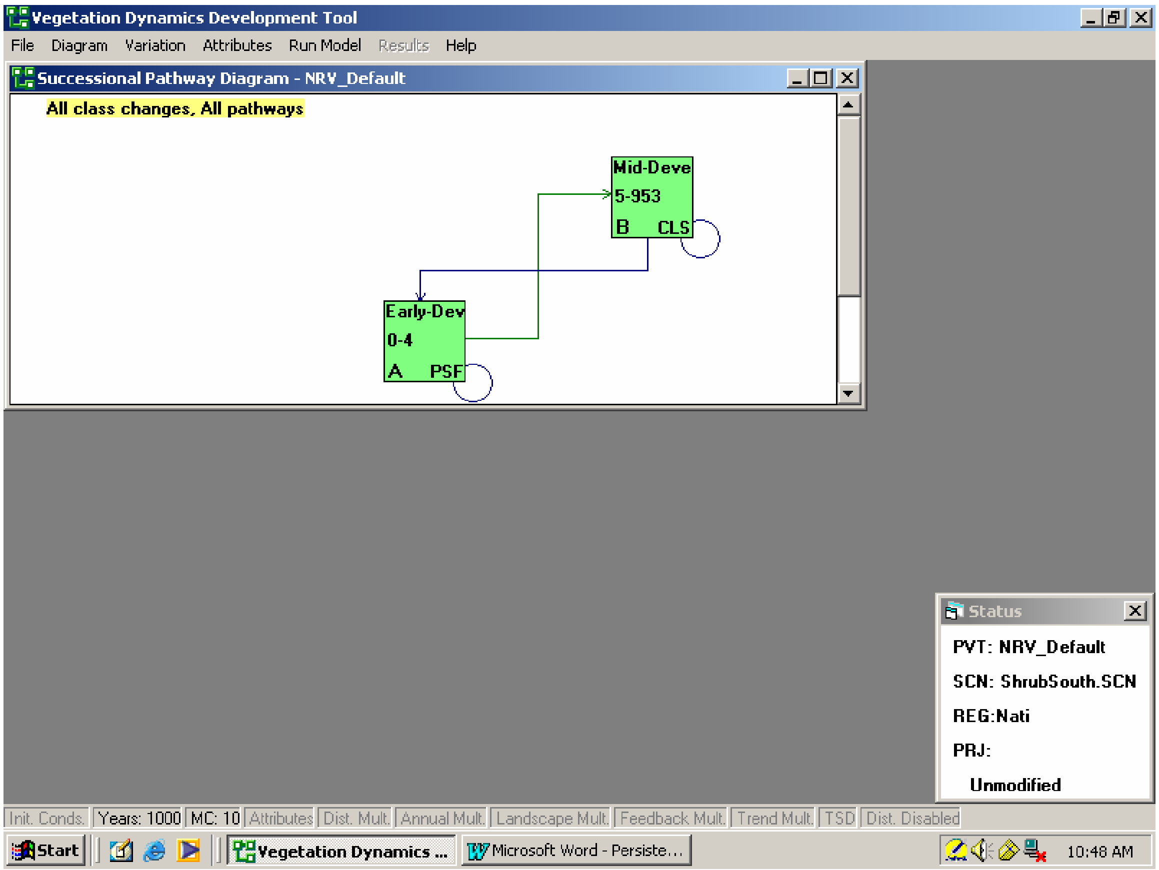
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Fire Regime Condition Class (FRCC) Interagency Guidebook Reference Conditions

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First Draft Date: March 3, 2004 **Most Recent Edit:** August 5, 2004
Status: In development **PNV Code:**

Potential Natural Vegetation (PNV) Name: Tussock Tundra 2

Fire regime group: V

Geographic Area: Brooks Range foothills, Brooks Range, Beaufort Coastal Plain, Bristol Bay lowlands, Yukon-Kuskokwim Delta, Ahklun Mountains

Physical Stetting Description:
Tussock Tundra 2 PNV sites are widespread and common throughout arctic and much of western Alaska (excluding the Seward Peninsula) on flats, gentle slopes with gradients up to 10 percent, and alpine sites (Viereck et al 1992). Permafrost is usually present at depths of 30-50 cm. Soils are generally poorly drained, gleyed, and often with a poorly decomposed organic horizon at the surface, which may constitute most of the active layer. Frost scars are common.

Biophysical Classification:
The Tussock Tundra 2 PNV occurs in the following ecoregions described by Nowacki et al (2001):
- Arctic Tundra - Brooks Range foothills (P1), Brooks Range (P3), Beaufort Coastal Plain (P9)
- Bering Taiga –Bristol Bay lowlands (P6), Yukon-Kuskokwim Delta (P8), Ahklun Mountains (P10)

The following community types described by Viereck et al (1992) are included in Tussock Tundra Bering & Arctic PNV group:

IIB1a – Closed Tall Willow Shrub (may succeed to tussock tundra as permafrost table rises)
IIB2a – Open Tall Willow Shrub (sere on tussock tundra sites)
IIB2d – Open Tall Alder-Willow Shrub (sere on tussock tundra sites)
IC2a – Open Low Mixed Shrub-Sedge Tussock Tundra
IIC1a – Closed Low Shrub Birch Shrub (sere on river terraces)
IIC2b – Open Low Mixed Shrub-Sedge Tussock Bog
IIC2l – Open Low Alder Shrub (successional relations unknown – likely sere in shrub-tussock tundra type)
IIIA2a – Bluejoint Meadow (sere in tussock tundra sequence on some sites on Seward Peninsula)
IIIA2d – Tussock Tundra (climax on poorly drained flats, plateaus, benches, and gentle slopes in northern and western Alaska)
IIIA3a – Wet Sedge Meadow Tundra (complex successional relations – may succeed to or from tussock tundra)

Identification of Key Characteristics of the PNV and Confuser PNVs:
The Tussock Tundra 2 PNV is dominated by sedges in a tussock growth form. *Eriophorum vaginatum* (cottongrass) is the primary tussock-former in most stands. Other indicator species include *Carex bigelowii* (bigelow sedge), *Carex spp.* (sedges), *Betula nana* (Dwarf white birch), *Ledum decumbens* (Labrador tea), *Vaccinium vitis-idaea* (Mountain cranberry), *V. uliginosum* (Bog blueberry*)*, and *Empetrum nigrum* (Crowberry). Grasses, including *Calamagrostis canadensis* and *Arctagrostis* spp. may also be present. Mosses *(Sphagnum* ssp.*)* may be absent or a minor constituent; lichens, including *Cetraria cucullata, C. islandica, Cladonia* spp., *Cladina rangiferina* (Reindeer lichen), and *Thamnolia subuliformis* are often, but are not always abundant.

The Tussock Tundra 2 PNV is very similar to the Tussock Tundra 1 PNV, which occurs in interior Alaska, on the Seward Peninsula, in Nulato Hills region of western Alaska, and the

Alaska Range transition region and which has a shorter mean fire return interval (MFI). Geographic location is the best determinant between Tussock Tundra 1 and Tussock Tundra 2. The Tussock Tundra 2 PNV is also similar to the Dwarf Shrub Tundra PNV which shares many of the same species and occurs in much the same region but lacks the tussock growth form.

Natural Fire Regime Description:
The fuel layer in sedge-shrub tussock tundra is dense and continuous and leads to large, fast spreading fires (Duchesne and Hawkes 2000, Racine et al 1987). Racine (1979) found much variation in burn intensity on a landscape scale on the Seward Peninsula, from completely unburned to intensely-burned. These patterns are related to variations in topography and the composition, moisture content and soil organic accumulations of the plant communities. Fires in *Eriophorum* tussock tundra types tend to be light because of the wet soil profile (Wein 1971). Burns in this type usually consume all aerial woody and herbaceous plant material and litter; regeneration is vigorous via rhizomes and root sprouts. Racine (1979) found that burning was generally less severe in the tussock-shrub and sedge-shrub tundra than in the birch and ericaceous shrub tundra of the Seward Peninsula. He found that tundra burns were patchy, with unburned communities and unburned patches within burned communities.

More fires occur near the forest-tundra ecotone and spread further if trees are present (Heinselman 1981). Wein (1976) reports that July and August are the most common months for lightning fires to occur in tundra ecosystems, while Racine et al (1983) found that distinct fire seasons occur in both June and July in the Noatak River watershed. Subsidence and thermal erosion following fire is usually minimal in tundra ecosystems (Walker 1996).

In most areas of tussock-shrub tundra on the Seward Peninsula, less than one half of accumulated organic soil layer was removed (Racine 1979). Thaw depths increased to reach into the mineral soils, but were not greatly increased except where organics were removed. Frost features were made more conspicuous, and soil nutrient concentrations (K and P) increased locally.

Mean fire return interval estimates for tussock tundra ecosystems include:

- 50-300 years (personal communication, FRCC experts' workshop March 2004)
- 180-1,460 years in forest shrub zone and 9,320 years in shrub subzone in northern Quebec; shorter cycle west of Hudson's Bay/in interior zone (Payette et al 1989)
- 612 years for Noatak River watershed (all vegetation types) (Racine et al 1983)
- Fire interval yet to be determined (Racine et al 1987)
- Rapid recovery following fire makes fire frequency difficult to determine (Wein 1971)
- The fire regime of tundra systems are likely quite variable from one region to another making generalizations difficult (Viereck and Schandelmeier 1980)

Other Natural Disturbance Description:
Frost action, which creates polygonal ground and other periglacial features, is a widespread, small-scale and continuous disturbance within the Tussock Tundra 2 PNV.

Change in the arctic and subarctic climate is another source of disturbance currently affecting tundra ecosystems.

Natural Landscape Vegetation-Fuel Class Composition:
The natural vegetation structure is a mosaic of the seral stages described below.

Natural Scale of Landscape Vegetation-Fuel Class Composition and Fire Regime:
Tundra vegetation types cover vast expanses of the landscape in arctic and western Alaska. Typical landscapes in these regions include the Tussock Tundra 2 PNV within a mosaic of other tundra types, including sedge dwarf shrub and wet sedge-grass meadow types.

Wien (1976) reports many tundra fires in the 1 to 100 ha size range and few large (thousands of ha) fires. Racine

(1979) reports that in 1977 lightning-caused fires burned 35,480 ha on the Seward Peninsula, with one fire burning 9,440 ha. Jandt and Meyers (2000) report that large fires (>200,000 ha) occur about every 10 years in the Buckland Valley and surrounding highlands of the Seward Peninsula. Racine et al (1983) found that 40 fires burned 100,000 ha (1000 km^2) in the 30,000 km^2 watershed of the Noatak River between 1956 and 1981.

Forty-three percent of wildland fires occurring in interior Alaska occur in treeless areas, primarily tundra bogs and fens (Viereck 1975).

Uncharacteristic Vegetation-Fuel Classes and Disturbance:

Uncharacteristic vegetation-fuel classes and disturbances result in different percentages of seral classes than those listed below for the Tussock Tundra 2 model.

PNV Model Classes and Descriptions:

Vegetation communities in the Tussock Tundra 2 PNV typically follow one of two alternate successional pathways; one which develops tussocks with shrubs following disturbance, and one which further develops a significant lichen component.

PNV Model Classes and Descriptions:

Class	**Modeled Percent of Landscape**	**Description** (After: Walker 1996, Racine et al 1983, Wein 1971, Auclair 1983, personal communication FRCC experts' workshop March 2004, Jandt and Meyers 2000)
A: 0-15 years Post disturbance cottongrass/sedge	3%	First year following fire *Eriophorum* (cottongrass) and *Carex* spp. (sedges) regrow via rhizomes, most vascular species begin to recover, shrubs sprout from rootstock. Sedges often capture site 6-10 years post fire. Grasses (*Calamagrostis* and *Arctagrostis*) are locally important following fire.
B: 10-250 years Tussock/shrub tundra	40%	Tussocks dominated by *Eriophorum* (cottongrass), *Carex* spp. (sedges) Lichens begin to re-establish but do not reach former abundance until 50-120 years following fire. Fire is difficult to detect even in the early stages of this class, however the proportions of species differs from the pre-burn community, with very few lichens, fewer shrubs and more sedges, grasses and cottongrass. Former abundances of all species are typically reached 50-120 years post fire. Lichens, if present, have < 25% cover.
C: 80-300 years Lichen/tussock/ shrub	57%	Tussocks are dominated by shrubs and lichens. Species composition is similar to that in Class B, but lichen cover is >25%.
Total:	100%	

Modeled Fire Frequency and Severity:

	Mean Probability	Mean Fire Frequency (years)	Description

		(inverse of probability)	
Replacement fire	.16	625	Based on literature and expert input
Mosaic fire	.02	5000	Based on literature and expert input
All Fire	.18	560	Based on literature and expert input
Other disturbances			

Modeled Fire Severity Composition:

	Percent All Fires	Description
Replacement fire	90	Based on literature and expert input
Non-replacement fire	10	Based on literature and expert input
All Fire	100	

References

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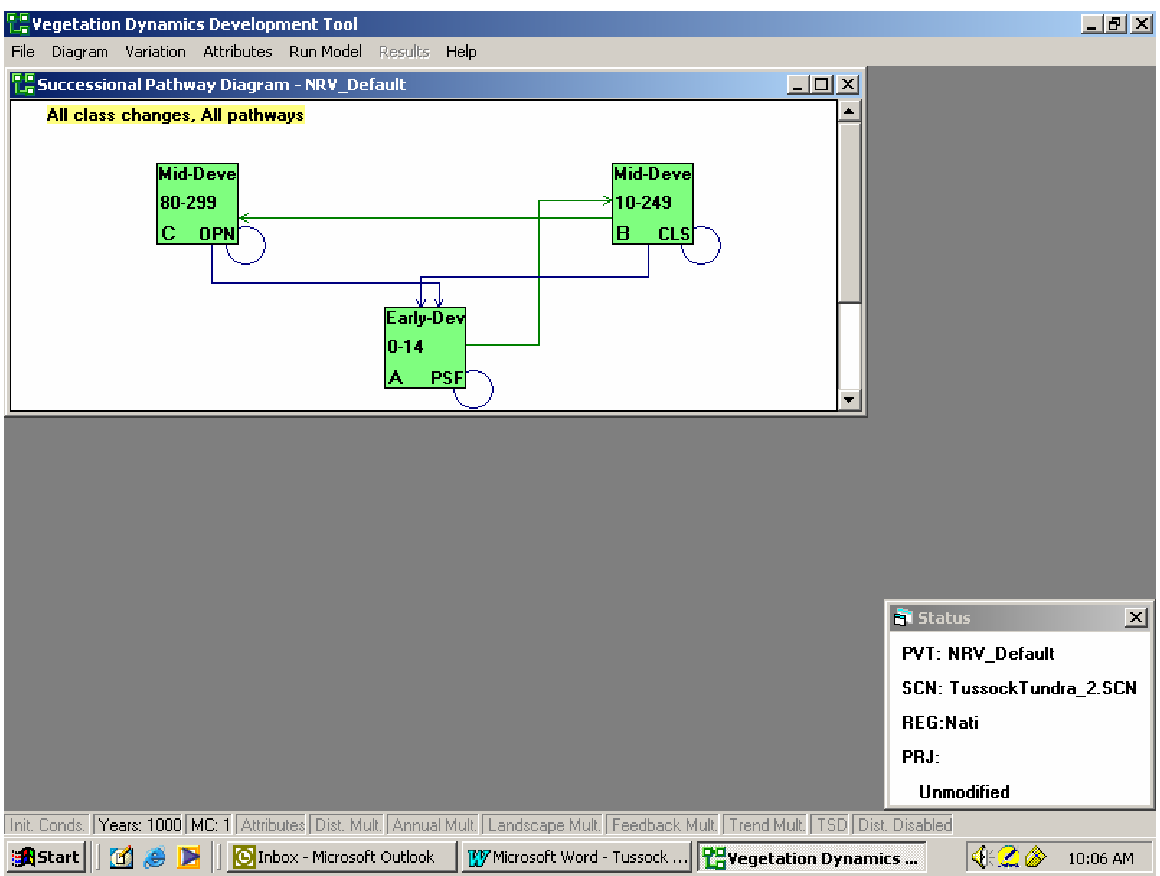

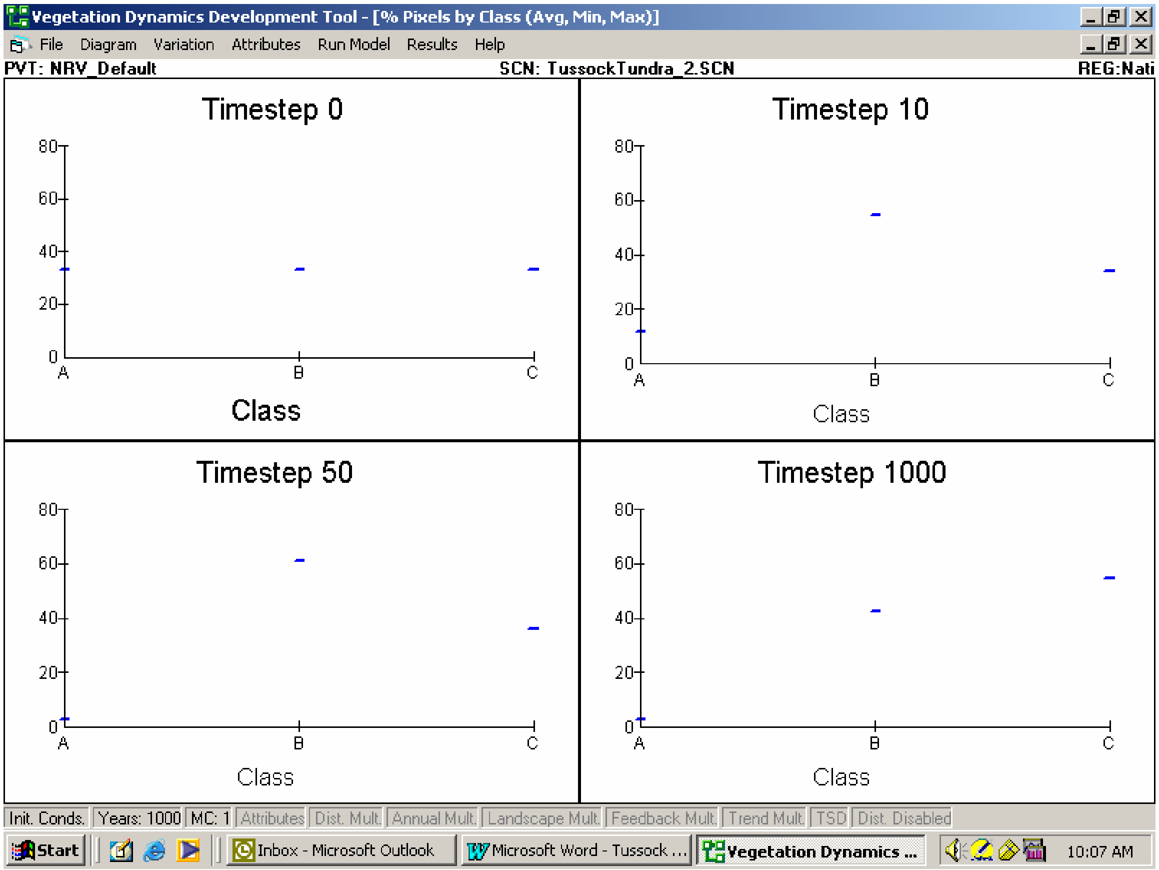

DRAFT

Fire Regime Condition Class (FRCC) Interagency Guidebook Reference Conditions

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First Draft Date: March 3, 2004 **Most Recent Edit:** August 5, 2004
Status: In development **PNV Code:**

Potential Natural Vegetation (PNV) Name: Non-Forested Wetland

Fire regime group: V

Geographic Area: Throughout lowlands and uplands of Alaska, but not found in mountains

Physical Stetting Description:
The Non-Forested Wetland PNV encompasses many different plant communities on a variety of wet sties; the common element is that the wetland communities are persistent over time and do not appear to be a sere of another PNV. Sites where the Non-Forested Wetland PNV occurs include coastal margins and marshes, tidal flats, ponds, sloughs, oxbow lakes and lake margins, sluggish streams, and upland depressions and thermokarst pits in arctic and northwestern Alaska. Soils range from mineral or organic-rich mucks to saturated peaty soils forming quaking mats (Viereck et al 1992). Permafrost may be present on sites in interior and arctic Alaska, but is generally absent under wetland communities elsewhere in the state.

Biophysical Classification:

The Non-Forested Wetland PNV occurs in the following ecoregions described by Nowacki et al (2001):

- Intermontane Boreal
- Alaska Range Transition
- Arctic Tundra
- Bering Taiga
- Bering Tundra
- Aleutian Meadows – Aleutian Islands (M1)
- Coastal Rainforests

The following community types described by Viereck et al (1992) are Non-Forested Wetland PNV group:

IIIA3d – Fresh Sedge Marsh
IIIA3e – Fresh Grass Marsh
IIIA3f – Subarctic Lowland Sedge Wet Meadow
IIIA3g – Subarctic Lowland Sedge-Shrub Wet Meadow
IIIA3h – Halophytic Grass Wet Meadow
IIIA3I – Halophytic Sedge Wet Meadow
IIIA3j – Subarctic Lowland Sedge-Bog Meadow
IIIA3k – Subarctic Lowland Sedge-Moss Bog Meadow

IIIB3a – Fresh Herb Marsh
IIIB3b – Subarctic Lowland Herb Wet Meadow
IIIB3c – Subarctic Lowland Herb Bog Meadow
IIIB3d – Halophytic Herb Wet Meadow

IIID1a – Pondlilly
IIID1b – Common Marestail
IIID1c – Aquatic Buttercup
IIIDid – Burreed
IIID1d – Water Milfoil
IIID1f – Fresh Pondweed
IIID1g – Water Star-Wort
IIID1h – Aquatic Cryptogam
IIID2a – Four-Leaf Marestail
IIID2b – Brackish Pondweed
IIID3a – Eelgrass

Identification of Key Characteristics of the PNV and Confuser PNVs:

The vegetation communities included in this PNV are diverse (see cross-walk to Viereck et al (1992) community types above). These same community types occur on different sites as part of a successional sequence of a different PNV. Therefore, the key to identifying the Non-Forested Wetland PNV is to match the community type with the site where it occurs according to the physical setting description and Viereck cross-walk above.

Many communities within this PNV are dominated by *Carex* spp.. Other common species include *Arctophila fulva*, *Puccinellia* spp., *Eriophorum* spp. and the tall emergent sedges *Scirpus validus* and *Eleocharis palustris*. Important shrubs include *Salix* spp. and *Myrica gale*. Low shrubs, including *Andromeda polifolia* and *Vaccinium oxycoccos* may be present on some inland sites. In Halophytic communities common forbs include *Honckenya peploides*, *Triglochin maritimum*, and *Plantago maritima*. Emergent herbs, including *Menyanthes trifoliata, Potentilla palustris*, *Caltha palustris* and *Equisetum fluviatile* are important on some sites. Aquatic plants such as *Hippuris vulgaris*, *Nuphar polysepalum*, *Nymphaea tetragona* or *Sparganium* spp. may also be present. Sphagnum and other aquatic mosses may be present or absent. Trees and lichens are absent.

The Non-Forested Wetland PNV is not easily confused with any other PNV in Alaska.

Natural Fire Regime Description:
Very little information is available about fire history in wetland communities in Alaska. Based on the types of sites and climates where this PNV occurs and the fire histories of adjacent PNVs, mean fire return interval (MFI) for the Non-Forested Wetland PNV was estimated at 1,000 years for this model.

Other Natural Disturbance Description:
Other natural disturbances include floods and grazing.

Natural Landscape Vegetation-Fuel Class Composition:
The natural vegetation structure is a mosaic of the seral stages described in the table below.

Natural Scale of Landscape Vegetation-Fuel Class Composition and Fire Regime:
The Non-Forested Wetland PNV exists within a landscape mosaic composed of forested, tundra and persistent shrub and herbaceous PNVs. Most of the other PNVs occurring in most of the region are characterized by large, primarily replacement fires.

Uncharacteristic Vegetation-Fuel Classes and Disturbance:
Uncharacteristic sites have disproportionate percentages of seral classes on the landscape relative to those listed below.

PNV Model Classes and Descriptions:

Class	**Modeled Percent of Landscape**	**Description**
A: Post-disturbance herbaceous 0-3 years	1%	Grasses, sedges and/or forbs colonize the site.
B: Mature closed 3-1000 years	99%	Grasses, sedges and/or forbs dominate the site.
Total:	100%	

Modeled Fire Frequency and Severity:

	Mean Probability	Mean Fire Frequency (years) (inverse of probability)	Description
Replacement fire	.06	2,500	Based on literature and expert input
Mosaic fire	.04	1,665	Based on literature and expert input
All Fire	.10	1,000	Based on literature and expert input
Other disturbances			

Modeled Fire Severity Composition:

	Percent All Fires	Description
Replacement fire	60%	Based on literature and expert input
Non-replacement fire	40%	Based on literature and expert input
All Fire	100%	

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Appendix R
Incident Complexity Analysis

Guide to Completing the Incident Complexity Analysis.
(Type 1, 2)

1) Analyze each element and check the response, Yes or No.

2) If positive responses exceed, or are equal to, negative responses within any primary factor (A through G), the primary factor should be considered as a positive response.

3) If any three of the primary factors (A through G) are positive responses, this indicates the fire situation is or is predicted to be of Type 1 complexity.

4) Factor H should be considered after numbers 1–3 are completed. If more than two of the items in factor H are answered yes, and three or more of the other primary factors are positive responses, a Type 1 team should be considered. If the composites of H are negative, and there are fewer than three positive responses in the primary factors (A-G), a Type 2 team should be considered. If the answers to all questions in H are negative, it may be advisable to allow the existing overhead to continue action on the fire.

Incident Complexity Analysis	YES	NO
A. Fire Behavior (Observed or Predicted)		
1. Burning index (from on-site measurement of weather conditions) predicted to be above the 90% level using the major fuel model in which the fire is burning.		
2. Potential exists for extreme fire behavior (fuel moisture, winds, etc.).		
3. Crowning, profuse or long-range spotting.		
4. Weather forecast indicating no significant relief or worsening conditions.		
Total		
B. Resources Committed		
1. 200 or more personnel assigned.		
2. Three or more divisions.		
3. Wide variety of special support personnel.		
4. Substantial air operation which is not properly staffed.		
5. Majority of initial attack resources committed.		
Total		
C. Resources Threatened		
1. Urban interface.		
2. Developments and facilities.		
3. Restricted, threatened, or endangered species habitat.		
4. Cultural sites.		
5. Unique natural resources, special-designation areas, wilderness.		
6. Other special resources.		
Total		
D. Safety		
1. Unusually hazardous fireline construction.		
2. Serious accidents or fatalities.		
3. Threat to safety of visitors from fire and related operations.		

4. Restrictions and/or closures in effect or being considered.		
5. No night operations in place for safety reasons.		
Total		
E. Ownership		
1. Fire burning or threatening more than one jurisdiction.		
2. Potential for claims (damages).		
3. Different or conflicting management objectives.		
4. Disputes over suppression responsibility.		
5. Potential for unified command.		
Total		
F. External Influences		
1. Controversial fire policy.		
2. Pre-existing controversies/relationships.		
3. Sensitive media relationships.		
4. Smoke management problems.		
5. Sensitive political interests.		
6. Other external influences.		
Total		
G. Change in Strategy		
1. Change in strategy to control from confine or contain		
2. Large amounts of unburned fuel within planned perimeter.		
3. WFSA invalid or requires updating.		
Total		

H. Existing Overhead		
1. Worked two operational periods without achieving initial objectives.		
2. Existing management organization ineffective.		
3. Overhead overextended mentally and/or physically.		
4. Incident action plans, briefings, etc. missing or poorly prepared.		
Total		

Incident Complexity Analysis (Type 3, 4, 5)

Fire Behavior	Yes	No
Fuels extremely dry and susceptible to long-range spotting or you are currently experiencing extreme fire behavior.		
Weather forecast indicating no significant relief or worsening conditions.		
Current or predicted fire behavior dictates indirect control strategy with large amounts of fuel within planned perimeter.		
Firefighter Safety		
Performance of firefighting resources affected by cumulative fatigue.		
Overhead overextended mentally and/or physically.		
Communication ineffective with tactical resources or dispatch.		
Organization		
Operations are at the limit of span of control.		
Incident action plans, briefings, etc. missing or poorly prepared.		
Variety of specialized operations, support personnel or equipment.		
Unable to properly staff air operations.		
Limited local resources available for initial attack.		
Heavy commitment of local resources to logistical support.		
Existing forces worked 24 hours without success.		
Resources unfamiliar with local conditions and tactics.		
Values to be protected		
Urban interface; structures, developments, recreational facilities, or potential for evacuation.		
Fire burning or threatening more than one jurisdiction and potential for unified command with different or conflicting management objectives.		
Unique natural resources, special-designation areas, critical municipal watershed, T&E species habitat, cultural value sites.		
Sensitive political concerns, media involvement, or controversial fire policy.		

If you have checked “Yes” on 3 to 5 of the analysis boxes, consider requesting the next level of incident management support.

Appendix S
Prescriptive Criteria for Wildland Fires Managed For Resource Benefit

1. Refuge Preparedness Level One

Fire Weather Index (FWI)* is 0-3, Average Buildup Index (BUI)** is less than 70

i. New wildland fires caused by lightning may be managed for resource benefit in all AIWFMP fire management option zones.
ii. Existing fire use incidents will be monitored at least once every 10 days, if weather, fire behavior and flying conditions warrant.

2. Refuge Preparedness Level Two

FWI is 4-13, Average BUI is less than 90

i. New wildland fires caused by lightning may be managed for resource benefit in all AIWFMP fire management option zones.
ii. Existing fire use incidents will be monitored at least once a week.

3. Refuge Preparedness Level Three

FWI is 14-23, Average BUI is between 90 and 100

iii. New wildland fires caused by lightning may be managed for resource benefit in all AIWFMP fire management option zones.
iv. Existing fire use incidents will be monitored every three days.

4. Refuge Preparedness Level Four

FWI is 24-28, Average BUI is between 100 and 110

v. New wildland fires caused by lightning may be managed for resource benefit only in Limited AIWFMP fire management option zones.
vi. Existing fire use incidents will be monitored daily.

1. Refuge Preparedness Level Five

FWI is greater than 28, Average BUI is greater than 110

vii. New wildland fires caused by lightning may not be managed for resource benefit – all new ignitions will receive appropriate response according to AIWFMP fire management option zone guidance.
viii. Existing fire use incidents will be monitored daily.

* FWI – is a Canadian Forest Fire Danger Rating System index that represents the intensity of a spreading fire.

** BUI is a Canadian Forest Fire Danger Rating System index that represents the total fuel available for combustion. It includes a seasonal drought component

Appendix T
Minimum Requirement Analysis.

ARTHUR CARHART NATIONAL WILDERNESS TRAINING CENTER

Not approved as policy-Draft

MINIMUM REQUIREMENT DECISION GUIDE

". . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act."

– Wilderness Act, 1964

Instructions and worksheets for the Minimum Requirement Analysis for actions, projects, and activities in Wilderness

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Introduction

More than 100 million acres of Federal land are managed as wilderness, a Congressional mandate that began with the passage of the Wilderness Act in 1964. In partnership with the public, wilderness managers have a responsibility to preserve and protect wilderness values.

Simply designating a wilderness does not assure its preservation. Careful management is needed to minimize the impacts from human activities in wilderness, including grazing, access to private lands, mining, management of fish and wildlife, fire and recreation. These activities have the potential to negatively impact the values that we are charged with protecting.

This guide is provided to assist managers in making appropriate decisions about their administrative actions in wilderness. The guidance comes from the Wilderness Act, agency policies, and the experience of 35 years of wilderness management. The wilderness resource is fragile and can be lost through the erosion from seemingly inconsequential decisions.

From Legislative Mandate to Agency Policy

A clear understanding and appreciation of the purposes and definitions contained in the 1964 Wilderness Act are necessary before considering appropriate management actions in wilderness.

The purpose of the Act is stated in Section 2 (a), "to secure for the American people of present and future generations the benefits of an enduring resource of wilderness."

Section 4 (c) of the Act prohibits certain activities in wilderness by the public and, at the same time, allows the agencies to engage in those activities in some situations. Section 4 (c) states:

> "except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

In the above language, Congress acknowledged that even though certain activities are prohibited, there are times when exceptions to these prohibitions will need to be made for administration of the area. However, from the regulations, special orders, and internal agency policy contained in Appendix A of this guide, it is clear that the wilderness management agencies should not view the language in Section 4 (c) as blanket approval to conduct projects or allow activities without an analysis of (1) whether the project or activity is necessary to meet the minimum requirements for the administration of the area, and (2) which tool or method should be used to complete the project that results in the least impact to the physical resource or wilderness values.

Agency employees entrusted with management of wilderness should set the highest standard possible when reviewing management practices in wilderness. Wilderness is intended to be managed differently from other public lands and this difference needs to be demonstrated to the public.

A Word About Traditional/Primitive Tools and Mechanical Transport

There isn't an all encompassing definition of traditional or primitive tools, but generally defined they include a variety of non-motorized devices such as hand saws, axes, shovels, and certain tools that give a mechanical advantage such as wedges, block and tackles, and winches. The Wilderness Act prohibits the use of motorized equipment and mechanical transport, but not mechanized equipment. Technological advances have improved the efficiency and function of traditional tools over the years. These improvements don't eliminate them from consideration as traditional tools. The defining characteristic of traditional or primitive tools is the reliance on human or animal power.

Mechanical transport includes travel within the wilderness by motorized vehicle of any kind. It also includes mechanical devices that provide transportation such as bicycles.

The use of traditional tools has been a cornerstone of wilderness management philosophy since 1964. As a result, certain skills that almost certainly would have vanished, have been kept alive. So few opportunities still exist to perpetuate these skills that are an important cultural tradition in our country. This is one of the benefits of wilderness.

How to Use This Guide

This guide has been developed to help provide consistency to the way project proposals in wilderness are evaluated and to ensure that we constantly strive to maintain or improve wilderness character through the decisions that are made. The information in this guide needs to be accompanied by a clear understanding of wilderness values and the ability to translate that understanding to a variety of complex and/or difficult projects in wilderness.

The guide is not a NEPA document, decision document or policy, but rather a series of self-explanatory worksheets designed to assist in thinking through and/or documenting your analysis. The worksheets include a two step minimum requirements analysis: first, to determine if the project or activity proposed is the minimum necessary for administration of the area for the purpose of the Act, and second, to determine which tool(s) will have the least impact to the wilderness resource. The worksheets lead the wilderness manager through a series of questions to provoke thought and understanding about the necessity of the proposed project and the most appropriate tools to use.

The minimum requirements analysis is provided to stretch our imaginations for the least imp active way of administering the wilderness. The wilderness manager may authorize any of the generally prohibited activities or uses listed in Sec. 4(c) of the Wilderness Act if they are determined to be the minimum necessary to do the job and meet wilderness management objectives.

When deciding what projects or activities to undertake and tools to use, follow these steps:

1. Complete a minimum requirement analysis, Step 1 of the worksheets, for all proposed projects or activities. This step should not be used to justify use of motorized equipment or mechanical transport, but rather, to scrutinize the project or activity and make the best decision for wilderness in the long term.

2. Complete a "minimum tool" analysis for the project. This analysis can follow the attached worksheet or, if not, should at least address the same points. If the analysis shows a justifiable need for motorized equipment, it is important to have this analysis in writing to provide to the official(s) who can authorize the use of mechanical transport or motorized equipment in wilderness. For some units, this analysis may become an integral part of an environmental analysis required to document a decision to use motorized equipment.

Ongoing management practices, especially if they involve mechanical transport, motorized equipment, or structures, should be reviewed to determine if they are still necessary or the best way to complete the task at hand.

How Does the Minimum Requirements Analysis Tie to NEPA?

The minimum requirement analysis is intended to assist you in making a decision and the worksheets will document your analysis. This process does not take the place of NEPA.

If a formal decision under NEPA will be required to implement your project, consider formatting your minimum tool analysis so that it can be incorporated directly into your environmental analysis. The minimum requirements analysis will tie to your statement of Purpose and Need for the project in your environmental analysis.

Minimum Requirements Worksheets

STEP 1 - DETERMINING THE MINIMUM REQUIREMENTS

(a two part process)

PART A - Minimum Requirement Key to making a determination on wilderness management proposals

(This flow chart will help you assess whether the project is the minimum required action for administration of the area as wilderness. Answering these questions will help determine **IF** this action is really the **minimum required** action in wilderness.)

Guiding Questions

Use the available space or additional sheets as necessary.

Is this an emergency? (i.e. a situation that involves an inescapable urgency and temporary need for speed beyond that available by primitive means, such as fire suppression, health and safety of people, law enforcement efforts involving serious crime or fugitive pursuit, retrieval of the deceased or an immediate aircraft accident investigation.)

Answer: **YES:** ☐ **NO:** ☐

Explain:

If **Yes**, then: Document rationale for line officer approval using the minimum tool form and proceed with action.

If **No**, then: ⇓ *go to next question*

Does the project or activity conflict with the stated wilderness goals, objectives, and desired future conditions of applicable legislation, policy and management plans?

Answer: **YES:** ☐ **NO:** ☐

Explain:

If **Yes**, then: Do not proceed with the proposed project or activity.

If **No**, then: ⇓ *go to next question*

Are there other less intrusive actions that should be tried first? (i.e. signing, visitor education, or information.)

Answer: **YES:** ☐ **NO:** ☐

Explain:

If **Yes**, then:

If **No**, then:

Implement other actions using the appropriate process.

⇓

go to next question

Minimum Requirements Worksheets

Can this project or activity be accomplished outside of wilderness and still achieve its objectives? (i.e. some group events.)	**Answer:** **YES:** ☐ **NO:** ☐ **Explain:**

If **Yes**, then:

Proceed with action outside of wilderness using the appropriate process.

If **No**, then:

⇓

go to next question

Is this project or activity subject to valid existing rights? (i.e. a mining claim or right-of-way easement.)	**Answer:** **YES:** ☐ **NO:** ☐ **Explain:**

If **Yes**, then:

Proceed to minimum tool section of this document, STEP 2.

If **No**, then:

⇓

go to next question

Is there a special provision in legislation (the 1964 Wilderness Act or subsequent wilderness legislation), that <u>allows</u> this project or activity? (i.e. maintenance of dams and water storage facilities with motorized equipment and mechanical transport or control of fire, insects and disease.)	**Answer:** **YES:** ☐ **NO:** ☐ **Explain:**

If **Yes**, then:

The proposed project or activity can be **<u>considered</u>** but is not necessarily <u>required</u> just because it is mentioned in legislation. *Go to Part B, as needed.*

If **No**, then:

⇓

Proceed to Part B, Responsive Questions

Minimum Requirements Worksheets

PART B - Determining the Minimum Requirement

Responsive Questions for Minimum Requirements Analysis: Explain your answer in the response column. If your responses indicate potential adverse impacts to wilderness character, evaluate whether or not you should proceed with this proposal. If you decide to proceed, begin developing plans to mitigate impacts, and complete the Minimum Tool Analysis in this guide. Some of the following questions may not apply to your proposed project or activity.

	RESPONSIVE STATEMENT
EFFECTS ON WILDERNESS CHARACTER	
How does the project or activity benefit the wilderness resource as a whole as opposed to maximizing one resource?	
If this project or activity were not completed, what would be the beneficial and detrimental effects to the wilderness resource?	
How would the project or activity help ensure that human presence is kept to a minimum and that the area is affected primarily by the forces of nature rather than being manipulated by humans?	
How would the project or activity ensure that the wilderness provides outstanding opportunities for solitude or a primitive and unconfined type of recreation? (i.e. does the project or activity contribute to people's sense that they are in a remote place with opportunities for self-discovery, adventure, quietness, connection with nature, freedom, etc.)	
MANAGEMENT SITUATION	
What does your management plan, policy, and legislation say to support proceeding with this project?	
How did you consider wilderness values over convenience, comfort, political, economic or commercial values while evaluating this project or activity?	

b) SHOULD WE PROCEED?	YES: Go to Step 2	NO: Stop

Minimum Requirements Worksheets

STEP 2 - DETERMINING THE MINIMUM TOOL
(the Minimum Tool Analysis)

These questions will assist you in determining the appropriate tool(s) to accomplish the project or proposed activity with the least impact to the wilderness resource. This analysis can be used as part of the NEPA process if desired. This analysis can be documented on the following form or on additional sheets. Directions are in **bold** type. Prompting questions are in *italics*.

Develop several approaches to resolve the issue or problem. At a minimum consider the following three methods:			
Alternative 1: An alternative utilizing motorized equipment or mechanical transport	**Alternative 2: An alternative using non-motorized equipment and non-mechanical transport.**	**Alternative 3: Variations of method 1 and 2, as appropriate.**	**Alternative 4: Other ideas?**
Describe the alternatives. Be specific and provide detail. *What is proposed?* *Why is it being proposed in this manner?* *Who is the proponent?* *When will the project take place?* *Where will the project take place?* *How will it be accomplished? (What methods and techniques will be used?)*			
Alt#1:	Alt#2:	Alt#3:	Alt#4:
Utilize the following criteria to assess each method (a brief statement should suffice) :			
Biophysical effects Describe the environmental resource issues that would be affected by the project. Describe any effects this action will have on protecting natural conditions within the regional landscape (i.e. insect, disease, or noxious weed control). Include both biological and physical effects.			
Alt#1:	Alt#2:	Alt#3:	Alt#4:

Social/recreation/experiential effects
Describe how the wilderness experience may be affected by the proposed action.
Include effects to recreation use and wilderness character.
Consider the effect the proposed action may have on the public and their opportunity for discovery, surprise, and self-discovery.

Alt#1:	Alt#2:	Alt#3:	Alt#4:

Societal/political effects
Describe any political considerations (i.e. MOUs, agency agreements, local positions) that may be affected by the proposed action.
Describe relationship of method to applicable laws.

Alt#1:	Alt#2:	Alt#3:	Alt#4:

Health and safety concerns
Describe and consider any health and safety concerns associated with the proposed action.
Consider the types of tools used, training, certifications, and other administrative needs to ensure a safe work environment for employees.
Consider the effect the proposed action may have on the health and safety of the public.

Alt#1:	Alt#2:	Alt#3:	Alt#4:

Economic and timing considerations Describe the costs and timing associated with implementing each alternative Assess the urgency and potential cumulative effect from this proposal of similar actions.			
Alt#1:	Alt#2:	Alt#3:	Alt#4:
Formulate a preferred action. Be specific and describe in detail below.			
Choose a preferred alternative:			
Further refine the preferred alternative to minimize impacts to wilderness.			
What will be the specific operating requirements for the action? Include information on timing, locations, amounts, etc… Be as specific as possible.			
What are the maintenance requirements? Describe any ongoing or repeat efforts that will be necessary.			
What standards and designs will apply?			
Develop and describe any mitigation measures that apply.			
What will be provided for monitoring and feedback to strengthen future effects and preventative actions to be taken to help in future efforts?			

	Signature	Name	Position	Date
Prepared by:				
Recommended by:				
Recommended by:				
Approved by:				

NOTE: THIS MAY NOT APPLY TO YOUR AGENCY. REFER TO YOUR AGENCY'S POLICY ON NEPA REQUIREMENTS BEFORE USING THIS WORKSHEET.

Determine the appropriate level of NEPA analysis and documentation. Answer the following questions.

Guiding Questions

Use the available space or additional sheets as necessary.

Is the action authorized by a previous NEPA document?

Answer:	**YES:** ☐	**NO:** ☐
Explain:		

If **Yes**, then:

Proceed with action, document approval for those actions requiring use of motorized equipment or mechanical transport with a letter of delegation from the appropriate line officer.

If **No**, then:

⇓

go to next question

Is the action of limited scope and duration and qualifies under one of the Secretary of Agriculture exemptions or Chief of the Forest Service exemptions for categorical exclusion without a case file?

Answer:	**YES:** ☐	**NO:** ☐
Explain:		

If **Yes**, then:

Proceed with action, document approval for those actions requiring use of motorized equipment or mechanical transport with a letter of delegation from the appropriate line officer.

If **No**, then:

⇓

go to next question

Is the action of limited scope and duration, has no extraordinary circumstances, and qualifies for a Chief of the Forest Service exemptions for categorical exclusion with a case file?

Answer:	**YES:** ☐	**NO:** ☐
Explain:		

If **Yes**, then:

Scope interested publics and prepare Decision Memo for the appropriate line officer.

If **No**, then:

⇓

go to next question

Minimum Requirements Worksheets

Is the action likely to have significant adverse effects on the wilderness resource or human environment?	

If **Yes**, then: If **No**, then:

Proceed with an EIS and ROD for the appropriate line officer.	Scope interested publics and prepare an EA and Decision Notice for the appropriate line officer.

Answer:	**YES:** ☐	**NO:** ☐
Explain:		

MINIMUM REQUIREMENT ANALYSIS
APPENDIX A

Agency Policy related to minimum requirement/minimum tool

Bureau of Land Management:

Code of Federal Regulations 6303.1

How does BLM carry out administrative and emergency functions?
As necessary to meet minimum requirements for the administration of the wilderness area, BLM may:

(a) Use, build, or install temporary roads, motor vehicles, motorized equipment, mechanical transport, structures or installations, and land aircraft, in designated wilderness;

(b) Prescribe conditions under which other Federal, State, or local agencies or their agents may use, build, or install such items to meet the minimum requirements for protection and administration of the wilderness area, its resources and users;

(c) Authorize officers, employees, agencies, or agents of the Federal, State, and local governments to occupy and use wilderness areas to carry out the purposes of the Wilderness Act or other Federal statutes; and

(d) Prescribe measures that may be used in emergencies involving the health and safety of persons in the area, including, but not limited to, the conditions for use of motorized equipment, mechanical transport, aircraft, installations, structures, rock drills, and fixed anchors. BLM will require any restoration activities that we find necessary to be undertaken concurrently with the emergency activities or as soon as practicable when the emergency ends.

National Park Service:

Director's Order #41:
Wilderness Preservation and Management

C. Wilderness Management Issues

2. Application of the Minimum Requirement Concept

. . . except as necessary to meet the minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area) there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, not other form of mechanical transport, and no structure or installation within any such area.

– The Wilderness Act: Section 4(c)

All management decisions affecting wilderness must be consistent with a minimum requirement concept . . . . When determining minimum requirement, the potential disruption of wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience. If a compromise of wilderness resource or character is unavoidable, only those actions that preserve wilderness character and/or have localized, short-term adverse impacts will be acceptable.

– NPS Management Policies: 6.3.5 Minimum Requirement

The National Park Service will apply the minimum requirement concept to all administrative activities that affect the wilderness resource and character. The application of the minimum requirement concept is intended to minimize impacts on wilderness character and resources and must guide all management actions in wilderness.

Wilderness managers may authorize (using a documented process) the generally prohibited activities or uses listed in Section 4(c) of the Wilderness Act if they are deemed necessary to meet the minimum requirements for the administration of the area as wilderness and where those methods are determined to be the 'minimum tool' for the project. The use of motorized equipment and the establishment of management facilities are specifically prohibited when other reasonable alternatives are available. The minimum requirements process cannot be used to permit roads or inappropriate commercial enterprises within wilderness unless these are authorized by specific legislation.

The minimum requirement concept is to be applied as a two-step process that documents:

(1) A determination as to whether or not a proposed management action is appropriate or necessary for the administration of the areas as wilderness, and does not pose a significant impact to the wilderness resources and character; and,

(2) If the project is appropriate or necessary in wilderness, the selection of the management method (tool) that causes the least amount of impact to the physical resources and experiential qualities (character) of wilderness.

It is important to understand the distinctions between the terms "Minimum Requirement," and "Minimum Tool."

<u>Minimum Requirement</u> is a documented process the NPS will use for the determination of the appropriateness of all actions affecting wilderness.

<u>Minimum Tool</u> means a use or activity, determined to be necessary to accomplish an essential task, which makes use of the least intrusive tool, equipment, device, force, regulation, or practice that will achieve the wilderness management objective. This is not necessarily the same as the term "primitive tool," which refers to the actual equipment or

methods that make use of the simplest available technology (i.e., hand tools).

Park managers will apply the minimum requirement concept when making all decisions concerning management of the wilderness area. This includes decisions concerning administrative practices, historic properties, proposed special uses, research, and equipment use in wilderness.

Planned administrative actions that may result in an exception to a prohibited use (i.e., chainsaws, aircraft use, radio repeater sites, rock drills, patrol structures, weather stations), or have the potential to impact wilderness resources and values must be consistent with an approved wilderness management plan and be documented in accordance with the park's minimum requirements process. The minimum requirements process will be conducted through appropriate environmental analysis (e.g., categorical exclusions, environmental assessment/ FONSI, or an environmental impact statement/Record of Decision).

When determining the minimum requirement for a proposed action, the manager will strive to minimize the extent of adverse impact associated with accomplishing the necessary wilderness objective. The determination as to whether or not an action has an adverse impact on wilderness must consider both the physical resources within wilderness, and wilderness characteristics and values. These characteristics and values include: the wilderness's primeval character and influence; the preservation of natural conditions (including the lack of man-made noises); cultural resource values, the assurance of outstanding opportunities for solitude; the assurance that the public will be provided with a primitive and unconfined type of recreational experience; and the assurance that wilderness will be preserved and used in an unimpaired condition.

Managers must give appropriate consideration to the aesthetic values of wilderness as well as the physical resource. These factors take precedence over cost or convenience in determining minimum requirement. National Parks with wilderness must have a documented process for applying the minimum requirement concept. Reference Manual #41: Appendix F includes examples of "decision trees," which may be adopted or referred to as a procedure by which alternatives can be assessed and final management decisions developed. These decision tree examples do not alleviate a park's responsibility for providing adequate environmental compliance documentation for individual projects.

U.S. Fish and Wildlife Service:

Refuge Manual
8. Wilderness Area Management

8.5 Definitions.

A. Minimum tool. The minimum action or instrument necessary to successfully, safely, and economically accomplish wilderness management objectives.

8.8 Administrative guidelines.

A. Use of motorized equipment. Motorized equipment may be used in special circumstances if it is the minimum tool necessary to accomplish a task safely and without long term impairment of the area's wilderness character. However, except where Congress specifically authorizes such uses in the establishing laws or in other acts modifying the Wilderness Act such as ANILCA, the use of motor vehicles, motorized equipment, mechanical transportation, and the landing of aircraft would not be used in the routine administration of wilderness. The determination of when motorized equipment constitutes the minimum tool will be left to the refuge manager. Some examples of special situations are given below:

(1) Emergency situations involving the public's health and safety, including search and rescue operations.

(2) Activities essential to accomplishing refuge objectives. For example, if bighorn sheep tanks dry up and the only means of supplying water is by trucking it into the tanks or, where grazing is permitted, bringing a veterinarian in by truck to treat seriously ill cattle.

(3) In the control of fire, insects, diseases, or other hazards.

C. - Final paragraph related to wildfire management and minimum tool:

While an aggressive approach to wildfire control on certain wilderness areas may be in order, the method(s) utilized should be the "minimum tool." The minimum tool may include, but is not limited to, lookout towers, tool caches, firebreaks, motorized land, water or air equipment, and chemical retardants. In conducting wildfire control activities, care must be taken to ensure that control methods do not harm the refuge and wilderness area more than the wildfire itself. For example, extensive bulldozed firebreaks on a hillside that result in permanent scars and soil erosion may have a far greater adverse effect than the temporary effect of fire. These kinds of situations should be carefully analyzed and adequately provided for in the refuge management plans.

Forest Service:

2320 Manual Direction

2326 - USE OF MOTORIZED EQUIPMENT OR MECHANICAL TRANSPORT IN WILDERNESS

1. Accomplish management activities with non-motorized equipment and non-mechanical transport of supplies and personnel.

2. Exclude the sight, sound and other tangible evidence of motorized equipment or mechanical transport within wilderness except where they are needed and justified.

2326.03 Policy

2. Do not approve the use of motorized equipment or mechanical transport unless justified as described in 2326.1. For definition see 2320.5.

2326.1 - Conditions Under Which Use May Be Approved. Allow the use of motorized equipment or mechanical transport only for:

1. Emergencies where the situation involves an inescapable urgency and temporary need for speed beyond that available by primitive means. Categories include fire suppression, health and safety, law enforcement involving serious crime or fugitive pursuit, removal of deceased persons, and aircraft accident investigations.

2. Aircraft or motor boat use established before the area was designated as wilderness by the Act of 1964 or subsequent wilderness legislation.

3. Exploration and development of valid existing mineral rights (FSM 2323.7).

4. Access to surrounded State and private lands and valid occupancies (FSM 2326.13).

5. To meet minimum needs for protection and administration of the area as wilderness, only as follows:

    a. A delivery or application problem necessary to meet wilderness objectives cannot be resolved within reason through the use of non-motorized methods.

    b. An essential activity is impossible to accomplish by non-motorized means because of such factors as time or season limitations, safety, or other material restrictions.

    c. A necessary and continuing program was established around the use of motorized equipment before the unit became a part of the National Wilderness Preservation System, and the continued use of motorized equipment is essential to continuation of the program.

    d. Removal of aircraft wreckage when non-motorized methods are unsuitable.

Specify, for each wilderness, the places and circumstances in which motorized equipment, mechanical transport, or aircraft are necessary for protection and administration of the wilderness and its resources in the forest plan.

The Line Officer approving the use of motorized equipment, aircraft, or mechanical transport shall specify what uses of that equipment are suitable and will have the least lasting impact to the wilderness resource. Schedule use of this equipment to minimize impact on wilderness visitors.

Code of Federal Regulations:
CFR 292.6
Commercial enterprises, roads, motor vehicles, motorized equipment, motorboats, aircraft, aircraft landing facilities, airdrops, structures, and cutting of trees.

Except as provided in the Wilderness Act, subsequent legislation establishing a particular Wilderness unit, or 294.2(b), 294.2(c), and 294.2(e), paragraphs (c) and (d) of this section, and 293.7, 293.8, and 293.12 through 293.16, inclusive, and subject to existing rights, there shall be in National Forest Wilderness no commercial enterprise; no temporary or permanent roads; no aircraft landing strips; no heliports or helispots, no use of motor vehicles, motorized equipment, motorboats, or other forms of mechanical transport; no landing of aircraft; no dropping of materials, supplies, or persons from aircraft; no structures or installations; and no cutting of trees for non-wilderness purposes.

MININUM REQUIREMENT ANALYSIS
APPENDIX B

DEFINITIONS

Mechanical Transport
Any contrivance which travels over ground, snow, or water, on wheels, tracks, skids, or by flotation and is propelled by a nonliving power source contained or carried on or within the device. *Source: 36 CFR 293.6a*

Mechanical Transport
Any contrivance for moving people or material in or over land, water, snow or air that has moving parts and is powered by a living or non-living power source. This includes (but is not limited to) wheeled vehicles such as bicycles, game carriers, carts and wagons. "Mechanical transport" does not include wheelchairs when used as necessary medical appliances, not does it include skis, snowshoes, sleds, travois, non-motorized river craft including drift boats, rafts, or canoes, or similar primitive devices. *Source: National Park Service Director's Order #41*

Minimum Tool
The least imp active method, equipment, device, force, regulation, practice, or use that will meet the management objective in a wilderness context. This represents the "how" question that must be asked to ensure that the process to implement the minimum required action will minimize impact on social and biophysical wilderness values. Minimum tool is not synonymous with primitive tool. In some cases the minimum tool could be a motorized tool or a form of mechanical transport.

Minimum Requirement
An action that is determined to be absolutely necessary but results in the least discernible impact on all the wilderness values and is the least manipulative or restrictive means of achieving a management objective in wilderness. This represents the "why" and "is it necessary" questions that must be answered before deciding that an action, that could potentially leave a mark of human influence in wilderness, is necessary.

Motorized Equipment
Machines that use a motor, engine, or other nonliving power sources. This includes, but is not limited to, such machines such as chain saws, aircraft, snowmobiles, generators, motor boats, and motor vehicles. It does not include small battery or gas powered hand carried devices such as shavers, wristwatches, flash-lights, cameras, stoves, or other similar small equipment. *Source: FSM 2320.5, 36 CFR 293.6b*

Permanent Improvement
A structural or non-structural improvement that is to remain at a particular location for more than one field season. Permanent improvements include such items as trails, toilet buildings, cabins, fences, tent frames, fire grills, and instrumentation stations. Permanent improvements may be allowed in wilderness, subject to a minimum requirement analysis. *Source: FSM 2320.5*

Primitive Skills
The proficient and safe use of primitive tools and methods of transportation.

Primitive Traditional Tool
Implements, devices, equipment, and tools that originated in the pre-motorized or pioneering era
such as the axe, cross-cut saw, hammer, wrench, hand winch, pulley, pack string, oar-powered or paddle-powered water craft, and skis. Modern versions of these tools and other hand or stock operated tools that are powered by a living source are also included.

Temporary Structure
Any structure that is easy to dismantle, that could be removed completely from a site between periods of actual use,

and that must be removed at the end of each season of use. *Source: FSM 2320.5*

Untrammeled
Not confined, not restrained, free from hindrances. *Source: American Heritage Dictionary*

Wilderness Appropriate Response
The minimum required action and the minimum tool selected by managers to respond to a wilderness issue, need, opportunity, or threat.

Wilderness Values
The recognized reasons for wilderness to exist and be preserved. Wilderness has natural values that are vital to the health of our planet as well as the enjoyment of those visiting them. Wilderness values include things such as watersheds for cities, benchmark for scientific research, critical habitat for wildlife, genetic material for plant and animal diversity, undisturbed geological resources, sanctuary from the pressures and pace of modern society, and a repository for cultural resources. The public values of wilderness include, but are not limited to, opportunities for scientific study, education, solitude, physical and mental challenge and stimulation, inspiration, and primitive recreation experiences.

OTHER RELEVANT TERMS

The following definitions are straight out of the dictionary but may be useful for the reader to help put the minimum tool/minimum requirement in context.

Appropriate
Especially suitable or compatible.

Minimum
The smallest quantity, number, or degree possible or permissible.

Necessary
That must be done; undeniable; mandatory; required; indispensable; inherent in the situation.

Requirements
Something needed; a necessity; something obligatory or demanded, as a condition; something required.

Tool
Something used in performing an operation; a means to an end.

MINIMUM REQUIREMENT ANALYSIS
APPENDIX C

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. Tudor Rd.
Anchorage, Alaska 99503-6199

IN REPLY REFER TO:
NWRS706-305.dgj

AUG 4 2006

Memorandum

To: Assistant Regional Directors, Refuge Managers and Project Leaders

From: Regional Director - Region 7 Thomas O. Melius

Subject: Cabin/Structure Protection Policy

The attached policy on cabin/structure protection on refuges in the advent of a fire will become effective October 1, 2006. The policy is fashioned to foster interagency coordination, and at the same time allows for the uniqueness of managing Alaska's National Wildlife Refuges. The policy will furnish guidance to the agencies that provide wildland fire suppression services on Fish and Wildlife Service managed lands and accommodates refuge needs.

Protection of cabins/structures from wildland fire is a long standing issue. Federal and State agencies have cooperated in developing cabin protection policies designed to address this issue. However these interagency efforts have not worked well as each agency has differing management directives. As a result, the Bureau of Land Management, the National Park Service, the State of Alaska, and the Bureau of Indian Affairs have subsequently developed their own cabin protection policies. This and other factors such as Solicitor opinions, potential liability issues related to the current policy, and the cost related to protection of cabins have lead us to formulate our own cabin protection policy.

The policy will not substantially change the way we do business now. Under this policy we will authorize Firewise treatments for current permittees in existing cabins. It leaves flexibility to not authorize Firewise treatments for new cabins or new permittees because of other resource considerations. The policy also provides for pre-planning decisions to protect or not protect a cabin/structure. It also provides the opportunity to collect and document data regarding historical and cultural structures.

In consideration of current permittees, advanced notice of the new policy will be provided to them prior to the effective date. The notice is for informational purposes and not for soliciting comments. Attached is a copy of the cover letter notifying current permittees of the new policy.

If there are questions regarding this policy, please contact Gene Long, Regional Fire Management Coordinator at (907) 786-3497.

U.S. Fish and Wildlife Service Wildland Fire Management
Interim Policy for Cabin/Structure Protection in Alaska

This policy will guide cabin/structure protection priorities for fire management activities on National Wildlife Refuges managed by the U.S. Fish and Wildlife Service in Alaska. This interim policy is effective immediately, amends regional policy RW-1, supersedes regional policy RW-22, and will remain in effect until revised. The policy establishes direction for fire management activities conducted on refuges by the U.S. Fish and Wildlife Service (FWS), Bureau of Land Management (BLM), Alaska Fire Service (AFS), the State of Alaska Division of Forestry (DOF), and the USDA Forest Service.

1. Public and firefighter safety is the first priority in wildland fire activities and decisions. Firefighter safety will not be compromised for structure protection.

2. The U. S. Fish and Wildlife Service may permit privately constructed cabins on refuge lands; however, we do not guarantee protection of the structure or contents in the event of a fire. The Federal Government is not responsible for fire protection of any permitted cabins/structures or associated personal property.

3. Cabin/Structure[1] management goals, objectives, and constraints should be identified by the refuge and displayed in refuge fire management plan maps and the Alaska Interagency Wildland Fire Management Plan (AIWFMP) Map Atlas. The refuge manager or designee will assign an appropriate fire protection level to all known structures managed by the refuge by December 31, 2006. During periods of high fire activity, structure protection priorities may be based on the availability of wildland fire management resources, rather than individual structure assessments.

4. Existing cabin permittees will be authorized to establish defensible space around the permitted cabin/structures using Alaska Wildland Fire Coordinating Group Fire Wise standards[2]. Permits for new cabins or new permittees of existing cabins may be issued without authorizing Firewise standards because of other resource considerations. In these situations, the permit must clearly state that the permittee understands the risk inherent in wildfire.

5. The refuge manager will specify the hazard fuel reduction responsibilities and guidelines, and authorized activities in the stipulations of the permit.

6. If specific guidance for cabin protection on National Wildlife Refuge lands is not available, the determination of fire structure protection levels is the responsibility of the refuge manager or designee, in accordance with the conditions of the special use permit and the

[1] 50 CFR Part 36.33. Cabin shall mean a small, usually single story three or more sided structure that is permanently and completely enclosed with a roof and walls. The roof and walls are not fabric, cannot be easily disassembled and are not removed seasonally.
[2] Reference Alaska Fire Wise standards, http://fire.ak.blm.gov/content/planning/firewise.pdf

current refuge fire management plan, or as a default the AIFWMP, to be made using the following criteria:

a. Any cabin, regardless of protection status, known to be occupied, will receive critical protection status consistent with firefighter safety.

b. The Service will inventory historical structures on refuge lands. In consultation with the State Historic Preservation Office, we will determine eligibility for the National Register and the appropriate management response for each structure in the event of wildfires.

   During a fire, if information is insufficient to determine the protection level for a historic or cultural structure, the suppression agency or Incident Commander should consult the refuge manager or designee, or if neither is available the Regional Fire Management Coordinator and the Regional Historic Preservation Officer. If practical and if the structure has integrity (intact roof and at least three standing walls), it should receive full protection until a decision is reached.

c. Full protection is given to FWS administrative or public use structures unless the refuge manager assigns a different level of protection. These federal facilities should receive protection commensurate with their monetary or resource management value as established by the refuge manager. As appropriate, the refuge should reduce hazardous fuels adjacent to federal facilities and structures that have been identified for protection.

d. Unauthorized structures on lands managed by the FWS will not be protected from fire.

6. This policy applies only to FWS permitted cabins/structures on lands administered by the FWS, including lands selected (but not conveyed) under the Alaska Native Claims Settlement Act.

Todd J Logan
Regional Chief, NWRS-R7

8/4/06
Date

Thomas O. Melius
Regional Director

11/28/06
Date

Memorandum

Dear Permittee

The U.S. Fish and Wildlife Service is reviewing our 1989 Regional cabin permitting system and policy. Part of that review includes policy as it relates to protection of remote cabins and structures in the event of fire. Because of Alaska's wildland fire activity, we decided to address the fire protection policy early in this review process

Enclosed is the interim policy clarifying the Service's cabin/structure protection policy. The interim policy will go into effect on October 1, 2006. This letter serves as advance notice of the new interim policy on cabin protection.

Please contact --------------at ------------- if you have questions.

Sincerely,

Refuge Manager

Radios

The Refuge maintains mountaintop UHF VHF radio repeaters located at Bend Mountain (N61° 39.378' W161º 33.481' elevation 1501 feet) and Kusilvak Mountain (N61º 59.981' W164º 32.832' elevation 1881 feet). A UHF base radio station is located at the Refuge headquarters in Bethel. VHF Base stations are also available in various operational field camps. These radios ARE NOT monitored on a regular basis. This system provides VHF coverage for most of the Refuge, and allows field communication with headquarters via the link.

The Refuge repeater frequency is monitored at Refuge Headquarters during normal working hours (8:00 A.M. to 5:00 P.M. Monday through Friday). After hours, the frequency is not monitored on a regular basis.
The Refuge has authorized DOF SWS to access the Refuge radio system for emergency fire suppression purposes. A phone line between Refuge headquarters and the DOF SWS dispatch radio console allows DOF SWS to monitor the Yukon Delta frequency and access it if necessary.

Yukon Delta

ZONE	CHANNEL	RX	TX	TONE (ANA)	NAC	CHANNEL DISP	DESCRIPTION	MIS
1	1	170.0250	170.0250	N/A	100	LOCAL DG	LOCA	DIGITAL
1	2	171.7250	169.8750	N/A	101	BEND DG	BEND MT RPT	DIGITAL
1	3	165.6125	163.5750	N/A	102	KUS DG	KULSIVIK RPT	DIGITAL
1	4		170.0250	100.0	N/A	LOCAL AN	BETHEL PHONE PATCH	ANALOG
1	5	171.7250	169.8750	94.	N/A	BEND AN	BEND PHONE PATCH	ANALOG
1	6	165.6125	163.5750	100.0	N/A	KUS AN	KUSILVAK PHONE PATCH	ANALOG

NWR VHF Frequencies Jan.1 ~June 15 2006

Aircraft Call Numbers

YDNWR HEADQUARTERS	Bethel BASE
N740 C-206	Interior 78*
N720 C-185	Interior 73*
N714 C-185	Interior 71*
N724 Husky A-1-B	Interior 74*

*Call signs used by the refuge.

Telephone Contacts

FWS Contacts

Appropriate contacts for Yukon Delta NWR fire management decisions listed in priority order:

Yukon Delta National Wildlife Refuge				
CONTACT	**POSITION**	**OFFICE**	**MOBILE**	**AFTER HRS.**
Doug Staller	Deputy Refuge Manager	543-1003		543-1977
Mike Rearden	Refuge Manager	543-1002		543-2904
Hollis Twitchell	Refuge Operations Specialist	543-1004		543-2895
Robert Lambrecht	FMO (stationed in Galena)	656-1231		656-4568
DOF SWS		524-3010		

USFWS Region 7- Anchorage, AK				
CONTACT	**POSITION**	**OFFICE**	**MOBILE**	**AFTER HRS.**
Gene Long	Fire Management Coordinator	(907) 786-3497	(907) 351-6817	
Mike Boylan	Refuge Supervisor, South	(907) 786-3329		
Todd Logan	Regional Chief (NWRS)	(907) 786-3667		
Danielle Jerry	Chief, Division of Natural Resources	(907) 786-3335		
Karen Murphy	Fire Ecologist	(907) 786-3501	(907) 351-2982	
Mary Kwart	WUI & RFA Coordinator	(907) 883-9411	(907) 350-4803	

Other numbers where refuge staff may be contacted:

Refuge Office 807 Hoffman Highway	(907) 543-3151
Refuge Hangar	543-1908
Bunkhouse	543-1020
Steel Building	543-1038
Refuge FAX	543-4413
Refuge Employee E-mail	firstname_lastname@fws.gov

Other Agency Contacts

Alaska Interagency Coordination Center, Ft. Wainwright, AK		
POSITION	**CONTACT**	**OFFICE**
Intelligence (AKDOF)	Sue Christensen	907-356-5671
Overhead	Anne Burns	907-356-5684
Logistics	Bob Dickerson	907-356-5680
Aircraft	Dave Kirk	907-356-5681
Weather (NPS)	Sharon Alden	907-356-5691
Dispatcher	John Gregg	907-356-5690

Bureau of Land Management, Alaska Fire Service, Galena, AK		
POSITION	**CONTACT**	**OFFICE**
FMO	Dave Whitmer	907-656-1222
AFMO	Marlene Eno-Hendren	907-656-1222
Dispatch	Matt Canon	907-656-1222

State of Alaska, Department of Natural Resources, Division of Forestry McGrath Area				
POSITION	**CONTACT**	**OFFICE**	**MOBILE**	**AFTER HRS.**
Duty Officer	**Report Fires!**			**524-3000**
FMO	Mike See			524-3010
FAX				

Other Co-operators

OTHER COOPERATORS			
AGENCY	**LOCATION**	**CONTACT**	**PHONE**
AK Army National Guard	Bethel		543-2223
AK Dept.of Environmental Conservation	Bethel		(907) 543-3215
AK Dept.of Fish and Game	Bethel		543-2433
AK Dept.of Transportation	Bethel	LJ Davis	(907) 543-2495
Association of Village Council Presidents	Bethel	Myron Naneng President	543-7300
AK State Troopers	Bethel		(907) 778-2245
Kuskokwim Native Association	Aniak		675-4384
NRCS	Bethel	Andy Oxford	543-7155
Craig Air (OAS)	Bethel		543-2575
Yukon Aviation (OAS)	Bethel	Cindy	543-3280
Emergency Hotline	**Bethel**		**911**
Federal Aviation Administration	Bethel Airport		(907) 543-2039
National Weather Service	Bethel		(907) 543-2236
NIFC- FWS Fire	Boise, ID	Andrea Olson	(208) 387-5597
NIFC- RAWS	Boise, ID	Buddy Adams	(208) 387-5475
YKHC Hospital	Bethel	Hospital Service	543-6300
Hospital Emergency Room	Bethel	ER	543-6395
Office of Aircraft Services	Anchorage		(907) 271-5258
Clinic (YKHC village services)	Various		543-6113
Bethel Fire and EMS	Bethel		543-2131

Electronic Data

The Refuge computer network provides tools and data essential to fire management. Available hardware includes laptop and desktop units, digital cameras, and GPS units (Trimble and Garmin). These items are available in Bethel and can be checked out to support the fire.

The Refuge maintains a GIS database with a wide variety of geospatial data. Many of these may be useful for planning fire related operations. A complete index of data is available on the office network. *(NEED LIST OF LAYERS THAT MIGHT BE HELPFUL FOR FIRE)*

Other fire related information is available from the following sites:

SITE	URL	AVAILABLE INFORMATION
Alaska Fire Service	http://fire.ak.blm.gov/	Daily situation reports, RAWS data, weather forecasts, lightning and fire occurrence maps, drought indices, and more
Fire Effects Information System	http://www.fs.fed.us/database/feis/	Species data
FWS Fire	http://fire.r9.fws.gov/	Daily situation reports, weather links
FWS Region 7 Home	http://r7internet.fws.gov/	Contacts, Policy
National Weather Service	http://www.alaska.net/~nwsar/	Forecasts, Satellite images, maps
Western Region Climate Center Active Fire Maps	http://www.wrec.sage.dri.edu/index.html http://actviefiremaps.fs.fed.gov	Archived RAWS data MODIS remote sensing
NIFC	http://www.nifc.gov/	National Interagency Fire Center
Redbook	http://www.fire.blm.gov/Standards/redbook.htm	Federal Wildland Fire policy/direction
Fire Regime and Condition Class (FRCC)	http://fire.org/frcc/	National website for FRCC information
Alaska Geospatial Data Clearinghouse	http://agdc.usgs.gov/data/blm/fire/index.html	Fire history map
FIREWISE	www.firewise.org	Fire protection for communities