4. Environmental Consequences

This chapter identifies, describes, and compares the effects on the physical, biological, and human environment of the two alternatives proposed by this draft Plan. Current management (Alternative A, the No Action Alternative) provides the basis for comparing the effects of the action alternative (Alternative B). The direct, indirect, and cumulative effects on refuge resources of various management actions proposed by each alternative are analyzed in this chapter.

Direct effects are the impacts that would be caused by the alternatives at the same time and place as the action. **Indirect effects** are impacts that occur later in time or distance from the triggering action. **Cumulative effects** are incremental impacts on the environment resulting from adding the impacts of an alternative to the impacts resulting from other past, present, and reasonably foreseeable future actions, including those taken by federal and non-federal agencies, as well as actions undertaken by individuals. Cumulative impacts may result from singularly minor but collectively significant actions taking place over a period of time.

An analysis of the effects of management actions on the **physical environment** has been conducted for soils, fire, and water and air quality.

An analysis of the effects of management actions on the **biological environment** has been conducted for vegetation; and fish, bird, and mammal populations. Although all plant and animal species on the Refuge are important, many species are not expected to experience any change—or at most, a negligible one—as a result of implementing either of the alternatives. For that reason, not all refuge species are discussed in this chapter.

An analysis of the effects on the **socioeconomic environment** has been conducted for subsistence, local population and economy, recreational use, cultural resources, and wilderness and river values.

Any proposal for future development or a new use on the Refuge would trigger an analysis process and possibly a Plan amendment. An analysis of whether or not the proposed development was appropriate for the Refuge would be conducted first. If it was determined to be appropriate, an evaluation of compatibility with refuge purposes would be required. If the proposal received a favorable compatibility determination, the project might be able to proceed or, if potential effects warranted, a site-specific analysis of the environmental effects would require that National Environmental Policy Act procedures be followed, and a plan amendment would be written. If the project involved a transportation or utility system, an ANILCA title XI analysis would be required.

4.1 Definition of Terms

Various terms were identified and used to provide a framework for conducting the environmental consequences analysis. These terms describe the impacts on identified refuge resources and recreational opportunities.

4.1.1 Impact Type

Beneficial impacts are those resulting from management actions that maintain or enhance the quality and/or quantity of identified refuge resources or recreation opportunities.

Adverse impacts are those resulting from management actions that degrade the quality and/or quantity of identified refuge resources or recreation opportunities.

4.1.2 Duration of Impact

Short-term impacts affect identified refuge resources or recreation opportunities; they occur during implementation of the management action but last no longer.

Medium-term impacts affect identified refuge resources or recreation opportunities that occur during implementation of the management action; they are expected to persist for some time into the future though not throughout the life of the Plan.

Long-term impacts affect identified refuge resources or recreation opportunities; they occur during implementation of the management action and are expected to persist throughout the life of the Plan and possibly longer.

4.1.3 Intensity of Impact

Negligible impacts result from management actions that cannot be reasonably expected to affect identified refuge resources or recreation opportunities at the identified scale.

Minor impacts result from a specified management action that can be reasonably expected to have detectable though limited effect on identified refuge resources or recreation opportunities at the identified scale.

Moderate impacts result from a specified management action that can be reasonably expected to have apparent and detectable effect on identified refuge resources or recreation opportunities at the identified scale.

Major impacts result from a specified management action that can be reasonably expected to have readily apparent and substantial effect on identified refuge resources or recreation opportunities at the identified scale.

4.1.4 Context or Scale of Impact

Under the **local scale,** beneficial or adverse impacts on a given resource occur only at a specific project site or its immediate surroundings and are relatively small in size (i.e., less than 15 acres).

For the **moderate scale,** beneficial or adverse impacts on a given resource occur beyond a specific project site but at a scale below that of the entire Refuge (i.e., 15–100 acres).

Under the **widespread scale,** beneficial or adverse impacts on a given resource extend beyond the moderate scale (i.e., greater than 100 acres).

4.2 Analyses

4.2.1 Physical Environment

4.2.1.1 Soils

Direct and Indirect Effects: Both alternatives would entail negligible to minor, local to widespread scale, and short- to long-term impacts on soils. These impacts would result from proposed activities under both alternatives. These activities include minor construction, wildland fire management (e.g., fireline construction), and the use of snowmobiles and ATVs.

Minor construction activities that could occur at the Galena facilities, the administrative cabins, and at any potential new site(s) include the construction of a small storage shed, outdoor bathroom, and temporary stair steps; the temporary placement of fuel containment barriers; clearing of vegetation around buildings; and small-scale excavation. These activities

would temporarily expose soils to erosion and could cover up some soils. Potential impacts would be local and on a very small scale measured in square feet rather than acres. Any erosion would be minimal due to flat topography and the use of State Best Management Practices designed to minimize erosion.

Wildland fire management could have both adverse and beneficial effects on soils. These effects could range from local to widespread in extent. Short- to medium-term adverse effects could result from fire suppression efforts or construction of firelines that expose soils over limited areas or from intense wildland fires that burn vegetation and ground cover on slopes greater than 30 percent. Severe fires occurring during extended periods of drought and fed by high fuel levels could damage soils across wide areas by exposing them to erosion. Wildland fires can benefit soil productivity by adding a flush of nutrients from the combustion of organic materials immediately following the fire.

The use of snowmobiles and ATVs along well-used trails will compact soils and negatively affect the ability of plants to grow in those soils along the trail if adequate snow cover is not present. Any adverse impact is expected to be local and would be moderate in scale.

Cumulative Effects: Neither of the alternatives is likely to have measurable cumulative effects on soils within the Refuge.

4.2.1.2 Wildland Fire

Direct and Indirect Effects: Studies of wildlife responses to wildland fire indicate a reorganization of plant and animal communities typically occurs. Each species is likely to respond in a different manner and level, depending on the state of the community prior to wildland fire, the extent and severity of the wildland fire, and many other factors.

Wildland fire effects on **birds** are largely related to the amount of structural change in habitat. The season of the fire is important. Nest site selection, territory establishment, nesting success, molting, and foraging can all be influenced by the timing of wildland fires. The quality of habitat prior to the wildland fire is also important. Most raptors tend to respond favorably to burned areas as reduced cover enhances hunting efficiency. Fires that create habitat patches with numerous standing dead trunks and limbs tend to provide favorable sites for insects, favoring insect consuming birds and primary cavity nesting birds. All ground nesting birds tend to be more affected by fire. Canopy nesting birds tend not to be as affected by understory consuming fires as they are by stand-replacing fires.

Moose tend to respond favorably to fire effects. Boreal forest fires set vegetation back to the early seral stage, which is preferred by moose. The early seral stage, when composed of preferred forage species, tends to produce the highest amounts of forage (Collins and Helm 1997). Early seral vegetation enables moose populations to grow. Many studies have shown that moose use burned areas of different ages at different times throughout the year. Maier et al. (2005) found that in early winter, moose in the central portion of interior Alaska preferred areas that had been burned 11–30 years prior.

While there is little dispute that fires are beneficial to moose and their habitat, the literature contains many papers arguing the positive and negative effects of wildland fire on **barren ground caribou** and their habitat (Klein 1982, Rupp et al. 2006). The primary source of concern is fire's effects on certain lichen species that are a preferred and important component of the caribou's winter diet. Lichens are associated with tundra and open spruce habitats that take a long time to get re-established. Various studies have cited lichen development taking

30 to 100 years to become well-established following wildland fire (Palmer 1942, Skuncke 1969, Scotter 1971, Viereck 1973, Pegau 1975).

Several researchers have made the argument that over the long term, wildland fires are actually necessary to maintain caribou habitat and that the long-term benefits actually outweigh the short-term negative effects. While there does not appear to be a clear cause and effect relationship between the occurrence of fire and caribou population declines, the apparent correlation between the occurrence of fire and changes in caribou numbers or distribution suggests that wildland fire may have other direct or indirect effects (other than destruction of lichen communities). Work on caribou-fire relationships has largely been carried out on large herds that travel over large areas. The effect of large fires affecting large proportions of available winter habitat for small caribou herds with a limited use area has not been examined. Changes in the frequency and intensity of wildland fires are expected to increase over time, which will likely have additional impacts to caribou habitat, most notably in the form of fewer but larger patches of lichen habitat (Rupp et al. 2006).

Concern has been expressed about fires pushing moose and caribou away from traditional use areas. During the 1996 Miller's Reach Fire in the Susitna Valley, several radio-collared moose were observed to only have a temporary displacement by the fire (H. Griese, ADF&G Area Biologist, personal communication, 1997). The refuge staff has collected a number of moose observations while wildland fires were active on the Refuge. These observations suggest that fires do not have anything more than a temporary effect on moose. In some cases, moose have been observed actively foraging in areas adjacent to active burns and on the vegetation that re-sprouts immediately following a fire.

Large carnivores typically have large home ranges and are little affected by fires. Ballard et al. (2000) found that wolf use of a large burned area changed little over the three years following the fire compared to before the fire in northwest Alaska. Johnson et al. (1995) found lynx to be most abundant in a 25- to 28-year-old burned area compared to a 6- to 8-year-old burned area and an unburned area. Johnson et al. (1995) found marten to be more abundant in the unburned area, least abundant in the 25- to 28-year-old burned area, and had a higher average age in the unburned area compared to the 6- to 8-year-old burned area.

Little work has been done looking at the direct or indirect fire effects on **beaver**. Beaver have been found to invade areas where fire has resulted in enhanced growth of willow, paper birch, and aspen (Kellyhouse 1979, Ream 1981).

Small mammals such as shrews, lemmings, voles, squirrels, and snowshoe hares tend to be killed or displaced by large intense fires (Ream 1981) but return very quickly. Johnson et al. (1995) found numerous red-backed voles in both unburned and a 25- to 28-year-old burned area; whereas yellow-cheeked voles were most numerous in a 6- to 8-year-old burned area. On the Kanuti National Wildlife Refuge, red-backed voles and shrews were captured in the summer following a fire; yellow-cheeked voles were not captured until the sixth year following the fire. By the following year, yellow-cheeked voles were more numerous than the smaller red-backed voles (L. Saperstein, Kanuti National Wildlife Refuge, personal communication, May 2007). Johnson et al. (1995) found snowshoe hares to be most abundant in a 26- to 28-year-old burned area compared to an unburned area and a 6-to 8-year-old burned area due to its greater abundance of cover and preferred forage.

Fire effects on **fish** can be both direct and indirect. Rieman and Clayton (1997) point out that direct effects to fish can include mortality, displacement, increased water temperature, and altered water chemistry. Indirect effects can include increased suspended sediments, increased

organic litter inflow, altered nutrient cycles, increased woody debris, and increased algal growth. Smaller streams tend to be more effected than larger streams and rivers. Effects are more pronounced in headwater streams (Minshall et al. 1989). While the effects from fire may be evident for extended time periods, these effects may not be catastrophic in nature.

Fire effects on **aquatic invertebrates** vary with the degree of sedimentation and changes in stream flow rates. Increases in fine sediments and in stream flow rates that affect the stream bed can cause reductions in numbers of invertebrates (Minshall et al. 1989). Minshall et al. (2001) found that the extent of the watershed that burned had a large influence on the amount of changes to the invertebrate community. The larger the burn area and the shallower the water body, the greater the effects are to aquatic invertebrates.

Fire affects water quality in a number of of ways. A wide variety of changes in stream temperatures have been reported in the literature. Stream temperatures typically range from 36 to 39 degrees Fahrenheit due to decreased shading from loss of streamside vegetation (Amaranthus et al. 1989, Minshall et al. 1989). Loss of vegetation from fire directly relates to increased sediment concentrations, which are most pronounced during the first few months following a fire.

Studies have reported a variety of changes in nitrogen and phosphorus in water following fire. Spencer and Hauer (1991) reported that both nitrogen and phosphorus increased dramatically during and for two days following a fire burning through a watershed. They found that nitrogen and phosphorus declined to pre-fire levels—from a few days to a few weeks following the fire. On the Kanuti National Wildlife Refuge, a post-fire study compared the nutrient chemistry (total nitrogen and total phosphorus) of lakes with burned versus unburned shorelines (Heglund et al. 2002). They found no significant differences in mean chemical and nutrient concentrations in burned and unburned lakes, but high levels of variability may have masked differences. Minshall et al. (1989) pointed out that moderately burned watersheds may, in fact, show little or no changes in stream chemistry.

In the boreal forest, fire can also have an impact to those areas underlain with **permafrost**. Lipovsky et al. (2006) reported an occurrence of numerous shallow (up 24 inches deep) landslides during and the year following extensive fires in the Yukon Territory. These landslides occurred on slopes as little as 10 degrees. These shallow landslides exposed the permafrost layer to additional seasonal melting.

Cumulative effects of wildland fire on wildlife and plant species are generally positive because interior Alaska ecosystems are fire-adapted.

4.2.1.3 Wildland Fire Use Fire

Direct, Indirect, and Cumulative Effects: The only difference between a wildland fire use fire and wildland fire is that the former is implemented to result in resource benefits; otherwise, the effects are the same on the landscape as for a wildland fire. Standard suppression activities are described in the Refuge Fire Management Plans. They are followed by the Alaska Fire Service, which is responsible for suppression on the Refuge.

4.2.1.4 Prescribed Fire

Direct, Indirect, and Cumulative Effects: The effects of prescribed fire will not be any different from those resulting from a wildland fire if the prescribed fire is implemented within the specified parameters. There are effects to vegetation and wildlife if prescribed fire occurs outside of the period of wildland fire occurrence. Prescribed fires implemented early in the

spring when the vegetation is actively growing have the potential to kill the vegetation. Fires set then can negatively affect cow moose and their young calves if the prescribed fire is set in a moose calving area. Moose calves at an early age cannot outrun a fire front and will suffer mortality or the cow-calf pair can be displaced from secure habitat and made more vulnerable to predators. Early spring burns have the potential to negatively affect nesting migratory songbirds by either destroying nest habitat or by causing mortality. On the positive side, prescribed burns can result in moose habitat that provides a higher quality of browse and early seral habitat. No cumulative effects are anticipated as only one prescribed burn has been completed on the Refuge.

4.2.1.5 Fire Suppression

Direct, Indirect, and Cumulative Effects: The direct and indirect effects of fire suppression can affect a small area or a large landscape. They can be short- and long-term in duration. They include not only the disruption of natural fire-related processes, such as nutrient cycling and early seral stage initiation, but also the loss of habitat vigor and production. The Critical and Full management options specified in the Alaska Interagency Fire Management and Refuge Fire Management plans will result in an accumulation of hazardous fuels over time in those areas. When fire does finally affect these areas, it will result in undesirable fire effects due to a higher intensity fire than what normally has affected the area. The effects include a decrease or loss of some vegetative species; a reduction of the permafrost layer; higher than normal runoff, erosion, and sedimentation; a long-term loss or shift in composition of wildlife habitat; additional suppression costs; and the potential loss of property.

4.2.1.6 Water Quality

Direct and Indirect Effects: Any effects of the alternatives on water quality are expected to be of short duration, local, and overall, of negligible to minor intensity. Much of the public use and refuge management activities occur on or adjacent to water (e.g., boating, rafting, hunting, fishing, camping, and floatplane operations). However, current and anticipated levels of public use pose very limited threats to water quality. Possible impacts could arise from spills occurring during transfer and storage of fuels supporting boating, aircraft, or other activities. Scientific sampling equipment, such as gauging stations, might be installed to meet the refuge objective of monitoring water quality and quantity. This equipment would have short- to long-term negligible effects on wildlife, habitats, or aquatic resources.

Some of the same activities mentioned previously that could impact soils directly—namely, minor construction, fire management, and snowmobiles—could also have indirect impacts on water quality because of runoff, erosion, turbidity, and sedimentation. As with the other impacts on water quality and the previously cited impacts to soils, these effects would likely be of short duration and local.

Cumulative Effects: While neither of the alternatives would contribute substantially to cumulative impacts on water quality within the Refuge, cumulative impacts might occur nonetheless from human activities off-refuge, primarily mining. Without the proper controls, mines on upstream tributaries could degrade water quality within the Refuge. Therefore, the Service will work closely with the Alaska Departments of Natural Resources and Environmental Conservation to ensure that any off-refuge mines meet water quality and environmental standards and do not impair water quality on the Refuge.

4.2.1.7 Air Quality

Direct and Indirect Effects: The effects of both alternatives on air quality are anticipated to be similar, and generally of short duration and local in extent with no measurable long-term degradation of air quality. The only exception to this would be during periods of high fire activity (such as occurred during 2004) throughout the State. During such periods, there are direct effects to individuals suffering with respiratory ailments. The only activities proposed under either of the alternatives that are likely to affect air quality are prescribed burning and access by motorized means. Due to the active, natural fire regime throughout the Refuge, the anticipated need for prescribed fire is very limited during the life of this Plan. Prescribed burning is included in the refuge Fire Management Plans (FMPs). Any prescribed burning would comply with the Alaska Enhanced Smoke Management Plan for Prescribed Fires.

The refuge FMPs allow wildland fire use to be implemented when there is a resource benefit (or benefits). On an infrequent basis, probably less than once per decade for any given location, the smoke from such fires could adversely affect air quality for a matter of hours, days, or weeks.

The current level of public use involving such motorized means of access as aircraft and outboard motors is not sufficient to affect air quality. Though snowmobiles have been identified as a source of measurable air pollution in high use areas, their current and anticipated levels of use on the Refuge should not appreciably affect air quality. Although neither of the proposed alternatives involve restrictions to public access, it is unlikely that the level of motorized access would be harmful to air quality during the life of this Plan. In recent years, higher fuel prices appear to have discouraged any increase in access to the Refuge by motorized means.

Cumulative Effects: Neither of the alternatives is likely to have a measurable cumulative effect on air quality within the Refuge.

4.2.2 Biological Environment

4.2.2.1 Vegetation

Direct and Indirect Effects: Any effects of the proposed refuge management actions on vegetation are anticipated to be of short duration and very localized. Potential exceptions follow. The most fragile areas, which would show signs of human use most readily, include those with very moist or very dry soils, wetlands, and alpine/subalpine areas. Under both alternatives, the introduction of non-native invasive plants to refuge lands is possible through natural dispersal or introduction by humans. Visitors or researchers conducting fieldwork) could introduce non-native plants. The Refuge will conduct surveys to determine if invasive plants become established and will take appropriate actions to prevent their spread.

At current and anticipated levels of public use, disturbance to vegetation would likely be localized and restricted to areas receiving repeated use, such as hunting camps on floatplane-accessible lakes or near rivers. The use of off-road vehicles for subsistence purposes has the potential to affect vegetation in some areas. Should damage be observed, the damaged areas will be monitored and assessed for negative effects. Biological investigations and field camps may similarly result in localized short-term disturbance to vegetation, but efforts will be made to minimize these effects. Should human use increase to levels that could result in long-term impacts to vegetation, the alternatives allow actions to protect resources (e.g., hardening campsites or closure of areas for off-road vehicle use).

Cumulative Effects: Public use and refuge management activities are not anticipated to have long-term effects on vegetation during the life of this Plan given current and projected levels of use.

4.2.2.2 Fish Populations

Direct and Indirect Effects: Under both alternatives, at current and anticipated levels of public use, proposed management actions are not expected to have measurable affects on fish populations. Harmful effects on fish populations would most likely be caused by declines in water quality and quantity or by over-harvesting. None of the alternatives include refuge management actions that would reduce the quantity or quality of aquatic resources. Likewise, none of the alternatives are anticipated to result in over-harvesting under current or projected levels of fishing pressure. However, if adverse effects were to occur, the Refuge would work with the appropriate State and federal regulatory bodies to make necessary management changes to keep the public use compatible with refuge purposes and to ensure protection of fishery resources.

Cumulative Effects: None of the alternatives include management actions that would have measurable cumulative effects on fish populations within the Refuge.

4.2.2.3 Bird Populations

Direct and Indirect Effects: Under both alternatives, at current and anticipated levels of public use, no measurable impacts to bird populations are expected. Riparian areas and wetlands are usually considered the most sensitive habitats. They also tend to receive the primary impacts from human-caused habitat alterations and disturbances. Much of the public use and refuge activities occur on or adjacent to water (e.g., boating, rafting, hunting, fishing, camping, and floatplane operations). The anticipated use of these areas is relatively low. Objectives that call for monitoring of public use will help the refuge staff determine if use levels are detrimental to bird populations.

Cumulative Effects: Neither of the management alternatives is expected to have measurable effects on bird populations within the Refuge during the life of this Plan.

4.2.2.4 Mammal Populations

Direct and Indirect Effects: Under both alternatives, at current and anticipated levels of public use, scientific activities, and management activities, no measurable impacts to mammal populations are expected. Though activities conducted under this Plan may result in localized disturbances to wildlife, those disturbances would be expected to be of short duration and not detrimental to mammal populations. Hunting would be allowed under all alternatives and is managed through State and federal regulatory processes. Objectives to monitor wildlife populations and hunting pressure under the revised Plan will help the refuge staff determine if regulatory changes should be considered by the Board of Game or the Federal Subsistence Board to maintain populations within their ranges of natural variation.

Cumulative Effects: The proposed management alternatives are not expected to result in measurable cumulative effects on mammal populations.

4.2.3 Socioeconomic Environment

4.2.3.1 Subsistence

Direct and Indirect Effects: Neither of the proposed alternatives is likely to significantly affect subsistence resources, uses, or access to resources. If necessary in areas of low moose

density, the Federal Subsistence Board or the Alaska Board of Game would regulate moose hunting opportunities to minimize hunter conflicts and competition. Effects of management actions on vegetation, aquatic resources, birds, and mammals used for subsistence purposes are described in previous sections. Access for subsistence purposes will continue to be managed according to 50 CFR 36.12 and 50 CFR part 100.

Cumulative Effects: None of the alternatives is likely to affect subsistence use of the Refuge, nor access to subsistence resources.

4.2.3.2 Local Population and Economy

Direct and Indirect Effects: No proposed refuge management actions under either alternative are likely to have measurable effects on populations of the communities associated with the Refuge. Local employment is centered on city, State, and federal government; Native and village corporations; tribal governments; schools; Native non-profit organizations; and local businesses. Many jobs are seasonal or part-time. Spending by visitors from the Iditarod sled dog race and Iron Dog snowmobile race, as well as from hunting, would continue to provide a reliable, annual—but short-term—boost to local economies in terms of income and employment.

The primary mechanism by which the proposed alternatives could affect the economy is through direct spending by the Refuge to accomplish management objectives. Under both alternatives, there could be an influx of construction dollars from building a new, Service-owned headquarters in Galena. This would be a beneficial socioeconomic impact, but a minor, short-term one. For the Service, a new headquarters would have the long-term beneficial impact of not having to spend budget funds on leasing space, which would free up dollars for other activities.

Because refuge spending would not vary greatly among either proposed alternative, the effects of that spending were not analyzed. The number of recreational visitors to the Refuge is relatively low. Commercial guiding or outfitting activities bring a seasonal influx of money to the local economy.

Cumulative Effects: Neither of the alternatives is likely to have more than minor, local, beneficial effects on the economic conditions or population of the area. The cumulative effects of actions proposed under either of the alternatives are likely to be negligible.

4.2.3.3 Recreational Use

Direct and Indirect Effects: The State of Alaska has the primary responsibility of managing hunting and fishing throughout the State unless that authority is superseded by federal regulations. State and federal governments establish seasons and limits (which may differ between State and federal hunts or vary by species) on the number of animals and fish that may be harvested. These limits are based primarily on the health and size of the targeted fish and wildlife populations. Hunting and fishing guides are managed by the Refuge through the special use permitting process. No changes to the permitting process are proposed under either alternative.

The dominant influence on hunting, fishing, and wildlife observation opportunities are likely to be access to and the health and size of wildlife populations and fish stocks. Recreational access will continue to be managed according to ANILCA section 1110(a) and 43 CFR 36.11, regardless of the alternative selected.

Cumulative Effects: Cumulative effects of management activities on recreational public use would be minimal under both alternatives. It is expected that most refuge visitation would continue to be by residents from local communities pursing subsistence activities.

4.2.3.4 Cultural Resources

Direct and Indirect Effects: Cultural resources would be protected and managed in accordance with federal and State laws under both alternatives. Impacts would likely be negligible under both alternatives. People using refuge lands for a variety of purposes may cause some damage to sites. Some sites or resources may be lost to natural forces such as bank erosion. The overall impact on cultural resources under either alternative would be minimal, which is consistent with what has been taking place since refuge establishment.

Cumulative Effects: Neither alternative would be expected to have measurable cumulative effects on cultural resources.

4.2.3.5 Wilderness Values

Direct and Indirect Effects: Neither proposed management alternative is likely to result in permanent changes to the wilderness values of the Refuge, though some management actions (e.g., placement of boundary signs, and trail and research plot markers; prescribed fire; and motorized access) could temporarily result in local short-term adverse effects. The overall magnitude of these adverse effects would be negligible to minor. Within the designated Koyukuk Wilderness, the minimum requirements analysis would ensure that adverse effects are minimized.

Cumulative Effects: Neither alternative is likely to have cumulative effects on the designated Koyukuk Wilderness or the wild quality of the rest of the Refuge.

4.2.3.6 River Values

Direct and Indirect Effects: Neither alternative would alter the free-flowing nature of river segments. Management proposed under both alternatives would continue to protect river values.

Cumulative Effects: No measurable effects are likely under either alternative considered.

4.3 Relationship Between Short-term use of the Environment and Long-term Productivity

Under both alternatives, the primary on-site, short-term uses of the Refuge and its resources would be for subsistence, fishing, hunting, wildlife viewing, photography, and camping activities. Monitoring and regulation of fish and wildlife harvests by the Service and Alaska Department of Fish and Game would help ensure the long-term productivity of fish and wildlife populations. None of the short-term uses described in any of the alternatives would affect the long-term productivity of the ecosystem.

4.4 Irreversible and Irretrievable Commitment of Resources

No irreversible and irretrievable commitment of resources would occur with implementation of either of the alternatives. Each alternative defines options for management direction for the Refuge. Each action described in an alternative can be changed and would be examined on a regular basis. Major changes in the proposed management would initiate a revision of the Plan at any time.

4.5 Environmental Justice

All federal agencies are required by Executive Order 12898 to identify and address, as appropriate, any disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low income populations. This includes health risks and other impacts for people who rely principally on fish or wildlife for subsistence.

As described in chapter 3, communities associated with the Refuge are rural and have a high percentage of residents who are Alaska natives. Additionally, many of the residents of these villages have low incomes and maintain subsistence lifestyles. The nature of the revision of this Plan is very different from the proposals often associated with environmental justice issues, such as situating polluting facilities in low-income or minority urban or rural areas. Neither of the alternatives evaluated in the environmental assessment would disproportionately impose adverse effects on minority or low-income populations. Maintaining quality habitat and healthy populations of fish and wildlife and water quality and quantity while providing for continued opportunities for subsistence are all purposes of the Refuge. The Service cannot compromise these values and their associated uses under any management alternative. While the alternatives contain slightly different approaches to meeting the purposes, neither would favor activities or projects that would direct negative impacts toward low-income or minority populations.

4.6 ANILCA Section 810 Evaluation

Section 810 of the Alaska National Interest Lands Conservation Act requires an evaluation of the effects on subsistence uses for any action to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands.

This evaluation consists of:

- A finding of whether or not a proposed action would have a significant restriction on subsistence uses.
- A notice and hearing if an action is found to have a significant restriction on subsistence uses.
- A three-part determination prior to authorization of any action, if there is a significant restriction on subsistence uses.

Chapter 3 described the environment of the Refuge, including subsistence and other human uses. Section 4.2 of this chapter describes the anticipated effects of each alternative on the environment, including subsistence and other uses. Because this is a long-range programmatic plan that describes possible changes in management direction for the Refuge, it does not propose any site-specific development or allow any new types of uses or development that would pose risks to subsistence uses of the Refuge.

The preferred alternative (Alternative B) does not contain actions that would reduce subsistence uses because of direct effects on wildlife or habitat resources or that would increase competition for resources. Similarly, the preferred alternative would not change the availability of resources by altering their distribution or location. The general goal is to maintain habitat and wildlife populations currently occurring on the Refuge. Finally, the preferred alternative would not reduce subsistence uses because of limitations on access, by physical or legal barriers, to harvestable resources. This evaluation concludes that the actions would not result in restrictions of subsistence uses. Additional section 810 analyses may be required during the implementation of this plan for specific proposals and actions.

4.7 Summary of Environmental Effects

Our analysis has allowed us to determine that the alternatives would have very similar impacts to refuge resources and human uses of the Refuge. All adverse impacts, from both alternatives, would be expected to be minor to negligible and not cumulative. There would also be some beneficial impacts from actions undertaken under each alternative, and these would range from negligible to moderately beneficial.