4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This chapter provides an evaluation of the potential effects or impacts of each of the alternatives on the resources described in the issue statements presented in Chapter 1, Purpose and Need for Action. Appendix F provides a summary of potential ecosystem effects of invasive plants found in Alaska NPS units. Appendix G provides a summary table of potential environmental fate and effects of proposed herbicides for use in Alaska NPS units.

4.2 Impact Criteria and Assessment

For each issue selected for detailed analysis (see section 1.3) and for which the subject resources are described in chapter 3, the direct, indirect, and cumulative effects are analyzed. The effects to the subject resources are analyzed on the basis of the duration, context, and intensity of the impacts. Summary impact levels (characterized as negligible, minor, moderate, or major) are given for each issue topic in the analyses. Definitions of impact terms are provided below. Table 4-1 presents a summary of impact level thresholds.

Table 4.1 – Summary Impact of Level Thresholds

Negligible	Minor	Moderate	Major
Effects would tend to be low intensity, temporary, and would not affect unique resources.	Effects would tend to be low intensity and short duration, but common resources may sustain medium intensity and long-term effects.	Effects on common resources would tend to be medium to high intensity and long-term, while important and unique resources would tend to be affected by medium to low intensity and short-term to temporary impacts, respectively.	Effects would tend to be medium to high intensity, long-term to permanent, and affect important to unique resources.
Impairment occurs when a resource no longer fulfills the specific purposes in the enabling legislation or its role in maintaining the park's natural integrity			

<u>Duration:</u>
Temporary: Impacts would last no more than a season, or for the duration of the discreet activity, such as maintenance of a road or trail segment.
Long-Term: Impacts would extend for several years up to the life of the project.
Permanent: Impacts are a permanent change to the resource that would last beyond the life of the project even if the actions causing the impacts were to cease.

<u>Context:</u>
Common: The affected resource is widespread, and is not identified in enabling legislation as important to the park, nor is it rare within or outside the park. The portion of the affected resource impacted by the action does not fill a unique role within the park or its region of the park.

Important: The affected resource is identified by enabling legislation, or is rare either within or outside the park. The portion of the affected resource does not fill a unique role within the park or its region of the park.
Unique: The affected resource is identified by enabling legislation, and the portion of the affected resource uniquely fills a role within the park and its region of the park.

Intensity
Low: A change in resource condition is perceptible, but does not measurably alter the resource function in the park ecosystem, cultural context, or visitor opportunity.
Medium: A change in a resource condition is measurable or observable, and an alteration is detectable to the resource function in the park ecosystem, cultural context, or visitor opportunity.
High: A change in a resource condition is measurable or observable, and an alteration to the resource function in the park ecosystem, cultural context, or visitor opportunity is clearly and consistently observable.

4.2.1 Assumptions for the Cumulative Effects Analysis

Past human impacts to park areas, ongoing activities other than invasive plant control efforts, and future planned developments and activities need to be considered in the cumulative analyses. A simple way to view cumulative impacts is with an equation a + b = c, where "a" is the effects of past, present, and future impacts of human activities not addressed by the alternative, "b" is the effects of the alternative to control invasive plants, and "c" is the total combined effects to the resource of all these activities. Examples of prominent human activities that could impact invasive plant infestations are noted below.

- Cumulative Impacts of Mining: The NPS completed three environmental impacts statements in 1990 to address the cumulative effects of mining in Denali National Park and Preserve (USDI NPS 1990a), Wrangell-Saint Elias National Park and Preserve (USDI NPS 1990b), and Yukon-Charley Rivers National Preserve (USDI NPS 1990c). These documents addressed the acres of mining effects on park resources like: aquatic resources, wetlands, wildlife resources, subsistence, recreation and visitor use, visual quality, wilderness resources, cultural resources and local economies.
- Denali National Park and Preserve Entrance Area and Road Corridor Plan EIS: This 1997 plan outlines future developments from the entrance area to Kantishna in the park (USDI NPS 1996a). Many of these projected developments have been completed.
- Denali National Park and Preserve Backcountry Management Plan EIS: This 2005 plan addresses desired levels of uses and methods of access into Denali National Park and Preserve other than along primary road corridors and entrance areas (USDI NPS 2005a).
- Katmai National Park and Preserve Brooks Camp Development Concept Plan EIS: This 1996 plan addressed the goal to move the existing Brooks Camp facilities with problems associated with fuel leaks and sewage treatment limitations in an archeological district and high use bear habitat to an upland area with fewer of these issues (USDI NPS 1996b). This project has not been implemented due to lack of funding and political reasons; however, the park is planning to move maintenance and fueling functions from the margin of Brooks Lake to the road Y leading to the Valley of Ten Thousand Smokes.

- Gates of the Arctic National Park and Preserve All-Terrain Vehicle for Subsistence Use LEIS: This legislative EIS called for the exchange of NPS lands for Native Corporation lands to accommodate dispersed all-terrain vehicle (ATV) access to subsistence hunting grounds and private properties and allotments near Anaktuvuk Pass and to reduce adverse impacts on park lands and wilderness (USDI NPS 1992). Congress got involved with this EIS because de-authorizing and designating Wilderness was involved, which takes Congressional action. BLM is in the process of making land conveyances to the two parties. In summary, the NPS allows ATV access rights on 126,632 acres of park lands and conveys 30,642 acres of park lands in fee to Native Corporations. The non-federal offering provides public access across 148,484 acres of Native Corporation lands, forgoes development rights on 116,949 acres of Native corporation lands, and conveys 38,840 acres to the NPS. About 74,000 acres of Wilderness was de-authorized in GAAR and 57,000 acres were designated in GAAR and another 17,000 acres were added to Noatak National Preserve. Use of ATV's on park lands can lead to the transport of invasive plant seeds and plant parts into otherwise pristine areas. All terrain travel also disturbs soil and vegetation; creating conditions that promote the spread of invasive species.

- Commercial Lodges and Concession Contracts: There are 6 commercial lodges and commercial joint ventures on Alaska National Park lands, which provide lodging, meals, and visitor services that cover about 20 acres in 3 parks (DENA, KATM, and GLBA). Many other lodges on inholdings surrounded by park lands or on adjacent area lands provide visitor services within parks. In 2006 the NPS issued 106 concession contracts to various providers for recreational guiding, sport hunting and outfitting, recreational equipment rentals, air taxi and air charters, cruise ships, vessel charters, dog sledding, food and lodging, and convenience sales. Many of these visitor services and activities could introduce exotic plants into parks.

- Roads: There are 12 roads or road clusters traversing over 275 miles in Alaska National Parks. Road side areas are disturbed surfaces and vehicles are major vectors for exotic plant translocations. Table 4-2 provides the miles of roads surveyed by the NPS Exotic Plant Management Team (EPMT) in Alaska Region National Parks.
    - There are documented off-highway vehicle (OHV) trails traversing about 566 miles in Alaska National parks. GLBA has designated about 63 miles of OHV trails in the Dry Bay area and closed about 21 miles of OHV trail (USDI NPS 2007a). WRST is addressing OHV trails with a new EIS, but the future outcome of this process is not known. Table 4-3 summarizes OHV trails by park.
    - "Documented" means centerline mapped and condition assessment in hand. Most are not being actively managed as OHV trails (such as BELA's documented) and some (like CAKR) are largely on state tide lands (below MHW).

Table 4.2 Roads & OHV Trails surveyed by the EPMT Program within Park Boundaries

Park	*Name*	*Length (km)*	*Length (mi)*
DENA	Park Road to Kantishna	148	92
DENA	Parks Highway	11	7
WRST	McCarthy Road to Kennecott	95	59
WRST	Nabesna Road	62	38.5
KLGO	Dyea Roads	4	2.5
GLBA	Gustavus Road	7	4
GLBA	Dry Bay Roads	30	19
KATM	Lake Camp Road	6	4
CAKR	DMTS (Red Dog Mine) Road	37	23
KEFJ	Exit Glacier Road	2	1
LACL	Port Alsworth Roads	3	2
	TOTAL	**440**	**274**

Table 4.3 Miles of OHV Trail Distances by NPS Unit in Alaska

ALAG	Unknown but unlikely
ANIA	none
BELA	40 documented
CAKR	74 documented
DENA	54 documented
GAAR	30 documented
GLBA	72 documented
KATM	28 documented (traded out with Paug-vik on Pike Ridge)
KLGO	6 documented
KOVA	none
LACL	17 documented
NOAT	0 documented
WRST	214 documented
YUCH	31 documented
TOTAL	**566**

- Airstrips: Nine maintained airstrips and 3 helicopter landing areas exist in or are surrounded by Alaska NPS units. Airstrips provide another avenue for exotic invasive plants to arrive into remote locations in parks. A list of park and FAA identified airstrips is provided below. Many additional seasonal and unofficial landing strips and seaplane landing areas exist throughout the parks in Alaska, which are used by air taxi operators and NPS personnel.
- Climate Change: Gradually warming average temperatures and changing precipitation patterns are known to affect natural resources in Alaska. Because of greatly reduced albedo (sunlight reflectance) from receding annual sea ice limits, receding glaciers, and more rapidly retreating annual snow lines, temperature increases and precipitation pattern changes are more pronounced in Alaska than in other regions of the USA. Increasing growing degree days and increasing water deficits are projected in Alaska over the next few decades (ACIA

2005, pp 810-812). Climate change in Alaska creates disturbances that could be invaded by nonnative plants if they are introduced to the disturbance areas. In a draft climate change strategy, the NPS Alaska Region recognizes climate change could affect all stages of invasive species establishment, including: 1) transport, 2) colonization, 3) establishment, and 4) landscape spread. The cumulative effects of climate change are addressed under effects to aquatic resources, soils, vegetation, wetlands and floodplains.

Table 4.4 FAA and NPS Documented Airstrips in Alaska National Parks

PARK	LOCATION/NAME	RUNWAY 1=NPS-Owned 2=Private	HELICOPTER ONLY
DENA	McKinley Park Strip	1	
DENA	Kantishna Airstrip	1	
DENA	Stampede Airstrip	1	
GAAR	Anaktuvuk Pass	2	
GLBA	Dry Bay Airstrip/Alsek River	1	
GLBA	East Alsek River	1	
GLBA	Cape Spencer	1/USCG	X
KLGO	Chilkoot Trail/Sheep Creek Ranger Station	1	X
KLGO	Chilkoot Trail Canyon City Trail Crew Cabin	1	X
LACL	Port Alsworth	2	
LACL	Wilder/Natwick Airstrip @ Port Alsworth	2	
WRST	Chisana	1	
WRST	May Creek	1	
WRST	Jakes Bar		
WRST	Young Creek		
WRST	Swift Creek		
WRST	Unnamed (5 mi W. Swift Ck)		
WRST	McCarthy	1	
WRST	Glacier Creek		
WRST	Devil's Mountain Lodge		
WRST	Sportsman's Paradise		
WRST	Unnamed 10 mi. W. of Slana		
WRST	Horsefeld		
WRST	Unnamed @ Ptarmigan Lake		
YUCH	Coal Creek	1	

4.3 Effects to Aquatic Resources and Fish

Below are brief descriptions of the effects that invasive riparian plant species could have on aquatic resources in Alaskan park units. The information on the effects of invasive riparian plants is derived largely from *Invasive Plants of Alaska* (AKEPIC 2005) and from the USDA Forest Service Fire Effects Information System invasive plant database: http://www.fs.fed.us/database/feis/plants/weed/weedpage.html. Other sources are cited as necessary.

A number of riparian invasive plants have been found in Alaskan National Parks, though not all are riparian obligates. These include white sweetclover, smooth brome grass, yellow toadflax, reed canarygrass, common sheep sorrel, common tansy and Japanese knotweed. Of these, several are known or are likely to have detrimental and long-lasting effects on aquatic ecosystems.

White sweetclover (*Melilotus alba*) establishes extensively along early successional river bars throughout Alaska and has already been found in dense mono-specific patches along a number of Alaskan rivers. Extensive infestations exist along the Stikine, Matanuska and Nenana Rivers (Conn *et al*. 2008). White sweetclover is a nitrogen fixer with the capacity to alter nutrient cycling rates in and near riparian areas; this in turn can alter community metabolic processes in the stream itself. It also has the capacity to alter sedimentation rates in river ecosystems. Finally it appears to out-compete native riparian flora. White sweetclover has been detected in DENA, KLGO, and WRST and near GAAR, GLBA, SITK, and YUCH. However, the species is pervasive in Fairbanks and has been found along the Dalton Highway, so it is probably only a matter of time before it appears in GAAR and YUCH. Although there are not extensive infestations currently in Alaskan National Parks, white sweetclover is difficult to eradicate mechanically and requires several treatments per year. Hence, continued efforts to control white sweetclover using purely mechanical means are likely to fail in the long run. The result could be substantial alterations of affected aquatic ecosystems.

Yellow toadflax (*Linaria vulgaris*) is an aggressive invasive that is common in disturbed sites. It colonizes river gravel bars and riparian pastures and has been shown to compete with cottonwood seedlings for establishment sites on gravel bars. Yellow toadflax is very difficult to control mechanically. Although to date mechanical control has apparently been successful at retarding establishment of yellow toadflax, it is not likely to do so over the long term, with potentially deleterious effects on aquatic ecosystems.

Smooth brome grass (*Bromus inermis*) is commonly found in riparian zones, and is often used for stream bank and stream bottom stabilization. It is an aggressive colonizer and competitor in the lower 48, though it is more widespread in upland areas. While the direct effects of smooth brome grass infestation on aquatic ecosystems are unclear, based on its effects in upland areas it may out-compete native riparian species and alter fire regimes. Either of these could have potentially negative impacts on adjacent aquatic ecosystems. Smooth brome grass is difficult to control mechanically.

Although to date it has only been documented in GLBA, reed canarygrass (*Phalaris arundinacea*) is likely to become a serious problem in some Alaskan park units. It is highly invasive and forms dense persistent monotypic stands along stream banks, in riparian wetlands and in spring margins that exclude and displace native plant species. It can also interfere with the natural hydrology of adjacent streams, eliminating the scouring action needed to maintain spawning gravels and promoting the deposition of fine sediments.

Japanese knotweed (*Polygonum cuspidatum*) is a very successful invader of riparian habitats throughout North America. It is a very aggressive species and often forms monotypic stands that shade out native vegetation. A combination of unique life-history features makes it well-adapted to dynamic riparian and floodplain habitats, particularly gravel bars and the lower parts of stream banks. It is adapted to disturbed, low-nutrient habitats, and can tolerate poor soils and prolonged submersion. Its rapid early season growth to heights of 2-6 meters allows it to shade out native riparian vegetation. It can impede stream flow, exacerbate the effects of flooding, lower fish habitat quality and reduce the food supply for juvenile salmonids. Information regarding Japanese knotweed was obtained from Soll *et al.* (2006) in addition to the sources cited above.

Common sheep sorrel (*Rumex acetosella*) is a common invader in floodplain and riparian habitats. It is well adapted to disturbed sites and reaches peak abundance at low soil nitrogen. Although its potential effects on aquatic ecosystems are not well documented, it may out-compete native riparian species and alter nutrient flow. Common tansy (*Tanacetum vulgare*) is another invasive that grows along streams and has been shown to restrict water flow, altering hydrology and potentially promoting deposition of fine sediment (Carlson *et al*. 2008 or http://www.lpcweeds.org/Commontansy.htm).

4.3.1 Impacts from Alternative 1 – No Action

4.3.1.1 Direct and Indirect Effects on Aquatic Resources and Fish:

The analysis below shows that so long as periodic physical removal proves sufficient over the long term to keep invasive plant infestations from becoming established, the effects of Alternative 1 on aquatic resources, including fish and water quality, would probably be minor. However, it is not clear whether species like white sweetclover, which is relatively difficult to eradicate mechanically and requires several treatments per year, can be kept in check over the long term under Alternative 1.

Under Alternative 1, the no-action alternative, the NPS would continue to monitor and physically remove invasive plant infestations. This approach has been effective for all detected infestations in and near riparian areas except for perennial sowthistle on estuarine shores of Strawberry Island in Glacier Bay proper and oxeye daisy adjacent to the Dry Bay fish plant and airstrip and near a riverine slough of the Alsek River in Glacier Bay National Preserve. NPS crews attempted to remove perennial sowthistle on Strawberry Island, but only a small portion of the 2.5 acre infestation could be dug up, and this effort failed to remove all roots and seeds in the treated area. The NPS has attempted to remove oxeye daisy infestations in Glacier Bay National Preserve, but the acre-size patch at the Dry Bay fish plant persists. The NPS continues to detect and remove biomass of reed canarygrass near Gustavus, but the species continues to return, especially where ground disturbance occurs.

NPS crews would continue to remove white sweetclover from roadsides and river bars near Slana in WRST and in the front country area of DENA, which prevents its escape onto this portion of the Nenana River. Japanese knotweed has been pulled from 2 locations not immediately adjacent to water for over 5 years in SITK, where it continues to return.

Under the no-action alternative aquatic resources and water quality are not likely to be adversely affected in Alaska NPS units, provided that Exotic Plant Management Teams (EPMTs) continue to diligently locate and remove new infestations. If some of the invasive plants described above become established at population levels that exceed established thresholds for successful manual control, then the no-action alternative would be ineffective in protecting aquatic resources. Given increasing levels of visitation, a warming climate, limited staff and tens of millions of acres to patrol, the most likely scenario is that Alternative 1 will not be able to effectively control the establishment of invasive riparian plant species indefinitely, leading eventually to substantial and potentially irreversible ecological harm to the affected aquatic ecosystems.

4.3.1.2 Cumulative Effects:

Substantial effects from past mining activity continue to impact streams in Alaskan NPS units, especially DENA, WRST and YUCH. The majority of mining in DENA occurred in the Kantishna Hills, where substantial impacts to streams persist. These impacts include altered channel morphology, increased turbidity and suspended sediment loads and heavy metals contamination. The stream morphology of at least 12 drainages in the Kantishna Hills was substantially altered; in some cases up to 90% of the stream was disturbed. The total affected acreage is estimated to be in excess of 1,300 acres, most of which is within active stream channels or riparian areas (USDI NPS 2005b). The major impacts in YUCH occurred along Coal Creek and Woodchopper Creek where dredging and mining impacted about 900 acres. There are more than 400 abandoned mine sites in WRST. Although many of these were upland hard-rock mines, mining activity in WRST has had substantial impacts to stream ecosystems, including altered channel morphology, increased sedimentation, elevated metal concentrations and low pH. The areas with the most mining-related impacts to streams are Nabesna, Chisana, Nizina and Kennicott (Weeks 2003).

There are over 275 miles of roads in Alaska NPS units, with the majority located in WRST and DENA. Most of these roads are unpaved, and consequently can lead to increased turbidity and sedimentation in streams that cross or parallel the roadbed. These effects are generally more severe when the road crosses the stream bed itself, rather than being located on a culvert or bridge. An example is the Upper Moose Creek Road in DENA (now restricted to ATV use), which crosses Spruce Creek 36 times in one 15 mile section. While these effects can sometimes be observed for substantial distances downstream, in general the impacts tend to be relatively localized. During heavy precipitation events, the increase in turbidity and sedimentation may be substantial and propagate for considerable distances downstream. Alaska NPS units also contain many hundreds of miles of ATV trails, including over 200 miles of trails in WRST. These trails are vectors for the spread of invasive plants in addition to creating direct impacts to aquatic resources, primarily through the effects of stream crossings and travel in riparian areas. Studies are planned to attempt to quantify the effects of ATV trails on stream ecosystems along the Nabesna Road corridor in WRST.

Numerous airstrips and helicopter landing pads exist in Alaska NPS units, and some of these are located on riverine gravel bars or near riparian areas (*e.g.*, on floodplain terraces). Most airstrips have been located on well-drained dry land because landing wheel planes on soft wet ground is unsafe. The effects of airstrips on floodplains are negligible because flood events would simply run over or around the gravel airstrips. However, there are some species that could easily be introduced into these dry areas that could migrate to riparian zones (e.g. white sweetclover and dandelions), ultimately impacting the riparian or aquatic environment.

Although, with the exception of the DENA park road corridor and cruise ships in GLBA, KLGO, and SITK, visitation to Alaskan NPS units remains fairly low, localized impacts due to recreational activities do occur. These impacts can include disturbances in riparian zones (*e.g.*, trampling of vegetation and stream banks, increased sedimentation due to runoff from trail erosion) and alterations of water quality (e.g., *E. coli* or Giardia contamination). In WRST, Copper, Tanada, and Ptarmigan Lakes have seasonally high recreational use. Trail erosion is substantial at Sanctuary River in DENA, for example.

Aquatic systems are being affected by climate change. Most Alaska glaciers, including those in Alaska NPS units, have receded rapidly since the 1950s, and they contribute about 9% of the measured ocean level increase over the last century (Arendt *et al*. 2002 and Larsen *et al*. 2007). Dramatic glacial recession in Glacier Bay has led to a rebound of the land mass due to the removal of the heavy ice (Larsen *et al*. 2003, 2004, and 2005). Receding glaciers create bare exposed ground from rebounding, drying of stream systems, and creation of areas that could be infested with nonnative plants. Receding glaciers also reduce snow and water storage areas resulting in more frequent large floods. Such floods could create pulses of elevated turbidity and disturbances to riparian zones, exposing them to invasive plant infestations. Additionally, about 25% of pond areas have disappeared across the state since the 1950s, particularly in the Copper River Basin, North Slope, Interior, and Kenai Peninsula areas (Riordan *et al*. 2006).

The cumulative effects of past, present, and expected future human activities and climate change effects are substantial and significant. The incremental increase from the no-action alternative to manage invasive plants would result in a minor additional impact on aquatic resources and water quality in Alaska NPS units.

4.3.1.3 Conclusion:

The impacts to aquatic resources and water quality from the no-action/status quo alternative to control invasive plants would be minor and on balance beneficial. The no-action/status quo alternative would not likely remain effective, however, in controlling the establishment of invasive plants along aquatic habitats over the long term. No impairment to Alaska NPS unit streams and lakes would result from the implementation of this alternative.

<u>4.3.2 Impacts from Alternative 2 – NPS Proposed IPMP</u>

4.3.2.1 Direct and Indirect Effects of Alternative 1 on Aquatic Resources and Fish:

Provided that herbicide applications near or in streams and lakes are limited and carefully conducted, the analysis below shows impacts of Alternative 2 to aquatic resources (including fish and water quality) in Alaskan NPS units would be minor. Overall, the impact of Alternative 2, should be beneficial to aquatic resources by preventing the establishment of invasive riparian plant species with known harmful effects. Effects on water quality should be minimal given the limited area and duration of the herbicide applications and the short half-lives of these herbicides in natural waters. All herbicide use would be in accordance with the manufacturer label, which incorporate the findings of the background studies including the effects of herbicide use in and around water bodies.

The NPS proposed action alternative to include a decision tree for the possible use of herbicides where warranted would result in the removal and effective control of invasive plant infestations. Manual removal has been effective for detected infestations in floodplain and wetland areas except for perennial sowthistle on or near estuarine shores (E2EM1/USN) of Strawberry Island in Glacier Bay and oxeye daisy near the Dry Bay fish plant and airstrip located mostly on uplands but near a riverine slough (R1US/UB) of Alsek River (see section 3.8 for wetlands descriptions). The proposed use of Milestone VM® herbicide (aminopyralid) to remove these infestations would reduce human impacts that would otherwise occur from extensive trampling and digging in these areas. Any treatment areas with adjacent slope contours leading to runoff and accumulation of aminopyralid in water would be treated with an aquatically approved glyphosate. The adjacent small palustrine and estuarine beach wetlands on Strawberry Island would be returned to natural and healthy plant populations. Oxeye daisy would be removed from the airstrip entry way location at Dry Bay, thereby reducing the potential for plant seed transport and the migration of this species into adjacent area riverine shores.

The proposed uses of glyphosate to remove 2.1 acres of reed canarygrass near Bartlett Cove in GLBA and Habitat to remove 0.1 acre of Japanese knotweed near Indian River in SITK would protect palustrine and riverine wetlands near those areas as habitat for aquatic resources. As noted in appendix G, glyphosate with surfactants often has a half life of less than one week, which may be slightly to moderately toxic to fish and invertebrates. The glyphosate and surfactant are strongly absorbed by soil particles, but glyphosate may wash off into surface waters after heavy rains. These chemicals do not bioaccumulate in fish. So long as application occurs when there is a good weather window with no impending rain storms and placed as distant from surface waters as practicable, the impacts to fish and other aquatic organisms can be minimized. See the discussion below on the impacts of glyphosate to aquatic taxa. When glyphosate is to be applied to vegetation located in water or likely to runoff into an aquatic setting, only products labeled for aquatic use would be applied (e.g. Aquamaster®, Aquaneat®, Rodeo®). The herbicide Habitat® is labeled for safe use in aquatic settings. Its active ingredient imazapyr is known to have low toxicity to invertebrates and is practically non-toxic to fish. It does not build up in aquatic animals.

NPS crews would continue to remove white sweetclover from roadsides and river bars near Slana in WRST and in the front country area of DENA, which prevents its escape onto this portion of the Nenana River. Yellow toadflax has been reduced along Exit Glacier Road where some small wetlands areas occur nearby. Japanese knotweed has been pulled from 2 locations not immediately adjacent to water for over 5 years in SITK, where it continues to return.

Floodplain functions are not likely to be adversely affected in Alaska NPS units so long as EPMTs diligently locate and manually remove new infestations. If some of the invasive plants described in section 4.3 exceed the ability to control manually or are unresponsive to manual control, then the proposed action alternative would allow for rapid, effective control methods to remove or reduce invasive plant infestations that could harm floodplains and aquatic resources over a wider distribution.

Three of the herbicides proposed under Alternative 2 (2,4-D, glyphosates with certain surfactants, and triclopyr Garlon 4) have acute toxic effects on aquatic taxa (high LC50's for those aquatic organisms that have been tested); therefore, their use in or near aquatic ecosystems could have harmful, though probably temporary, adverse effects. Studies on sublethal exposure levels still rely on relatively high concentrations relative to those expected from spot application on terrestrial plants (e.g., Relyea 2005). Generally speaking, concentrations in the mg/L range have been used. No studies have been conducted on ecological responses to the very low concentrations of herbicides that could reasonably be expected to occur in aquatic habitats as a result of spot applications as proposed under Alternative 2. Relatively little is known regarding the potential effects of chronic low-level exposure of most of these herbicides on aquatic taxa, so we cannot predict with any confidence what the effects of such exposure may be on aquatic resources. Information on the relative toxicity of the proposed herbicides to aquatic taxa is derived from U.S. Forest Service risk assessments or other relevant literature as cited and provided in appendix C. See appendix C for the Relative Aquifer Vulnerability Evaluation (RAVE) and appendix G for herbicide fate and effects summaries. The following analyses are also presented for potential effects of the proposed herbicide in aquatic settings.

2,4-D

In accordance with the USFS risk assessment of 2-4D, the application of 2,4-D esters should be avoided altogether in the vicinity of aquatic ecosystems, due to the extreme sensitivity of many aquatic taxa to this formulation. Alternative 2 had carefully indicated that 2,4-D will only be used if other herbicides or treatment types have been proven unsuccessful. 2,4-D is an effective herbicide with a long history of use. Consequently, its effects have been relatively well studied. There are a number of different formulations of 2,4-D with widely varying toxicities to aquatic taxa. The most important distinction is between formulations using the DMA salt and those composed of one of a variety of ester compounds of 2,4-D. These esters are generally much more toxic than the acid/salt formulations, and this is particularly the case for aquatic taxa.

Little is known about bioaccumulation of 2,4-D in freshwater food chains, although it has been demonstrated in some fish species, or about the effects of long-term low-level exposure on aquatic organisms or ecosystems. Relatively low concentrations have been shown to kill fathead minnow eggs. Adsorption of 2,4-D to soils (normally low for salts, higher for esters) is increased with decreasing pH, increased organic content. Decreasing pH also inhibits hydrolysis of 2,4-D esters. Degradation of 2,4-D esters is slower in colder soils and in the presence of excessive soil moisture.

Although it is specifically designed for use in aquatic systems, Aqua-Kleen is a butoxyethyl ester formulation of 2,4,-D. Each of the other 2,4-D formulations proposed for use under Alternative 2 is also an ester and hence would be acutely toxic to aquatic taxa. Direct application of 2,4-D esters for control of aquatic invasives would be expected to cause mortality, perhaps substantial, among sensitive fish species (whose identities among Alaskan species are unknown, although rainbow trout [*Oncorhynchus mykiss*] appear to be relatively tolerant). However, because 2,4-D esters are not persistent, long-term exposure is unlikely. Because of the relatively small amounts involved, spot application of 2,4-D on terrestrial plants is unlikely to lead to problematic concentrations of 2,4-D in aquatic ecosystems, particularly for streams, rivers and large lakes. Repeated application near small ponds or wetlands should be approached with caution, as should application on riparian vegetation. Direct application to aquatic macrophytes should be avoided due to the likelihood of acute toxic effects on aquatic organisms, including fish and amphibians. Spills and immediate runoff are also potentially problematic. At the upper range of Forest Service application rates, spills or runoff of 2,4-D salts could lead to toxic effects on aquatic macrophytes. On the other hand, spills or immediate runoff could lead to acute toxicity effects on aquatic plants and animals at all application rates for 2,4-D esters. In its Risk Assessment of 2,4-D, the USDA Forest Service recommended "consideration … [of] … alternate herbicides" near aquatic ecosystems and that "… the use of 2,4-D should be limited to situations where other herbicides are ineffective or to situations in which the risks posed by 2,4-D can be mitigated". Information from USDA Forest Service (2006).

Glyphosate
Glyphosate, the active ingredient in Roundup and a number of other commercial herbicides, is itself relatively nontoxic to fish, but surfactants included in some formulations appear to be highly toxic (POEA, the surfactant used in some Roundup formulations is particularly toxic), and may also increase the toxicity of glyphosate. Most studies of glyphosate toxicity have not considered the effects of surfactants (most use technical grade glyphosate), so the toxicity results that are available are difficult to interpret. Nevertheless, some salmonid species have been shown to be highly sensitive to technical grade glyphosate irrespective of the surfactant. Furthermore, as the Forest Service Risk Assessment makes clear, the difficulty in determining which formulations (which surfactants) were tested for toxicity during the initial EPA approval process makes it difficult to associate particular formulations with particular risk levels. However, it appears that Roundup Pro and Roundup Ultra contain the most toxic surfactants. In addition, Trumbo (2002) found 30% mortality in fathead minnows exposed to water collected near a Rodeo/R-11 application to control purple loosestrife and determined that the toxicity was related to the presence of R-11. In a related study, R-11 was also found to be moderately toxic to larval amphibians (Trumbo 2005). Little information is available regarding the toxicity of the other formulations listed under Alternative 2. Although not yet documented, deleterious effects on aquatic microorganisms can be expected because these microorganisms share the target metabolic pathway with higher plants. Some glyphosate/surfactant combinations have also been shown to be highly toxic to larval amphibians. Although glyphosate apparently has relatively low toxicity to aquatic invertebrates, the effects of surfactants have not been well studied. Based on the data that are available, enough is known to postulate that some surfactants may be much more toxic to invertebrates than others.

At typical application rates, less-toxic formulations are probably a low risk to aquatic taxa. More toxic formulations would not be used near surface waters. Importantly, there have been no studies of the potential for chronic effects among the most acutely toxic formulations. The Forest Service risk assessment of glyphosate states "this risk characterization strongly suggests that the use of more toxic formulations near surface water is not prudent." Furthermore, they state "the use of [less toxic formulations of] glyphosate near bodies of water where sensitive species of fish may be found (e.g., salmonids) should be conducted with substantial care to avoid contamination of surface water." Only glyphosate formulations labeled for use near water (without toxic surfactants) would be used near water and applications would not occur when salmonids are present. See also the decision tree. Information is from USDA Forest Service (2003a).

Chlorsulfon
According to the Forest Service risk analysis, detectable damage to aquatic macrophytes is plausible at typical application rates of chlorsulfon. There is a large range of sensitivities to chlorsulfon among algae, but changes in phytoplankton communities have been observed at concentrations as low as 1 ug/L. The limited data on toxicity to aquatic animals suggests it to be much lower in general. Information is from USDA Forest Service (2004a).

Triclopyr
Although data on the toxicity of triclopyr to aquatic taxa are limited, they suggest that formulations with Triclopyr BEE (*e.g*., Garlon 4) are substantially more toxic to aquatic taxa than Triclopyr TEA formulations (*e.g*., Garlon 3A). Information is from USDA Forest Service (2003b).

Of the remaining 4 herbicides proposed for use under Alternative 2, three (imazapyr, metsulfuron methyl, and aminopyralid) are classified by the USDA Forest Service or the Environmental Protection Agency as low risk or practically non-toxic to aquatic taxa at normal application rates. Aminopyralid is slightly toxic to aquatic algae and macrophytes and has been shown to reduce early life-stage survival and growth of some fish species. Imazapyr appears to be relatively non-toxic to fish and aquatic invertebrates at normal application rates, but some species of aquatic macrophytes are sensitive and no data are available on toxicity to amphibians. Information is from USDA Forest Service (2004b, 2004c, 2004d)

Data regarding the toxicity to aquatic taxa of Clopyralid, the last herbicide proposed for use, are very limited. The few data that do exist suggest that clopyralid has relatively low acute toxicity to fish. However, there are no data on the effects of chronic exposure to fish. There are limited data on invertebrates, and these suggest that both acute and chronic toxicities are low. There are no data regarding either acute or chronic effects of clopyralid on amphibians. According to the EPA analysis (USEPA 2005), based on these limited data no adverse effects of clopyralid on aquatic taxa would be expected at normal application rates.

4.3.2.2 Cumulative Effects:

Substantial effects from past and ongoing mining activity, roads, visitor and administrative buildings, ORV trails, airstrips, increasing human activities and climate change impacts continue to impact streams and other aquatic resources in Alaskan NPS units, especially DENA, WRST and YUCH as described in section 4.3.1.2. The cumulative effects of past, present, and expected future human activities and climate change on aquatic resources and water quality are substantial and potentially moderate. The incremental increase from the implementation of Alternative 2 to manage invasive plants would result in a minor additional impact on aquatic resources and water quality in Alaska NPS units.

4.3.2.3 Conclusion

The impacts to aquatic resources and water quality from Alternative 2 to control invasive plants would be minor and on balance beneficial, provided that appropriate measures are taken when herbicides are applied near streams and lakes. However, it would be necessary to carefully consider the potential toxic effects of each of the herbicides when application near aquatic ecosystems is warranted. No impairment to Alaska NPS unit aquatic resources would result from the careful implementation of this alternative.

4.4 Effects to Cultural Resources

Cultural resources occur in all of Alaska parks and include archaeological resources, ethnographic resources, cultural landscapes, and historic structures. While there may be potential for impacts to these resources from invasive plant eradication actions, until specific sites and proposed removal methods are identified, it is difficult to determine impacts to cultural resources. The consideration of cultural resources and exotic plant management in Alaska's NPS units involves two issues: 1) whether invasive species themselves are cultural resources, and therefore warrant preservation; and 2) whether the management of invasive species could adversely affect cultural resources. As noted in EA section 1.2.5 NPS Management Policies, exotic plants would not be allowed in NPS units unless the identified exotic species itself has a high level of historic significance and is a contributing feature of a landscape, district, or site listed on or eligible for listing on the National Register of Historic Places, and the exotic species in non-invasive.

4.4.1 Impacts from Alternative 1 – No Action

4.4.1.1 Direct and Indirect Impacts of Alternative 1:

Potential Impacts to Archeological Resources
The method of treating invasive species could adversely affect archeological resources. Archeological sites are an obvious example where invasive species removal by hand, mechanical or biochemical means could potentially harm or destroy the integrity of an archeological site. For instance, mechanical removal could alter the distribution of surface artifacts or disturb shallow archeological deposits. Furthermore, although Alaska Natives did not cultivate plants prehistorically; in historic archeological sites culturally significant exotic plant taxa may be present that could be impacted in the course of the invasive species action.

Potential Impacts to Cultural Landscapes
It is possible that NPS management practices outlined in this document, as articulated for alternative 1, could potentially compromise the integrity of the characteristics contributing to a cultural landscape. Historic roads and trails are examples where many infestations of invasive species occur along these corridors. The proposed treatment should take into consideration potential affects to the structural integrity of roads and trails. When vegetation is removed, by hand or mechanical means, erosion often becomes an issue. Therefore erosion control must be an integral part of any invasive species management regime along these historic corridors. And finally, any decision to maintain an exotic or invasive species which is part of a defined cultural landscape needs to be carefully weighed against its potential for ecological harm beyond the identified historic boundaries.

Potential Impacts to Ethnographic Resources
Invasive plants may threaten ethnographic resources by supplanting traditionally-used plants, or by impeding access to harvesting areas. Alternatively, possibly after several generations, exotic plants may eventually come to be used in traditional ways. A further consideration is that efforts to eradicate invasive plants may have greater impacts than the invasive plants themselves, since treatments might also damage native plants and animals.
Potential Impacts to Historic Structures/Buildings
It is unlikely that historic buildings and structures could be impacted negatively from physical removals of invasive plants unless foundations are undermined in some manner.

Because physical plant removal activities at all National Register listed and eligible sites are subject to NHPA Section 106 reviews and compliance, the potential for any adverse effects to the subject cultural resources noted above would not likely exceed any more than an accidental minor level. If adverse effects are determined to be likely from the proposed plant removal activities, ways would be sought to avoid, minimize, or mitigate the adverse effects.

4.4.1.2 Cumulative Effects:

Past impacts to cultural resources in areas near invasive plant control efforts have been scattered but widespread. Most of these impacts have occurred near roads, airstrips, ORV trails, foot paths, mining areas, building sites, campsites, and day-use areas, which is where most invasive plants would likely occur. Vandalism and looting are some of the most egregious past and ongoing adverse impacts to cultural resources, but these effects are diminishing with better NPS law enforcement and education programs. Application of NHPA Section 106 compliance has resulted in greatly diminished adverse effects from NPS actions. Due to the magnitude of the past and proposed new infrastructure in Alaska NPS units and the associated public access and potential for vandalism and looting, the overall effects to cultural resources is judged to be moderate. The minor additive effects from the past and ongoing NPS physical control activities on invasive plants would not change the overall cumulative effects on cultural resources in the Alaska Region.

4.4.1.3 Conclusion:

Because of the relatively small treatment areas in Alaska National Parklands and the use of NHPA Section 106 reviews to protect archeological and historical resources, the potential impacts to cultural resources from the no-action (status quo) alternative to physically control and remove invasive plants are judged to be minor. No impairment to cultural resources in Alaska NPS units would result from this alternative.

<u>4.4.2 Impacts from Alternative 2 – NPS Proposed IPMP</u>

4.4.2.1 Direct and Indirect Impacts of Alternative 2:

Potential Impacts to Archeological Resources
As in alternative 1, physical methods of treating invasive species could adversely affect archeological resources. Similarly, certain chemical treatments might change the soil chemistry

and effect the preservation of bone and other archeological remains. The potential of chemical treatments to affect the accuracy of radiocarbon age determinations is unknown. Furthermore, although Alaska Natives did not cultivate plants prehistorically; in historic archeological sites culturally significant exotic plant taxa may be present that could be impacted in the course of the invasive species action.

Potential Impacts to Cultural Landscapes
It is possible that NPS management practices outlined in this document for alternative 2 could potentially compromise the integrity of the characteristics contributing to a cultural landscape. For example, buildings and structures, which are often components of cultural landscapes could also be impacted negatively from physical effects of herbicides and other toxic substances used in the eradication of invasive species. These chemicals may adversely affect physical materials of historic buildings and structures.

Historic roads and trails are another example, given that many infestations of invasive species occur along these corridors. The proposed treatment should take into consideration potential affects to the structural integrity of roads and trails. When vegetation is removed, by hand, mechanical, or biochemical means, erosion often becomes an issue. Therefore erosion control must be an integral part of any invasive species management regime along these historic corridors. And finally, any decision to maintain an exotic or invasive species which is part of a defined cultural landscape needs to be carefully weighed against its potential for ecological harm beyond the identified historic boundaries. Furthermore, control of invasive plants with herbicides could result in the damage or death of the culturally significant plants near treatment sites.

Potential Impacts to Ethnographic Resources
Invasive plants may threaten ethnographic resources by supplanting traditionally-used plants, or by impeding access to harvesting areas. Alternatively, possibly after several generations, exotic plants may eventually come to be used in traditional ways. A further consideration is that efforts to eradicate invasive plants may have greater impacts than the invasive plants themselves, since chemical and other treatments might also damage native plants and animals. As noted for several listed herbicides in table 2.4, the potential to damage or kill native plants near treatment sites is likely, but adverse impacts on birds, mammals, and fish is low or less likely.

Potential Impacts to Historic Structures/Buildings
It is possible that historic buildings and structures could be impacted negatively, in that it is generally unknown what physical effects herbicides and other toxic substances used in the eradication of invasive species may have on the physical materials of historic buildings and structures.

4.4.2.2 Cumulative Effects:

Past impacts to cultural resources in areas near past and proposed invasive plant control efforts have been scattered but widespread. Most of these impacts have occurred near roads, airstrips, ORV trails, foot paths, mining areas, building sites, campsites, and day-use areas, which is where most invasive plants would likely occur. Vandalism and looting are some of the most egregious past and ongoing adverse impacts to cultural resources, but these effects are diminishing with better NPS law enforcement and education programs. Application of NHPA Section 106 compliance has resulted in greatly diminished adverse effects from NPS actions. Due to the magnitude of the past and proposed new infrastructure in Alaska NPS units and the associated public access and potential for vandalism and looting, the overall effects to cultural resources is judged to be moderate. The minor additive effects from the past and ongoing NPS physical control methods and potential future chemical control activities of invasive plants would not change the overall moderate cumulative adverse effects on cultural resources in the Alaska Region.

4.4.2.3 Conclusion:

Because of the relatively small treatment areas in Alaska National Parklands and the use of NHPA Section 106 reviews to protect archeological and historical resources, the potential impacts to cultural resources from the proposed action alternative (integrated invasive plant management with limited herbicide use to physically and chemically control and remove invasive plants) are judged to be minor. No impairment to cultural resources in Alaska NPS units would result from this alternative.

4.5 Effects to Human Health and Safety

<u>4.5.1 Impacts from Alternative 1 – No Action</u>

Defining Risk Levels
To determine the "risk level" associated with these activities the probability of an injury occurring and what the severity of the injury might be is determined by defining the terms.
(1) "Probability" is defined as: The chance that a given event will occur.
The probability rating is:
Low - If the factors considered indicate it would be unlikely that an accident could occur;
Medium - If the factors considered indicate it would be likely that an accident could occur; or
High - If the factors considered indicate it would be very likely that an accident could occur.
(2) "Severity" is defined as: the degree of injury or illness which is reasonably predictable.
The severity rating is: Low, First Aid Case; Medium, Serious injury or illness; High, Fatality.

4.5.1.1 Direct and Indirect Impacts of Alternative 1:

The analysis below shows the anticipated effects of Alternative 1 on human safety and health. These assessments are based on two conditions:

1. Job Hazard Analysis - (JHAs) are developed and followed for each of the jobs to be completed. Employees are expected to follow the JHAs recommendations (personal protective equipment use, equipment, work practices, etc.) when performing that job.

2. Training - Employees must receive all required training when completing jobs. See mitigating measures in EA section 2.4 regarding employee training and licensing and public notifications for invasive plant control activities. The potential impacts to the health and safety of the visiting public is expected to be less than to EPMT employees because they are not performing the tasks

or are distant from them; however, some exposure to fire and falling or flying debris from cutting or mowing is possible.

Description of Activities
Field employees manually or mechanically remove plants. Activities involve removing plants by hand, cutting or pulling with minor digging as the prevailing control method. In a few cases brush trimmers have been used for larger areas

Manual activities involving hand cutting, pulling and digging.
Potential Injuries are ergonomic injuries to the back, hand, knees and arms; or sprains, strains, cuts, and blisters. The probability of injury occurring is low to medium, and the severity of injuries is usually low.

Motorized activities involving brush trimmers.
Potential injuries are from impacts from flying particles or moving parts, cuts by moving parts, burns, bruising, and excessive vibration. The probability of injuries occurring is low. The severity of injuries is low to medium.

Thermal treatments include soil solarization and burning.
These activities include, covering the soil with plastic, control burning and spot burning with a propane torch. An employee health and safety analysis on control burning activities can not be completed until more site specific details are provided. Any "control burning" treatments would be planned and implemented under the guidance of wild land fire program. While covering the soil with plastic material, potential injuries include back injuries, sprains, and strains. The probability of injuries occurring is low. The expected severity of injuries is also low.

4.5.1.2 Cumulative Effects to Human Health and Safety in Project Areas:

The overall effects to human safety and health for this alternative would be low for the probability of an injury occurring and low for the severity of the injuries. If one were to compare this to other injuries that might be expected to occur from motor vehicle operations, ATV operations, or other slips, trips or falls that occur in normal park settings, the injury numbers and rates would be much lower from invasive plant control activities. No increases in human injuries would be expected to occur from this alternative.

4.5.1.3 Health and Safety Conclusion:

Removing exotic plants by the use of manual and motorized activities, soil solarization and weed burning have easily recognized hazards that can be predicted and easily controlled. The overall risk of human injury would be low and the impacts to human health and safety are judged to be minor overall.

4.5.2 Impacts from Alternative 2 – NPS Proposed IPMP

4.5.2.1 Direct and Indirect Impacts of Alternative 2:

This analysis below shows the effects of Alternative 2, "Decision Tree" on human safety and health. The potential effects to the visiting public would be less than to employees because they are not performing the tasks and signs would be posted warning people of activities. This alternative follows a decision tree that determines the method to be used. The two recommended options are physical control and herbicide use. The use of herbicides would only be considered after a careful evaluation of the target species and the surrounding environment (refer to decision tree for logic framework). The risks associated with physical control (manual, motorized, and solarization) have been described in more detail above in alternative 1. The additive risk of using herbicides is reviewed in this alternative. This assessment is based on three conditions:

1. Job Hazard Analysis - (JHAs) are developed and followed for each of the jobs to be completed. Employees are expected to follow the JHAs recommendations (personal protective equipment use, well-maintained equipment and herbicide supplies, good work practices, etc.) when completing that job.
2. Training/certification - Employees would receive all required training/certification when applying herbicides.
3. Recommendations on the labels and material safety data sheets (MSDSs) for each herbicide would be strictly followed. If these 3 conditions are not met, then the severity and probability of employee or public injuries would increase. See also mitigating measures in EA section 2.5 and herbicide best management practices in appendix H.

Hazard Rating of Selected Herbicides
The herbicides recommended for use and hazard ratings for each herbicide are shown in Table 4.5. Oregon State University and Intertox Inc. prepared a series of fact sheets to assist interested parties in understanding the risk associated with herbicides use by the Washington State Department of Transportation Integrated Vegetation Management program. Fact sheets have been prepared for all of the herbicides listed for use below. The complete fact sheets can be found at: http://www.wsdot.wa.gov/maintenance/vegetation/herbicide_use.htm

The Human Health and Risk Assessment associated with the identified herbicides according to these fact sheets is also provided in Table 4.5. Herbicides with the same active ingredients and equal or less toxicity than those evaluated in the table may be substituted in the future based on availability and current registration by EPA and ADEC.

Description of Activities
Employees would be mixing chemicals and water, cleaning equipment, storing and applying the designated herbicides. The herbicides would be applied using minimum volume techniques, backpack or hand held spray mechanism, injection, or wicks, brushes or sponges for direct contact with target plants. Spray mechanism would be equipped with flow regulators that control application rates, maximize effectiveness, and minimize drift. Under this alternative, the use of herbicides would be considered only after manual, mechanical, thermal, or cultural treatment methods have been ruled out using the decision tree.

Table 4.5 summarizes individual herbicide hazards and health ratings. Potential injuries to applicators may include: temporary eye irritation, skin irritation, nose and throat irritation, thermal burns, and lower back strains and sprains. The probability and severity of injuries occurring are both low.

An example of human health risk assessment is provided below for 2,4-D, which is at the more toxic end of the scale for proposed herbicides in alternative 2. This data is summarized from the Forest Service risk assessment web page for sensitive public members:

> "Upper bound hazard quotients for direct spray of a whole naked child with 2,4-D acid or salts are greater than 1 (the level of concern) for all application rates, ranging from a value of 3 for 0.5 lb a.e./acre, to a value of 28 for 4 lb a.e./acre. While this scenario is highly unlikely, it is a standard extreme scenario that is used in all Forest Service risk assessments as an indicator of the most serious exposures which could result from accidental spraying of members of the general public. All pesticide applications are conducted in a manner to avoid accidental spraying of members of the general public; however, this scenario suggests that such caution is particularly warranted with the use of 2,4-D. Based on central and upper-bound hazard quotients, adverse health outcomes are plausible following an accidental spill of 2,4-D into a small body of water. Upper bound hazard quotients for a young child consuming contaminated water following an accidental spill are 82, 41, and 328 for the typical, lowest, and highest anticipated application rates, respectively. Estimates of exposure via consumption of contaminated fish following an accidental spill result in hazard quotients of concern (i.e., greater than 1) for both subsistence and typical fish consumption scenarios.
>
> As with exposures to almost any chemical, there is particular concern for children, women who are pregnant or may become pregnant, the elderly, or individuals with any number of diseases. As discussed previously, reproductive-age females are sensitive to 2,4-D exposure. Developing fetuses are also sensitive to 2,4-D exposure at doses that are toxic to the mother. These issues were taken into account in the derivation of the acute and chronic RfD values for 2,4-D. Sunscreens increase the dermal permeability of 2,4-D. Consequently, individuals using sunscreens may absorb a greater dose of the compound, making them more likely than others to have adverse effects associated with dermal to 2,4-D. Studies with animals and humans suggest that 2,4-D is capable of causing adverse effects to the immune system. Accordingly, individuals who are immuno-compromised (e.g. the very young, the elderly, individuals with chronic illness) may be unusually sensitive to 2,4-D. The mechanism of action of 2,4-D involves disruption of the cell at the level of the membrane and basic metabolic functions. Individuals who have diseases involving the integrity of the cell membrane (e.g. sickle cell anemia) may be more sensitive than others to 2,4-D exposure. As with many chemicals there is some evidence that individuals, particularly children who are malnourished, may be at increased risk when exposed to 2,4-D (e.g., Ferri *et al*. 2003)."

In general, because proposed and potential herbicide applications would be relatively small, widely separated in space and time, and located and timed to avoid general public uses or with area closures, the potential adverse impacts to human health and safety would be minor.

4.5.2.2 Cumulative Effects to Human Health and Safety in Project Areas:

The overall effects to human safety and health from other injuries that might be expected to occur from motor vehicle operations, ORV operations, or other slips, trips, or falls that occur in normal park operations and visitation would be much greater than for potential injury numbers and rates from activities association with this alternative. No increase in employee OSHA recordable injuries would be expected to occur from this alternative and injuries to the public would be avoided with proper warning signs, emergency closures, and timing of control activities.

4.5.2.3 Conclusion:

As noted for alternative 1, removing exotic plants by the use of manual and motorized activities and soil solarization have easily recognized hazards that would result in low risk of injuries to employees or the general public. Removing exotic plants by the use of the identified herbicides with approved application methods and proposed public notification and areal closures would result in low overall risk of injuries to employees or the public and the impacts to human health and safety are judged to be minor overall.

4.6 Effects to Soils

4.6.1 Impacts from Alternative 1 – No Action

4.6.1.1 Direct and Indirect Impacts of Alternative 1:

Alternative 1 includes the currently used pulling, cutting, and mechanical removal of invasive plant species. Also included under this alternative are thermal methods for weed control including soil solarization and burning. Because soils are a complex system, any change in physical or biological properties caused by measures to control them may result in changes to soils.

Cutting of invasive plant species is the least damaging option to soil, but can still have impacts. Personnel doing the work can compact the soil decreasing organic matter thickness and altering thermal regime, microbial populations, frost penetration, and water penetration. Cutting invasive plants can also increase light reaching the soil surface and thermal regime. Cut plant materials left on the soil surface can change soil thermal and moisture properties, effect carbon to nitrogen levels, and change microbial and other populations.

Mechanical methods also disturb soils. The trampling caused by weed control personnel trying to find and remove weeds is probably greater than when cutting methods are used. In addition, holes are left where roots are removed which greatly modifies soil thermal and moisture properties and have cascading effects on frost penetration and biological communities. Mechanical weeding methods may also move weed seed to the soil surface where they may germinate.

Table 4.5 Herbicide Hazard and Health Ratings

Active Ingredient	Trade Names	EPA Reg. #	NPFA 704 Rating			EPA Toxicity Category	Signal Word	Cancer Risk	Non-Cancer Risk
			Health	Flam-mability	React-ivity				
2,4-D	Basic Solutions Lawn Weed Killer 1	239-2690	2	1	0	II (Moderate)	Warning	Negligible	Negligible
2,4-D	Eliminator Dandelion & Clover Killer	228-181-59144	1	1	0	II (Moderate)	Warning	Negligible	Negligible
2,4-D	Grass Roots Selective Weed Killer	228-181-40208	3	1	0	II (Moderate)	Warning	Negligible	Corrosive
2,4-D	Monterey Weed Whacker	228-181-54705	1	0	0	II (Moderate)	Warning	Negligible	Negligible
2,4-D	Brush Buster	228-186-54705	2	0	0	III (Low)	Caution	Negligible	Negligible
2,4-D	Spectracide Brush Killer	9688-138-8845	2	2	0	II (Moderate)	Warning	Negligible	Negligible
2,4-D & Triclopyr	Alligare Everett Herbicide	81927-29	3	1	1	III (Low)	Caution	Negligible	Skin
2,4-D & Triclopyr	Crossbow	62719-260	1	2	1	III (Low)	Caution	Negligible	Negligible
2,4-D & Triclopyr	Crossbow (L)	62719-260-34704	1	2	0	III (Low)	Caution	Negligible	Negligible
Aminopyralid	Milestone	62719-519	1	0	0	III (Low)	Caution	Negligible	Negligible
Aminopyralid	Milestone VM	62719-537	1	0	0	IV (Very Low)	Caution	Negligible	Negligible
Aminopyralid & Triclopyr	Milestone VM Plus	62719-572	3	1	1	III (Low)	Caution	Negligible	Skin
Chlorsulfuron	Glean XP	352-653	1	1	0	III (Low)	Caution	Negligible	Negligible
Chlorsulfuron	Telar DF	352-522	1	1	0	III (Low)	Caution	Negligible	Negligible
Chlorsulfuron	Telar XP	352-654	1	1	0	III (Low)	Caution	Negligible	Negligible
Clopyralid	Lontrel Turf & Ornamental	62719-305	2	2	1	III (Low)	Caution	Negligible	Negligible
Clopyralid	Transline	62719-259	2	2	1	III (Low)	Caution	Negligible	Negligible
Glyphosate	Aquamaster Herbicide	524-343	0	1	1	III (Low)	Caution	Negligible	Negligible
Glyphosate	AquaPro	62719-324-67690	1	1	0	III (Low)	Caution	Negligible	Negligible
Glyphosate	Rodeo/Glypro/Accord	62719-324	1	1	1	III (Low)	Caution	Negligible	Negligible
Glyphosate	Roundup Pro/Ultra	524-475	1	1	1	III (Low)	Caution	Negligible	Negligible
Glyphosate	Touchdown Herbicide	100-1117	1	1	0	III (Low)	Caution	Negligible	Negligible
Imazapyr	Arsenal	241-346	1	1	1	III (Low)	Caution	Negligible	Negligible
Imazapyr	Habitat	241-426	1	1	1	III (Low)	Caution	Negligible	Negligible
Metsulfuron-methyl	Escort XP	62719-37	1	1	1	III (Low)	Caution	Negligible	Negligible
Triclopyr	Garlon 3A[1]	62719-40	3	2	0	I (High)	Danger	Negligible	Corrosive
Triclopyr	Garlon 4		1	1	1	III (Low)	Caution	Negligible	Negligible

[1] The NPS wishes to retain the option of using Garlon 3A because it effectively controls broad-leaved invasive plants in "nonirrigation ditch banks, seasonally dry wetlands, floodplains, deltas, marshes, bogs, …and transitional areas between upland and lowland sites," such as Japanese knotweed.

NFPA 704 value	Health	Flammability	Reactivity
0	Poses no health hazard, no precautions necessary.	Will not burn	Normally stable, even under fire exposure conditions, and is not reactive with water
1	Exposure would cause irritation with only minor residual injury	Must be heated before ignition can occur	Normally stable, (but can become unstable at elevated temperatures and pressures)
2	Intense or continued but not chronic exposure could cause temporary incapacitation or possible residual injury	Must be moderately heated or exposed to relatively high ambient temperature before ignition can occur	Undergoes violent chemical change at elevated temperatures and pressures, reacts violently with water, or may form explosive mixtures with water
3	Short exposure could cause serious temporary or moderate residual injury	Liquids and solids that can be ignited under almost all ambient temperature conditions	Capable of detonation or explosive decomposition but requires a strong initiating source, must be heated under confinement before initiation, reacts explosively with water, or will detonate if severely shocked
4	Very short exposure could cause death or major residual injury	Will rapidly or completely vaporize at normal atmospheric pressure and temperature, or is readily dispersed in air and will burn readily	Readily capable of detonation or explosive decomposition at normal temperatures and pressures

Thermal methods include solarization and flaming. Solarization (using plastics to increase soil temperatures) has been effective in reducing weed seed populations in high-light locations, such as Israel and Mississippi, but has been less effective at northern latitudes due to lower light intensities. Clear and infrared-transmitting plastics produce higher soil temperatures than black plastic. Black plastic or other mulches could be used to control weeds by eliminating light. Solarization would effect the soil by increasing soil temperatures, effecting permafrost (when present), microbial populations and nutrient cycling. Because the plastics are impenetrable to rain, soil moisture would decrease over time, further effecting microbial populations, nutrient cycling, mycorrhizae, and roots of non-target species.

Flaming is used to kill aboveground portions of weeds. Soil organic matter could be ignited during this process which would affect soil thermal and moisture characteristics. Prescribed burns may convert dead plant accumulations to ash and charcoal, which can have beneficial effects on soil productivity for one to several growing seasons.

The effectiveness of non-chemical weed control and its effects on soil depends on a number of factors including: 1) The biology of the invasive plant, if the species is annual or perennial, and whether it would resprout after cutting and pulling; 2) the size of the infestation; 3) the density of plants in the infestation; 4) the type of weed control method used and its effectiveness; 6) the number of people used; 5) whether a seedbank or propagule bank exists; 6) the susceptibility of the soil to compaction and disturbance.

Non-chemical control methods are most effective and cause less damage to soil when the invasive species are annuals in a small area that can be easily pulled and do not resprout. If such an infestation is found and weeded before seed are produced, a small number of people can eradicate the infestation and can cause very little damage to soil from compaction from workers feet or holes made by pulling. If the infestation has already produced a seed or propagule bank, control teams will need to perform weedings over many years which will greatly increase soil compaction and other damage. Physical control methods could result in impacts to over 1,000 acres of soil by 2018 (see Table 2.1). Non-chemical means of control for very dense infestations may result in so much compaction due to the number of people required and soil disturbance from pulling that the damage resulting from trying to control the invasive plant could be greater than the damage done by these plants to the soil and other portions of the ecosystem.

There are a few high-density infestations or infestations of species that are resistant to control by non-chemical means where attempted mechanical weed control would be ineffective and cause major impacts to soils through trampling (compaction) and profile disruption. Five of these infestations are in GLBA. An infestation of perennial sowthistle on Strawberry Island is 2.4 acres in size, two infestations of oxeye daisy at Dry Bay are 0.9 and 0.4 acres in size, and one large and several small infestations of reed canarygrass near Bartlett Cove cover 2.1 acres. Japanese knotweed in SITK affects 0.1 acre near Indian River. Under Alternative 1 these infestations would not be completely controlled and impacts to soil by these species (severity unknown) would continue. Attempted control using mechanical methods would result in major impacts to soils due to trampling and profile disturbance. This activity is not likely, however, especially for sowthistle. Some invasive plant species would not be effectively removed by manual methods. They may irrevocably change soils through the addition of nitrogen or allelo-chemicals, changes in microbial and mycorrhizal populations, and changes to nutrient cycling and fire frequency. These areas could be adversely affected for long periods of time.

Surveys performed by NPS personnel show that 1,567 acres of park land have been infested with medium to high risk invasive weeds. These weeds may be causing impacts (severity not known) to soil on all of this area by altering light, thermal regime, nutrients, and biological interactions. Non-chemical weed control methods have been used to control invasive weeds on 44 acres, 2 % of the acres affected by invasive weeds. These weed control efforts have caused minor impacts to soils through compaction and profile disturbance caused by pulling.

4.6.1.2 Cumulative Effects:

Several thousand acres of soil have been adversely affected or destroyed throughout the Alaska region NPS units from past and ongoing mining, construction of roads, airstrips, ORV trails, public and administrative buildings, campsites, day-use areas, and other infrastructure and uses. Rough calculations indicate about 4,000 acres of surface area have been severely altered by mining, about 1,000 acres from roads, about 400 acres from ORV trails, 60 acres from landing strips, and another few hundred acres from buildings, campgrounds, trails, and other infrastructures. All totaled about 6,000 acres of pristine soil acreage has been lost to human activities throughout Alaska National Parklands. Compared to the millions of acres of pristine lands and soils unaltered by human activities this is a small percentage; however, the effects are long-term, severe, and generally located in high productivity areas, and therefore moderate. Adverse impacts to up to 2,000 acres from invasive plants and EPMT physical control actions, including access to invaded sites, would be minor to soils because effects would be localized and relatively short-term.

Climate warming in Alaska is thought to have increased average soil temperatures resulting in permafrost melt and increased microbial activity. Permafrost areas are thawing, creating thermokarst features where the land subsides into craters or gullies and melt zones along banks of streams, rivers, and shores collapse. Soil microorganisms are highly mobile, can tolerate most environmental conditions, and have short generation times that facilitate rapid adaptation to new environments associated with climate change. Recent experiments on arctic soils including heating and CO_2 enrichment resulted in altered microbial community composition and substrate use, generally leading to accelerated microbial activity and higher growth rates in the soils (Lipson *et al*., 1999 in ACIA 2005).

The minor additive effects of alternative 1 to other past, ongoing, and future impacts to soils from human activities and climate change would still result in no more than moderate overall impacts to soils.

4.6.1.3 Conclusion:

The no action alternative would result in small, localized adverse effects on NPS unit soils where EPMTs compact soil surfaces or dig up plant infestations, but these treatment areas could result in over 1,000 acres of soil disturbance by the year 2018. At large, high-density sites with difficult to control invasive plants, such as the 5.8 acres in GLBA, attempted physical control could result in long-term impacts to soil due to compaction and disturbance to organic layers and the soil profiles. The overall impacts to park soils and function would be minor over the next decade. This alternative would not result in impairment of soil resources in Alaska NPS areas.

4.6.2 Impacts from Alternative 2 – NPS Proposed IPMP

4.6.2.1 Direct and Indirect Impacts of Alternative 2:

Alternative 2 involves use of a decision tree to determine the most effective weed control method to eradicate or control invasive plant species while minimizing environmental impacts. It is expected that non-chemical means would be employed on small infestations of annual species where this method can be effective. For larger infestations or for invasive plants where mechanical control is ineffective, herbicides that are relatively environmentally benign may be used. The effects on soils from mechanical and thermal control methods that may be employed in this alternative are discussed above under alternative 1; however, large or difficult to control infestations would not receive physical control treatments under this alternative. The analysis below focuses on impacts to soils from herbicide uses.

An advantage to soils of herbicides for weed control is drastic reduction in soil trampling, damage to the organic layer, compaction and associated thermal and moisture effects of mechanical and thermal methods. Similar to mechanical methods, use of herbicides would result in increased light penetration to the soil surface as invasive species are killed. The dead weeds on the soil surface would reduce light penetration, perhaps insulate the soil, and result in higher soil C:N ratios as the organic matter was mineralized.

Herbicides may reach the soil directly during spray operations, can be translocated downward into roots (only herbicides that are translocated) or may reach the soil surface when leached from plant parts or when killed plant parts fall to the soil surface. Once an herbicide contacts the soil, its fate and effects depend on herbicide chemistry, soil properties, and environmental conditions. Thus it is difficult to generalize regarding the effects of herbicides on soils. The effects would be different for each herbicide and each soil/environment.

Appendix G summarizes the fate and effects of herbicides that could be used in Alternative 2. Solubility in water has an effect on how much of the soil the herbicide comes into contact with and how likely it would leach. More than one aspect of an herbicide’s chemistry and interaction with soils is needed to understand the herbicide effects to the soils. Various models have been developed to evaluate herbicide chemistry simultaneously with site specific soil and environmental data to determine the amount of leaching that should occur. Appendix C shows one such model, the Relative Aquifer Vulnerability Evaluation (RAVE). For example, glyphosate is highly soluble in water, but when it reaches the soil it tightly binds to soil particles and is not available to microorganisms and will not leach. Other herbicides, such as 2,4-D, do not have high affinity for soil clay or organic matter and are highly leachable. However, 2,4-D is readily biodegraded by soil bacteria and does not persist long in soil, thus lowering its leaching potential.

Environmental conditions also affect herbicide fate and effects on soil. Cold soil temperatures can slow volatilization and microbial decomposition of herbicides. Leaching may be increased with higher rainfall. Following is information describing the known fate and effects of the proposed herbicides in Alaska.

Glyphosate is strongly absorbed by soil particles and hence is unavailable to plant roots and has shown low soil mobility in lab and field studies (Senseman 2007). In the studies listed above, researchers were able to extract glyphosate from soils in the laboratory using strong chemicals and quantified them using analytical chemistry. The greater persistence of glyphosate in soils at high latitudes is not important, because it will not cause negative effects to plants, offsite movement, or groundwater contamination. Glyphosate is relatively immobile in soil, so does not tend to leach. It is primarily degraded through microbial action. Several studies have shown that it is only moderately persistent, with a soil field dissipation half-life averaging less than 60 days (e.g., Kollman and Segawa 1995). It is highly water soluble, and so has little tendency to bioaccumulate (Norris *et al*. 1991).

Burgoyne (1981) studied the persistence of 2,4-D at 4 locations in Alaska (Anchorage, Fairbanks, near Wasilla, and Eklutna). In all cases less than 0.6 parts per million 2,4-D were found by the end of the summer following spraying and none was detected a year after application. Stacey Frutiger studied degradation and leaching of 2,4-D at Delta Junction and Valdez, Alaska in 2006-2007 (thesis in preparation, UAF). Less than 12% of the applied 2,4-D reached the soil surface due to interception by plants and volitalization. The half-life of 2,4-D at Delta Junction was 13.4 days which is similar to other areas where fate of 2,4-D was studied. Unlike more temperate regions where 2,4-D usually degrades within 60 days, very low levels of 2,4-D were found in some samples in Frutiger's Alaska study after spring thaw 300 days after application. This was because of the short summer and long period that soils are frozen in Alaska. According to Frutiger, "The main conclusion drawn from these results is that once applied to sub-arctic, vegetated soils, 2,4-D will most likely have minimal impact on ground-water sources." Because of the very small areas where NPS would make applications, low toxicity to mammals, birds and fish, rapid degradation in soil with minimal risk for leaching, 2,4-D would be an appropriate herbicide to use to eradicate susceptible invasive plants that are not easily controllable in Alaska using physical means. Where safe, NPS will require applicators to wear disposable slippers over foot wear to prevent 2,4-D herbicide residues from being tracked off-site.

There have been a number of studies of triclopyr fate in Alaska soils. Tilsworth *et al*. (1991) studied triclopyr persistence at 6 locations along the Alaska Railroad starting in Seward and ending at Eielson Air Force base near Fairbanks. At all sites triclopyr was still detectable one year after spraying but only in one instance did triclopyr soil residue exceed one part per million. These results were similar to those found in Sweden by Torstenssen and Stark (1982). Tilsworth *et al*. found that very low levels of triclopyr leached to the soil 3-foot depth; however, no lateral movement of triclopyr was found. Rhodes (in review) studied the fate of triclopyr in soil at Delta Junction and Valdez. According to Rhodes, "Triclopyr residues persisted at the 0-5 cm depth for at least 300 days following application at both field sites. Transient increases in concentration at the 0-5 cm depth were observed, presumably resulting from residue wash-off associated with precipitation events or deposition of treated vegetation on the ground surface. Vertical mobility of triclopyr was limited, indicated by a large proportion of non-detects and relatively low concentrations recorded at the 10-18 cm and 30-38 cm depths. If triclopyr were to reach ground or surface waters through transport from the target area, concentrations should remain well below toxic levels with respect to aquatic and terrestrial organisms." The above studies of triclopyr soil fate performed in Alaska show that the herbicide is moderately persistent and that there is the potential for a small amount of leaching in some locations. However, due to the very small areas of application in NPS areas, the amount of triclopyr in groundwater probably would not be detectable. In addition, the low toxicity of this herbicide diminishes concern that triclopyr would have off-site impacts.

For all of the herbicides studied, increased persistence in an agricultural setting was a problem because of the potential for injury to susceptible crops that might be grown in subsequent years. Though the potential for leaching and off site movement are increased with longer soil persistence, this was not a problem due to the sorption characteristics of the herbicides.

Imazapyr, which is also degraded in soil primarily by microbial action, is both more stable and substantially more mobile than glyphosate, at least at soil pH>5, but in aqueous solution undergoes rapid photohydrolysis, and has not been reported in water runoff (half life of ~2 days) (Mallipudi *et al*. 1991). Imazapyr is highly water soluble, has not been shown to bioaccumulate, and is rapidly excreted (Miller *et al*. 1991).

Because it is much newer, less is known about the fate and effects of aminopyralid. Aminopyralid is degraded by soil microbial activity and has a moderate residence time in soil (average half life 40 days). It is highly mobile, due to its solubility, but is very rapidly photohydrolzyed in water (half life of 0.6 days). Because of its high solubility in water, it does not appear to bioaccumulate and is rapidly excreted (USDA FS 2005a and 2005b).

More recently, Newton *et al*. (2008) studied the dissipation rates of the herbicides glyphosate, imazapry, triclopyr, and hexazinone at upland and river bottom sites near Fairbanks and Windy Bay (southern tip of Kenai Peninsula), Alaska. The study concluded that the "low toxicity of these products and their metabolites combined with consistent dissipation and low mobility suggest that toxic hazard of their use at high latitudes need not be a matter of serious concern to humans, terrestrial wildlife, or aquatic systems. They are safe for use in management and rehabilitation of boreal forests when used properly." Furthermore, they recommend that "Dissipation at rates approaching those in warmer climates offer a hypothesis that micro-flora native to high latitudes may be adapted to destruction of such molecules at lower temperatures than may be indicated by experiments with microflora adapted to warmer climates. Residues pose no observable risk to wildlife or humans in the area of use when products are applied properly."

Many herbicides are degraded by microorganisms. Temporary increases in the populations of specific micro-organisms that degrade the particular herbicide can be expected. These microorganisms could compete with limiting nutrients with other soil organisms.

The top priorities identified for treatment with herbicide include seven GLBA infestations: perennial sowthistle on Strawberry Island, oxeye daisy in Dry Bay, and five infestations of reed canarygrass near Bartlett Cove. A persistent infestation of Japanese knotweed in SITK is also proposed for herbicide treatment. Manual removal of these infestations is not practical due to the extent of land covered and vegetative reproduction. Continued spread of these species could be very detrimental to the soil chemistry and surrounding ecosystems.

Glacial till soils are present at the perennial sowthistle infestation on Strawberry Island with abundant pebbles and thin organic layers. This area has a mean annual rainfall of 70 inches and an annual mean temperature of 41.5 degrees F. Aminopyralid (Milestone VM) has been proposed as the herbicide for control. This herbicide has extremely low toxicity to birds, mammals, aquatic invertebrates, bees, and fish and is very effective at controlling perennial sowthistle. It is applied at low rates (3 fl oz/acre) and is weakly adsorbed by soil. EPA gives a 104 day half life for aminopyralid in soil. The projected effect of this herbicide treatment on soils at Strawberry Island is: a temporary increase in microorganisms that degrade aminopyralid; temporary changes in soil thermal regime as perennial sowthistle and other susceptible plants are killed; an increase in soil C:N ratio as dead vegetation reaches the soil surface. The likelihood that some aminopyralid would leach to groundwater is high because of the high rainfall, low soil sorption, relatively great persistence and shallow groundwater. However, low application rates and extremely low toxicity of this herbicide mitigate any adverse consequences to organisms besides susceptible plants.

Aminopyralid at an application rate of 4 fl oz/acre is also proposed for control of two large infestations of oxeye daisy at Dry Bay. Soils there appear to be sandy with abundant pebbles and cobbles. Rainfall is very high (160 inches at Yakatat). The effects of aminopyralid to soils at this site would be similar to those at Strawberry Island. The likelihood for leaching would be greater due to sandy soils and lack of organic matter which decrease adsorption, higher rainfall, and a cooler climate (average temperature 39.5 degrees F at Yakatat). Again, the effect of leaching on non-target organisms should be minimal due to low application rates and extremely low toxicity.

Application of glyphosate (Roundup Pro or Aquamaster if close to water) to 2.1 acres of with reed canarygrass near Bartlett Cove in GLBA would be bound tightly by soil particles and not readily leached into underground or adjacent waters. Roundup is generally not active in soil and not available to plants from soil particles, but soil microorganisms break it down where it has a half-life of 3 to 130 days. The half life of the associated surfactants is less than one week. Because no known effect on soil microorganisms is known from glyphosate and its associated surfactants, the impacts to soil properties and productivity would be minimal.

Imazapyr (Habitat) to be used on 0.1 acre of Japanese knotweed in SITK can persist in soil from 6 months to 2 years, but exposure to sunlight and soil microorganisms contribute to breakdown rates. Imazapyr is soluble in water, but it has a low potential to leach into ground water. It has little effect on soil microorganisms and is nontoxic to conifers, so it is thought imazapyr does not affect soil productivity.

Overall, under Alternative 2 approximately 12 acres would be treated with herbicides the first year and if no delays to proposed management options occur, it is estimated that herbicide treatments would constitute less than 10% of the overall treatments in each subsequent year. The number of acres treated and associated impacts to soils by manual methods under Alternative 2 would be much less than under Alternative 1 over the next 10 years. Soil compaction, alteration in soil moisture and thermal regimes would result from trampling. There would be minor, short-lived changes in soil microorganisms caused by herbicides. The effects of trampling on the 6-acres of herbicide-treated soil would be much less than if manual weed control methods were used, and these weeds would be effectively controlled, eliminating the effects of nonnative plants on these soils.

4.6.2.2 Cumulative Effects:

Several thousand acres of soil have been adversely affected or destroyed throughout the Alaska region NPS units from past and ongoing mining, construction of roads, airstrips, ORV trails, public and administrative buildings, campsites, day-use areas, and other infrastructure and uses. Rough calculations indicate about 4,000 acres of surface area have been severely altered by mining, about 1,000 acres from roads, about 400 acres from ORV trails, 60 acres from landing strips, and another few hundred acres from buildings, campgrounds, trails, and other infrastructures. All totaled about 6,000 acres of pristine soil acreage has been lost to human activities throughout Alaska National Parklands. Compared to the millions of acres of pristine lands and soils unaltered by human activities this is a small percentage; however, the effects are long-term, severe, and generally located in high productivity areas, and therefore moderate. Adverse impacts to up to 1,000 acres of invasive plant infestations and about 861 acres of EPMT physical and chemical control actions up until 2018, including access to invaded sites, would be minor to soils because effects would be localized and relatively short-term. Climate change effects on soils in Alaska NPS areas would be similar as described in section 4.6.1.2. The additive effects of alternative 2 to other past, ongoing, and future impacts to soils would still result in no more than moderate overall impacts to soils.

4.6.2.3 Conclusion:

The effects on soil from physical control methods can be considerable due to trampling and thermal changes and depend on the area and intensity of disturbance and soil susceptibility. These effects would be reduced in area and intensity under alternative 2, totaling about 600 acres until year 2018. The effects of herbicides on soils would be minor and short-lived due to the small number of acres involved with the proposed herbicides. The overall impacts to park soils and function would be minor over the next decade. This alternative would not result in the impairment of soil resources in Alaska NPS areas.

4.7 Effects to Subsistence

For a summary evaluation and findings to subsistence resources and uses in the Alaska Region National Park System from the alternatives considered for invasive plant management, see the ANILCA Section 810(a) review in appendix A. The analyses of impacts to subsistence resources and uses draws heavily upon the analyses of effects to aquatic resources (4.3), human health and safety (4.5), vegetation (4.8), and wildlife (4.11). The analyses of effects focus on park areas where subsistence activities are authorized and where invasive plant management activities are expected to take place. It must be kept in mind, however, that invasive plant control methods in one location could have an indirect effect to subsistence uses and resources in an adjacent or distant location. For example, a migratory fish or animal resource could be adversely affected (population reduction) from habitat loss due to invasive plant infestations or similar resources could be adversely impacted from chemical contamination.

4.7.1 Impacts from Alternative 1 – No Action

4.7.1.1 Direct and Indirect Impacts of Alternative 1 on Subsistence

The analysis below shows the effects of alternative 1 on subsistence resources and uses would probably be minor so long as manual removal of invasive plants is adequate to avert major infestations of invasive plants. Fortunately, many of the most troubling invasive plant infestations occur in park units not allowing subsistence uses.

As described in section 4.3.1.1, NPS crews have so far successfully contained aquatic and riparian species that could eventually overwhelm manual control methods, except for the 2.5-acre perennial sowthistle infestation on the estuarine shores of Strawberry Island in GLBA, the 1-acre oxeye daisy infestation near the Dry Bay fish plant and runway adjacent to a slough of the Alsek River, and small patches of reed canarygrass near Bartlett Cove in GLBA and Japanese knotweed near Indian River in SITK. Subsistence is allowed in the Glacier Bay National Preserve in the Dry Bay area, but Strawberry Island and other locations within Glacier Bay National Park or SITK are not open to subsistence uses, so the impacts of invasive plants and manual control methods there would have no adverse impacts on subsistence. White sweetclover (*Melilotus alba*) has formed major infestations and monocultures along river bars of the Stikine, Nenana, and Matanuska Rivers of Alaska, but to date NPS crews have manually removed small infestations along portions of the Nenana River in DENA and Copper River in WRST. Subsistence uses do not occur in the entrance area and Parks Highway corridor of DENA, so control of white sweetclover has no direct effect on subsistence here. Subsistence uses do occur along the Copper River, and eventually white sweetclover could become widely established there and adversely affect habitat for moose, fish, and various bird species, leading to an indirect adverse effect on subsistence resources. White sweetclover contains coumarin, a substance toxic to animals (AKEPIC 2005). Also, sweetclover has been used for bee farming, and native pollinators could be distracted from native plant species, thereby reducing berry crops and reproduction of native species important for wildlife habitat. White sweetclover has been observed in fire-disturbed areas in Interior Alaska, possibly introduced from fire response crews (Heys pers. comm.). Thus this species could become widespread in YUCH, GAAR, DENA, and WRST and exceed the NPS EPMT crew capacities to control manually.

Other aquatic and riparian invasive plants species in Alaska park system units such as yellow toadflax, reed canarygrass, Japanese knotweed, sheep sorrel, and smooth brome grass occur primarily in park units where subsistence uses are not permitted, except smooth brome grass which is near Coal Creek in YUCH and in WRST along the McCarthy Road, but not in a riparian zone.

There would be no adverse impact to subsistence user health and safety from alternative 1, unless infestations become large enough to reduce primary subsistence food resources and then indirectly the health and well-being of subsistence populations. This outcome is not anticipated at this time because infestations are relatively small in area, scattered, and many do not occur in areas subject to subsistence uses.

As discussed in sections 4.6.1.1 and 4.8.1.1, the direct and indirect effects of physical control methods for invasive plants would result in short-term, small areal impacts to soil surfaces and nonnative vegetation. These activities would have virtually no adverse effect on subsistence resources and uses, especially since most control efforts would occur in early summer and subsistence hunting or gathering periods are mostly in late summer and early fall.

Table 3.1 displays the various invasive plants found in and near Alaska NPS units and appendix F summarizes the known effects of these plants on wildlife and its habitat. Fourteen known invasive plant species occur in NPS units where subsistence is allowed. The common dandelion occurs in six such park units, but its threat level is considered relatively low. Black bears have been observed foraging this species in GLBA, and it is commonly eaten by moose, grouse, and gophers, and birds eat the seeds. Narrowleaf hawksbeard occurs in three park units allowing subsistence, and its environmental and wildlife threats effect are similarly low. Oxeye daisy occurs in many parks, but the most extensive infestations are in Dry Bay. The entire plant has a disagreeable odor, grazing animals avoid it, and it contains chemicals toxic to most insect herbivores. This species produces 1,300 to 4,000 fruits annually that can persist for years before germinating and can reproduce vegetatively (AKEPIC 2005). White sweetclover can dominate large tracts of open areas, especially river bars and recent burns, which may alter habitat for wildlife and attract pollinators away from native plants. It occurs in DENA and near other parks with subsistence (GAAR, WRST, and YUCH). Presently oxeye daisy, common dandelion, hawksbeard, and white sweetclover pose a low threat to subsistence resources and uses; however, if unchecked, oxeye daisy could displace native vegetation and wildlife habitat, thereby reducing the overall populations of subsistence food sources. As noted above, the physical control methods in alternative 1 would have at most minor effects on subsistence wildlife resources and uses.

4.7.1.2 Cumulative Effects:

Subsistence resources (vegetation, berries, wildlife habitat, and wildlife distributions) have been adversely affected by over 275 miles of road, about 560 miles of ORV trails, past and ongoing mining, 6 commercial lodges and associated activities, several airstrips and helipads, NPS administrative activities and developments, and competing recreational activities such as general hunting. Many of the access facilities are used by subsistence and recreational users of NPS areas.

The McCarthy and Nabesna Roads and attached ORV trails in WRST are used extensively by local rural residents for access to subsistence resources. The Denali Park Road is used for access to the Kantishna area by local rural residents to gather berries and to hunt moose and other wildlife in the fall, but this road is used primarily by recreational visitors during the busy summer season.

The GAAR ATV Subsistence Use Legislative EIS authorized a land exchange between the NPS and Anaktuvuk Pass to allow ATV access to hunting grounds while unaffected lands would be provided to the NPS, including an equal exchange of lands for wilderness designation. This agreement affected over 300,000 acres of land near Anaktuvuk Pass and removed about 30 miles of ATV trails from NPS management. The Dry Bay ORV EA (NPS 2007a) has resulted in a decision to close about 20 of 80 miles of ORV trails, including reclamation of widened areas along ORV trails to remain in use. The Cantwell Subsistence ORV EA (USDI NPS 2007b) has resulted in a decision to allow continued uses of ORVs for subsistence hunting and gathering in the traditional use area on the south side of the Alaska Range, but trails are to be closed or hardened where they traverse wetlands or other sensitive areas. Short segments of ORV trails or primitive roads are used for access to subsistence resources in YUCH at Coal and Woodchopper creeks.

Commercial lodges occur in or near subsistence use areas of Alaska NPS units at GLBA in Dry Bay (3), DENA Kantishna area (3), Alagnak WSR (7), KATM Preserve at Nonvianuk Lake (2), WRST along Nabesna and McCarthy roads and Chisana and other remote locations (12), LACL Port Alsworth area, GAAR at Walker and Takahula lakes. Guided hunts from these facilities could compete with local rural residents for subsistence resources in these ANILCA conservation system units.

In preserves where general hunting, guided hunts, and outfitter-guided trips occur, competition for subsistence resources may occur. This is a sensitive issue in the Western Arctic National Parklands; however, invasive plants are not yet documented in these park areas.

The impacts to subsistence resources from various past and ongoing uses and developments have been widespread and extensive, displacing vegetation and wildlife habitat, fracturing wildlife distributions. The impacts may result in reduction of and competition for resources with subsistence users. Because ANILCA Title VIII recognizes a preference for subsistence uses of these resources, the larger impacts should be reduced by closures to general uses. These impacts to subsistence resources and uses could be construed as moderate overall. The impacts of the no action (status quo) alternative involving physical control methods of invasive plants would contribute a minor additional impact to subsistence resources and uses, resulting in no more than the overall moderate cumulative effect on subsistence resources and uses.

4.7.1.3 Conclusion:

The continuation of the no-action (status quo) alternative to control invasive plants in Alaska NPS units with physical control methods would result in minor impacts to subsistence resources and uses. Should these methods fail to contain infestations resulting in greater habitat losses of important subsistence resources, then the area of impact could increase. The no-action alternative would not result in the impairment of subsistence resources and uses identified in the enabling legislation for the affected conservation system units.

4.7.2 Impacts from Alternative 2 – NPS Proposed IPMP

4.7.2.1 Direct and Indirect Impacts of Alternative 2 on Subsistence

The effects of physical control methods of invasive plants on subsistence resources and uses would be similar to those described in Alternative 1. The decision tree currently directs all sites that have vegetation harvested by humans to be treated manually.

For other, non-vegetation subsistence harvesting areas herbicides would be considered for a control option after going through the decision tree. This alternative would result in less human disturbance to subsistence resources and use areas from repeated large manual control teams. The primary difference of effects on subsistence resources and uses is the difference between the impacts of allowing infestations to increase from ineffective manual control methods to rapidly treating these infestations with minimum-volume spot treatments with herbicides.

As noted in sections 4.5 and 4.11, none of the proposed herbicides pose a serious risk to humans or wildlife inadvertently exposed to these chemicals. For risks to human and ecological health see: http://www.fs.fed.us/foresthealth/pesticide/risk.shtml and the summary table 4.5.2. None of the proposed herbicides pose more than a negligible cancer or non-cancer risk to humans from accidental intake. Herbicide applicators are trained in safe application procedures of herbicides, including proper use of personal protective equipment (PPE). Treated areas would be posted and the public would be notified in local offices and newsletters to avoid treated areas for a safe period of time. Timing and locations of applications would be selected to maximize effectiveness to remove invasive plants while avoiding public and subsistence use periods. In general, herbicide applications are most effective in early summer when invasive plants are rapidly growing. Most non-vegetation subsistence activities in parks take place in mid to late summer fall (fishing, egging, hunting),. The current proposed treatment areas are relatively small and limited (1 acre in Dry Bay GLBA, 2.5 acres on Strawberry Island in GLBA where subsistence does not occur, and 2 acres in Bartlett Cove where subsistence does not occur) and future potential treatment areas would likely be as small or smaller, the extent and period of potential exposure of subsistence resources and subsistence users to herbicides is small in area (less than 20 acres/year out of 40,000,000 acres[2]) and limited in duration. Treated areas would be closed, so potential exposure to subsistence users would be extremely low.

As noted in section 4.3.2.1 several of the proposed potential herbicides could have acute toxic effects on aquatic organisms; however, the NPS would not likely apply these chemicals in or near aquatic systems pursuant to recommended uses and the decision tree for invasive plant control. Often the herbicide chemical is less toxic than the esters or surfactants combined with the herbicide. Mixtures with 2,4-D, glyphosate (Roundup), chlorsulfon, and triclopyr (Garlon) are known to be toxic to aquatic taxa. Mixtures with imazapyr, metsulfuron methyl, and aminopyralid are relatively non-toxic to fish and slightly toxic to aquatic algae and macrophytes. Data on toxic effects of clopyralid on aquatic taxa is limited, but suggests low acute toxicity to fish, but no adverse effects are expected from normal application rates. Again, because of the limited extent and duration of potential herbicide applications in or near aquatic resources in NPS units in Alaska, likely adverse effects to subsistence resources and users are very low.

[2] Prompt attention should result in lower acreage infestations, consequently less need for herbicide applications.

As a specific example, the risk assessment for aminopyralid (Milestone, a relatively new and low toxicity herbicide) from the web page noted above provides a worst case scenario supporting the low likelihood of an adverse impact to the general public or subsistence users:

> Take a combined scenario where an individual is sprayed on the lower legs, stays in contact with contaminated vegetation, eats contaminated fruit, drinks contaminated ambient water, and consumes contaminated fish at rates characteristic of subsistence populations. In such a case, the combined hazard quotient would be 0.0935 (0.006 + 0.0005 + 0.02 + 0.007 + 0.06), below the level of concern by a factor of about 10.6. Similarly, for all of the chronic exposure scenarios, the addition of all possible pathways at the maximum application rate leads to a combined hazard quotient of about 0.0884 which is below the level of concern by a factor of about 11.

The same risk assessment reported effects to sensitive subgroups exposed to dosages higher than recommended field application rates. Impacts to eye movements in mice and muscular coordination in rabbits resulted in gavage (force-feeding) experiments. These results were not always reproducible, and the impacts could have been caused by something other than the chemical. Furthermore, wildlife and humans are not likely to be exposed to aminopyralid in the same manner and at the higher doses administered to these test animals.

Considerably more risk assessment data is available for 2,4-D, which is at the more toxic end of the scale for proposed herbicides in alternative 2. The U.S. Forest Service risk assessment web page reports the following for sensitive public members, including subsistence populations (see also section 4.5.2):

> "Estimates of exposure via consumption of contaminated fish following an accidental spill (into water) result in hazard quotients of concern (i.e., greater than 1) for both subsistence and typical fish consumption scenarios. For subsistence populations (i.e., those who may eat wild caught fish as a necessity rather than a sport), upper bound hazard quotients for fish consumption range from a low value of 4 for the lowest anticipated application rate to a high of 32 for the greatest anticipated application rate. Comparable hazard quotients for consumption by the general population range from 0.8 at the lowest application rate to 7 at the highest application rate.
>
> On the basis of hazard quotients presented in worksheets, the only longer term exposures which could plausibly result in adverse health effects are those associated with consumption of fruit and vegetation. The upper bound hazard quotients for ingestion of contaminated vegetation are higher than those for ingestion of fruits, with values of 38, 19, and 152, for application rates of 1, 0.5, and 4 lb a.e./acre, respectively. These results suggest that adverse health effects are plausible should such exposures occur. These adverse effects could target the developing fetus as well as the blood, kidney, liver, thyroid, eyes, reproductive system, immune system, and nervous systems of adults."

In general, because proposed and potential herbicide applications would be relatively small, widely separated in space and time, located and timed to avoid general public and subsistence resources and use areas, and treated areas would be posted and closed to public uses for an appropriate period, the potential adverse impacts to subsistence uses and users would be minor. On the other hand the protection of native, wild subsistence resources and habitat over the long run would be a major beneficial effect.

4.7.2.2 Cumulative Effects:

Cumulative effects to subsistence resources and uses under alternative 2 would be similar to those described in alternative 1 section 4.7.1.2. These impacts to subsistence resources and uses could be construed as moderate overall. The impacts of alternative 2 involving physical and chemical (herbicide) control methods of invasive plants would contribute minor short-term adverse effects on subsistence resources and uses in terms of small lost use areas for short periods of time. In the long term this would result in the protection of natural habitat for plants, fish, and wildlife and thus protect subsistence resources. Exposure of subsistence users to herbicides would be negligible because treated areas would be posted and closed for appropriate periods of time. Overall the cumulative effects on subsistence resources and uses from all human activities in Alaska NPS areas would still be moderate.

4.7.2.3 Conclusion:

Alternative 2 (IPMP with herbicide option) uses a decision tree to decide the best method to control invasive plant infestations in Alaska NPS units, including physical and chemical (herbicide) control methods where appropriate, would result in minor impacts to subsistence resources and uses. Long term beneficial effects could accrue from the prevention of rapidly spreading invasive plants and the resultant loss of subsistence resources and use areas. The preferred action alternative would not result in the impairment of subsistence resources and uses identified in the enabling legislation for the affected conservation system units.

4.8 Effects to Terrestrial Vegetation

4.8.1 Impacts from Alternative 1 – No Action

4.8.1.1 Direct and Indirect Impacts of Alternative 1:

This analysis consists of two sections that consider separately the impacts of manual and mechanical control methods and the impacts of uncontrolled invasive plant populations on terrestrial vegetation.

Impacts of Manual and Mechanical Control Efforts

Personnel conducting invasive plant management would cause short-term, direct impacts to vegetation from foot and ORV traffic en route to invasive plant populations and during control efforts, particularly with work crews. Individual plants would be trampled resulting in no effect, reduced vigor, or death depending on the stature and structure of the plant and the amount and duration of pressure applied. Infrequent impacts to individual plants generally do not affect plant populations, plant communities, or ecological processes. The impacts of intrusion into parks on vegetation resources would therefore be directly adverse, site-specific, short-term, and minor.

Cutting is effective for some species but not others and for native plants in the same area can result in no effect, reduced vigor, or death depending on the stature and structure of the plant and the selectivity, height, and frequency of the cutting. Infrequent impacts to individual plants generally do not affect plant populations, plant communities, or ecological processes. The impacts of intrusion into parks on vegetation resources would therefore be directly adverse, site-specific, short-term, and minor.

Digging and pulling are ground disturbing activities that may cause minor mechanical disturbance to individual native plants. A small percentage of human-disturbed ground in Alaska parks have been treated and would be treated under this alternative using these methods. However, infrequent impacts to individual plants generally have negligible to minor impacts to plant populations, plant communities, or ecological processes.

Interagency Fire Plans have been approved for BELA, CAKR, DENA, GAAR, KOVA, LACL, NOAT, YUCH, and WRST that would permit the use of prescribed fire or spot-burning. For other parks, a Prescribed Fire Plan would have to be prepared prior to the use of these methods. Parks with approved plans would benefit from the direct effects of removing stagnant, dead plant accumulations while converting that mass to ash and charcoal. Fires tend to increase species diversity and reduce woody species relative to grass and forbs species. The impacts of prescribed fire on vegetation resources would therefore be directly beneficial, site-specific, short-term, and moderate.

The effect of fire on plants is species-specific. Fire may either increase or reduce germination and vigor of plants. Prescribed fire may have adverse impacts on some individual plants, but would affect a relatively small portion of the overall population. Overall, prescribed fire would have infrequent adverse, short-term, minor impacts on individual plants. Infrequent impacts to individual plants generally do not impact plant populations, plant communities, or ecological processes. Prescribed fire could encourage the establishment of exotic plants following fires. However, follow-up treatments would be used to control exotic plants after fires, as needed. The impacts of fire on vegetation resources are therefore directly beneficial and adverse, site-specific, short-term to long-term, and minor.

Impacts of Uncontrolled Infestations

Manual and mechanical methods are not effective for control of particular invasive plant species under certain circumstances (Art 1996, Radosevich *et al*. 1997, Sheley *et al*. 1999, Monaco *et al*. 2002, Czarapata 2005). Pulling and cutting can stimulate resprouting among certain invasive plant species, which are generally those that reproduce vegetatively and have substantial root reserves. Results include infestations with increased density and size, are more difficult to control in the future, or require regular treatment for continued suppression. Manual and mechanical methods can also be unfeasible due to large population sizes and individual plant morphology. Soil disturbance resulting from pulling and digging plants can increase invasive plant seedbank germination rates.

Where physical control of invasive plant infestations fail, then individual parks would need to conduct additional compliance measures to obtain clearance to use herbicides where necessary for invasive plant control. This could result in delays in taking action, which could result in moderate impacts from expansion of existing infestations or establishment of new infestations. This alternative would therefore increase the amount of future effort required to rehabilitate native plant populations. For example, the populations of perennial sowthistle and oxeye daisy proposed for initial herbicide application under Alternative 2 are beyond the feasibility of manual or mechanical control. Under Alternative 1, these infestations would continue to grow in size and density, displacing native plants in their vicinity and increasing the probability of dispersal into new areas.

The highest-risk invasive plants in Alaska are likely to spread substantially if ineffectively controlled by physical methods under Alternative 1. The resulting impacts to terrestrial vegetation would be many and varied. At the most basic level, invasive plants displace native plant communities by forming dense monocultures and out-competing native plants for moisture, light, and nutrients. In addition, they can alter plant community composition and diversity. In certain cases, invasive plants cause genetic modification of closely related native plant species through hybridization. Uncontrolled infestations of invasive plant infestations could result in moderate adverse impacts to native vegetation.

Invasive plants can also impact terrestrial vegetation indirectly through changes to the biotic or abiotic environment. For example, pollinators can be attracted to invasive rather than native plants, reducing reproduction rates in the native species. Invasive plants can also carry diseases that can be transmitted to native species, reducing their vigor or survival. Some invasive plant species alter soil nutrient composition, particularly among nitrogen-fixing legumes, and moisture availability, thereby altering native plant community composition. Finally, invasive plants can affect disturbance regimes and the rate and composition of plant succession following disturbances. For more thorough accounts of the impacts of individual species on terrestrial vegetation, refer to *Invasive Plants of Alaska* (AKEPIC 2005).

4.8.1.2 Cumulative Effects:

The primary anthropogenic impacts to terrestrial plants in Alaska parks are the clearing of native vegetation for facilities and transportation corridors and the maintenance of pioneer plant communities where trees and shrubs would inhibit an area's administrative use. Additional impacts include irregular disturbance by visitors and park staff through trampling and camping-associated activities.

Approximately 275 miles of road exist in Alaska parks; an average disturbance width of 10 m would indicate overall vegetation impact of 1,094 acres. More than 560 miles of OHV trails traverse Alaska parks; an average disturbance width of 3 m would indicate overall vegetation impact of 561 acres. Nine FAA-recognized airstrips and 3 helicopter landing areas exist in or are surrounded by Alaska NPS units, and probably more than 100 landing areas are used on a regular basis. While there is no standard size for these areas, a rough estimate of 10 acres per area would indicate over 1,000 acres of vegetation impact. There are 6 commercial lodges and commercial joint ventures on Alaska National Park lands, which provide lodging, meals, and visitor services, that cover about 20 acres in 3 parks (DENA, KATM, and GLBA). There are approximately 1,550 acres of land in the Kantishna area of DENA that have been impacted by mining, of which

517 acres are currently being revegetated (DENA Reclamation of Mined Lands Program 2001). The NPS completed three environmental impacts statements (DENA, WRST, and YUCH) to address the cumulative effects of mining (USDI NPS 1990a, b, and c). Finally, park buildings, campgrounds, and other facilities have disturbed vegetation in most park units in the vicinity of existing infestations.

The interaction between invasive plant species and climate change may also change management effectiveness. Mechanical removal may become ineffective for plants as growth rates change or overwintering success increases (Hellman *et al*. 2008). Warmer and drier summers have resulted in the record wild land fire season in Alaska during summer 2004 (6.6million acres) (ACIA 2005, pg 838) and the 3rd largest fire season in summer 2005 (4.6 million acres). A record size tundra fire occurred on the North Slope of Alaska on the north side of GAAR in summer 2007 (0.25 million acres). Furthermore, warmer winters and drier conditions are known to result in increased spruce bark beetle and bud worm infestations in Alaska, which can lead to dead and dying or burning boreal forests (ACIA 2005). These large fires create disturbances that nonnative plants have invaded (Villano and Mulder 2008). Lastly, arctic and alpine tundra areas are being replaced by shrubs throughout the state, which some researchers attribute to climate change effects (ACIA 2005).

The impacts of physical control methods under Alternative 1 to terrestrial vegetation would be minor relative to the scale of other impacts of human actions and climate change effects.

The impacts of uncontrolled invasive plant infestations due to ineffectiveness, on the other hand, would be multiplicative according to the amount of cleared vegetation in the vicinity of the infestations. For example, if an infestation is bounded on one side by pavement and on all others by a wetland, the cumulative impacts of ineffective control would be no greater than the direct impact of the control method. If an infestation is surrounded by an area that has been cleared of native vegetation, ineffective control will result in greater impacts due to the ability of the infestation to expand. In general, cleared vegetation in Alaska parks would provide the opportunity for invasive plants to rapidly spread, such as along roads or trails or in cleared areas, while intact plant communities would limit their expansion.

4.8.1.3 Conclusion:

The overall success of invasive plant management under Alternative 1 would vary from park to park. Where physical control methods are successful in managing invasive plant infestations, the impacts on native vegetation resources would be minor and beneficial. Where physical control methods are not successful in managing invasive plant infestations, the impacts on native vegetation resources could be adverse and moderate in the next 10 years. This alternative would not result in impairment to vegetation resources in the short-term but could do so over the long-term.

4.8.2 Impacts from Alternative 2 – NPS Proposed IPMP

4.8.2.1 Direct and Indirect Impacts of Alternative 2 to Terrestrial Vegetation

Impacts of manual and mechanical control methods to terrestrial vegetation are discussed in 4.8.1.1. These impacts would be the same under Alternative 2 with the exception of areas where herbicides are used.

Herbicides are effective in reducing and eliminating invasive plant infestations when used as a component of a long-term IPM. Examples of successful use of herbicides are described. The Greater Yellowstone EPMT has shown remarkable success in controlling a number of species throughout their region. Examination of data from Grant-Kohr's NHS shows 97%, 95%, and 59% decreases in the extent of treated areas over the past 2-3 years (Fig. 4.1). Concurrent reduction in effort (treatment hours) have also been observed. Although all of these infestations exceed the scale of the infestations currently found in Alaskan NPS units, it shows the success that EPMT teams are having with herbicide applications.

The USFWS in Alaska has made a long-term commitment to treating orange hawkweed on Camp Island in Kodiak NWR. In 2008, their herbicide use was less than 20% of what was used initially in 2003 (Fig. 4.2). The reasons why this infestation has taken multiple years to treat are (1) they are dealing with long-established, fairly large infestations that have presumably loaded the soil with an abundance of viable seed; (2) the herbicide does not kill the seed and plants continue to germinate through the years; (3) quite a few plants in the first few years were missed once the native vegetation recovered and obscured these plants from view (e.g., they were germinating and invisible until the standing (windrowed) dead native vegetation was moved/removed in spring; and (4) initially USFWS did not make an effort to search for and remove flowers of plants that were missed by spring herbicide treatment (they could have been seedlings then or they could have been hidden by dead, windrowed vegetation). Currently, USFWS makes a large investment in the spring to search the area around any found hawkweed plant to delineate the area of the entire patch, and they make at least two trips during the summer to search for and remove flowers and mark these sites for future treatment.

Where herbicides are used, non-target plants subject to drift or interspersed with the target invasive plant could experience no effect, reduced vigor, or death depending on the sensitivity of the plant species to the specific herbicide and the dose to which the plant was subjected. Infrequent impacts to individual plants generally have negligible to minor impacts on plant populations, plant communities, or ecological processes. The impacts of pesticide use on vegetation resources would therefore be directly adverse, site-specific, short-term, and negligible to minor.

Personnel conducting invasive plant management would cause short-term, direct impacts to vegetation from foot and ORV traffic en route to invasive plant populations and during control efforts, as in Alternative 1. The number of personnel, their duration at treatment sites, and the extent of surface pressure, however, would be significantly less for herbicide application relative to manual and mechanical treatments. Infrequent impacts to individual plants generally do not affect plant populations, plant communities, or ecological processes. The impacts of intrusion into parks on vegetation resources would therefore be directly adverse, site-specific, short-term, and negligible to minor.

Impacts to native broadleaf plants vary by herbicide and species. The preferential use of herbicides that have the least impact on the native plant species within and adjacent to an invasive plant infestation would minimize damage to and promote the re-establishment of healthy native vegetation capable of resisting invasion. Active ingredients considered for use under Alternative 2 vary in their selectivity (the degree to which they affect certain plant families and have little to no impact on others). For example, glyphosate is non-selective and for the purposes of this document would be spot sprayed in high density areas. Most grasses are resistant to aminopyralid, chlorsulfuron, clopyralid, triclopyr, and 2,4-D, therefore these pesticides would be considered for use in areas that have a mix of native grasses and the target invasive species. The same rationale would hold true for conifers resistance to imazapyr and metsulfuron.

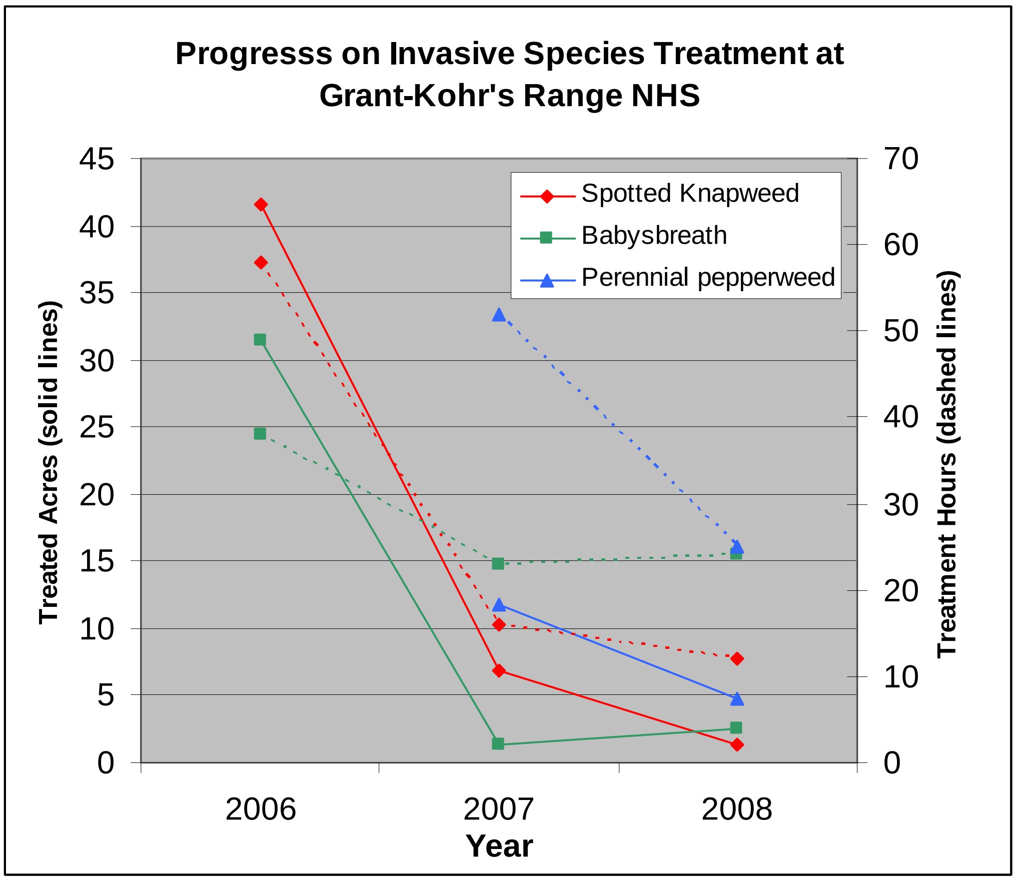

Figure 4.1. Plot showing reduction in treated acres and treatment hours for three invasive plant species in Grant-Kohr's NHS by the Greater Yellowstone EPMT.

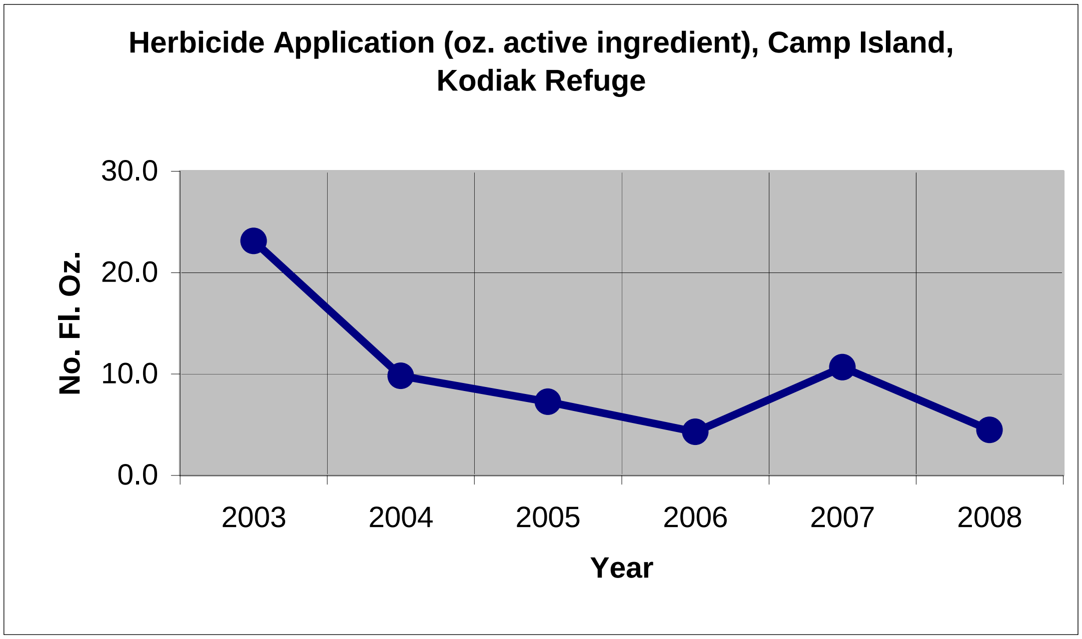

Figure 4.2. Amount of Transline® applied to treat orange hawkweed on Camp Island, AK by USFWS

For the sites in GLBA where herbicides would initially be used, the target invasive plant species – perennial sowthistle, oxeye daisy, and reed canarygrass – have achieved sufficient density to crowd out native plant species. Herbicide use could harm the native vegetation in the midst of the infestations, but implementation of the best management practices for herbicide use listed in the Alternative 2 description would minimize such impacts.

The long-term results of herbicide use are reduced treatment time at infestation sites, less site disturbance, and a more rapid recovery of the native plant communities. Once treatments are complete, the native plant communities surrounding the infestations are nearby and prepared to re-colonize the site with dispersal distances for native plants generally less than 50 feet.

4.8.2.2 Cumulative Effects:

See Cumulative Effects of Alternative 1 for a description of human impacts and climate change to terrestrial vegetation other than invasive plant control in Alaska parks. Furthermore, climate change could inhibit chemical controls if plants become more tolerant to herbicides with increased CO_2 (Hellman *et al*. 2008). The impacts of herbicide use under Alternative 2 to terrestrial vegetation would be negligible due to the small size of applications being considered relative to the scope and surface area of the land managed, and the scale of other impacts resulting from human actions and climate change.

4.8.2.3 Conclusion:

Alternative 2 would result in effective control of invasive plant infestations and benefit native plant vegetation and ecosystem integrity. The minor short-term adverse impacts would be outweighed by the long-term benefits to native vegetation. This alternative would not result in impairment to vegetation resources.

4.9 Effects to Wetlands and Floodplains

4.9.1 Impacts from Alternative 1 – No Action

4.9.1.1 Direct and Indirect Impacts of Alternative 1:

The analysis below shows impacts to floodplains and wetlands in Alaska NPS units would be minor because periodic manual removal of invasive plant species would keep these infestations in check and because most invasive plant infestations in Alaska NPS units primarily inhabit upland habitats.

Under the no-action alternative the NPS would continue to monitor and physically remove invasive plant infestations. Yellow toadflax has been reduced along Exit Glacier Road where some small wetlands areas occur nearby. NPS crews have successfully removed white sweetclover from roadsides and river bars near Slana in WRST and in the front country area of DENA, which prevents its escape onto this portion of the Nenana River.

Physical removal has not been effective for all detected infestations in floodplain and wetland areas, including perennial sowthistle on estuarine shores (E2EM1/USN) of Strawberry Island in Glacier Bay proper and oxeye daisy near the Dry Bay fish plant and airstrip located mostly on uplands but near a riverine slough (R1US/UB) of Alsek River. NPS crews attempted to remove perennial sowthistle on Strawberry Island, but only a small portion of the 2.5 acre infestation could be dug up, and this effort failed to remove all roots and seeds in the treated area. Eventually perennial sowthistle could overwhelm the adjacent small palustrine wetland and take over the estuarine beach areas on the south side of this island. The NPS has annually removed the nearly acre-size infestation of oxeye daisy at the Dry Bay fish plant since 2005. Japanese knotweed has been pulled from 2 locations not immediately adjacent to water for more than 5 years in SITK, where it continues to return. Many reed canarygrass infestations in GLBA persist following manual removal.

The no-action alternative could result in the persistent infestation of perennial sowthistle in up to 2 acres of coastal estuarine and palustrine wetlands in GLBA, which in the grand scheme of things would result in a minor localized impact to wetland resources. Floodplain functions are not likely to be adversely affected in Alaska NPS units so long as EPMTs diligently locate and remove new infestations. If some of the invasive plants described above exceed thresholds for regular manual control methods, then the current no-action alternative would be ineffective in protecting floodplains and wetlands over a wider distribution.

4.9.1.2 Cumulative Impacts Analysis:

NPS estimates of past wetland impacts from mining in DENA, WRST and YUCH total over 3,000 acres (USDI NPS 1990a, b, and c). For DENA alone estimates totaled about 1,300 acres (USDI NPS 1990a). This is because placer mining for gold occurred in stream riparian habitat and adjacent wetland areas. The major impacts in YUCH occurred along Coal Creek and Woodchopper creek where dredging and mining impacted about 900 acres (NPS 1990c). In WRST, though more areas were mined, the estimates are lower because not all mining was placer mining in riparian wetlands areas. Much mining in WRST was hard rock in upland areas.

Over 275 miles of roads exist in Alaska NPS units (Heys pers.comm.), and an estimated 20% of this distance traverses wetlands. Roads and highways vary greatly in width, but with an estimated average width of 25 feet, the estimated past impacts to wetlands would have been about 160 acres.

A similar approach at estimating wetlands impacts from 560 miles of ORV trails (Meyer pers. comm.) averaging 8 feet in width results in past impacts of about 100 acres. A proposed action to close unneeded and repair widened segments of ORV trails in the Dry Bay area of GLBA could result in the recovery of about 16 acres of wetlands (USDI NPS 2007a). The net effect would be about 84 acres of past and projected cumulative impacts to wetlands from ORV trails.

Numerous airstrips and helicopter landing pads exist in Alaska NPS units (Barnes pers. comm.), and some of these occur on gravel floodplains or formerly riparian wetlands. Most airstrips have been located on well-drained dry land because landing wheel planes on soft wet ground is unsafe. Therefore no estimate of additional impacts to wetlands is provided for airstrips. The effects of airstrips on floodplains are negligible because flood events would simply run over or around the gravel airstrips.

The total past and projected impacts to wetlands from various developments of employee offices, residences, parking, gravel extraction, visitor service structures, and concession lodges totals a few acres (see USDI NPS 1996a, USDI NPS 2003). Most of these developments avoid wetlands, but an estimated 15 acres of wetlands have been disturbed statewide. New construction sites must address NPS policies to restore at least one acre of wetland for every acre of wetlands impacted. Some temporary impacts to floodplains occur where gravel extraction occurs in the Toklat River of DENA; however, natural replenishment rapidly replaces removed gravel.

The grand total of past and projected future impacts to wetlands in Alaska NPS units, including riparian and floodplain areas, is estimated at about 3,300 acres.

In addition to direct human impacts on wetlands, climate change is thought to be reducing some wetland areas and their function. As noted above in section 4.3.1.2, about 25% of pond areas have disappeared across the state since the 1950s, particularly in the Copper River Basin, North Slope, Interior, and Kenai Peninsula areas (Riordan *et al*. 2006). The loss of permafrost from melt is also causing some wetland areas to drain and dry out, diminishing their function as wetland areas. Wet areas on the Kenai Peninsula have decreased by about 88% over the last five decades (Klein *et al*. 2004).

The projected future persistent impacts to wetlands and floodplains from the no-action/status quo alternative to control invasive plants would add less than 2 more acres to this total.

The cumulative effects to wetlands from past, present, and future human activities would moderate overall. The incremental increase from the no-action alternative to manage invasive plants would result in a minor additional impact on wetlands and floodplain function in Alaska NPS units.

4.9.1.3 Conclusion

The impacts to wetlands and floodplains from the no-action/status quo alternative to control invasive plants would be minor. No impairment to regional park wetlands and floodplains would result from this alternative.

<u>4.9.2 Impacts from Alternative 2 – NPS Proposed IPMP</u>

4.9.2.1 Direct and Indirect Impacts of Alternative 2

The analysis below shows impacts to floodplains and wetlands in Alaska NPS units would be minor because periodic manual removal of invasive plant species and limited application of herbicides after careful review via a decision tree would keep these infestations in check where they occur in wetlands and floodplains. See section 3.8 for brief descriptions of the effects invasive plant species in Alaska NPS units could have on floodplains or wetlands.

NPS crews have successfully and would continue to manually remove white sweetclover from roadsides and river bars near Slana in WRST and in the front country area of DENA, which prevents its escape onto this portion of the Nenana River. New infestations of this species would likewise be controlled manually near wetlands and floodplains. Yellow toadflax has been reduced along Exit Glacier Road where some small wetlands areas occur nearby, but this infestation would continue to be treated manually unless it rapidly increases beyond effective physical control methods.

Reed canary grass was successfully removed from small roadside ditches near Bartlett Cove in GLBA, but other infestations have grown to over 2 acres so that application of a glyphosate product (Roundup Pro or Aquamaster) is advised, depending on proximity to water and wetlands. Japanese knotweed has been pulled from 2 locations not immediately adjacent to water for the last 5 years in SITK, where it continues to return. The application of imazapyr (Habitat) is advised to stop Japanese knotweed before it clogs wetlands and the banks of Indian River.

Alternative 2 would include a decision tree for the possible use of herbicides where warranted would result in the removal and effective control of invasive plant infestations. Manual removal has been effective for all detected infestations in floodplain and wetland areas except for perennial sowthistle on or near estuarine shores (E2EM1/USN) of Strawberry Island in Glacier Bay and oxeye daisy near the Dry Bay fish plant and airstrip located mostly on uplands but near a riverine slough (R1US/UB) of Alsek River. The proposed use of aminopyralid (Milestone VM) herbicide to remove these infestations would reduce human impacts that would otherwise occur from trampling and digging in these areas. Due to its low toxic nature, other than to broad-leaved plants, aminopyralid does not pose unacceptable risks to aquatic organisms, including aquatic plants (USDA FS and USDI NPS 2007). The adjacent small palustrine and estuarine beach wetlands on Strawberry Island would be returned to natural and healthy plant populations. Oxeye daisy would be removed from the airstrip entry way location at Dry Bay, thereby reducing the potential for plant seed transport and the migration of this species into adjacent area riverine shores.

The NPS proposed action alternative would result in the removal of the persistent infestation of perennial sowthistle in about 4 acres of coastal estuarine and palustrine wetlands in GLBA, which in the grand scheme of things would result in a minor localized beneficial impact to wetland resources. Floodplain functions are not likely to be adversely affected in Alaska NPS units so long as EPMTs diligently locate and manually remove new infestations. If some of the other invasive plant infestations described in section 4.9.1 exceed thresholds for regular manual control methods, then the proposed action alternative would allow judicious herbicide applications for rapid effective control to remove or reduce invasive plant infestations that could harm floodplains and wetlands over a wider distribution. We estimate up to 10 acres of wetlands would be treated to control such infestations over the next 10 years.

4.9.2.2 Cumulative Impacts Analysis:

The cumulative effects to floodplains and wetlands across all NPS units in Alaska from other activities such as mining, construction, roads, ORV trails, airstrips, and other human activities would be similar as described for alternative 1 in section 4.9.1.2. The grand total of past and projected future impacts to wetlands in Alaska NPS units, including riparian and floodplain areas, is about 3,300 acres. The projected future persistent impacts to wetlands and floodplains from alternative 2 to control invasive plants would return about 2 acres to natural vegetation and function in wetlands and floodplains in Alaska NPS units. The cumulative effects to wetlands from past, present, and future human activities would be moderate overall. The incremental increase from the proposed action alternative to manage invasive plants would result in a minor beneficial impact on wetlands and floodplain function in Alaska NPS units.

4.9.2.3 Conclusion:

The impacts to wetlands and floodplains from the NPS proposed action alternative to control invasive plants in about 4 acres of wetlands in GLBA and SITK in the short term and up to 10 acres of various wetlands and floodplains over the next 10 years would be minor and beneficial. No impairment to regional park wetlands and floodplains would result from this alternative.

4.10 Effects on Wilderness and Scenic Quality

4.10.1 Impacts from Alternative 1 – No Action

4.10.1.1 Direct and Indirect Impacts to Wilderness and Scenery from Alternative 1:

The effects of Alternative 1 on wilderness resources, (including undeveloped, untrammeled, naturalness, and opportunity for solitude or unconfined recreation) from the presence and spread of invasive plant species would be minor provided the manual or mechanical control efforts were mostly successful in controlling invasive plant species and preventing their spread into wilderness. However, it is not clear how successful these efforts would be with all species, and if an invasive species were to escape this control, then the effect on the naturalness quality of wilderness may be greater than a minor level. The effects from the monitoring and control efforts themselves, including the use of helicopters and the use of mechanical means of control such as brush whips, mowers and chainsaws, in wilderness would have a minor effect on the opportunity for solitude or unconfined recreation and on the untrammeled quality of the wilderness.

The presence of nonnative species in wilderness areas as a result of human activities constitutes a change in the natural ecosystem and poses a potential threat to the naturalness of wilderness by changing the way in which native plants and animals develop and respond to their environment. It is also a direct sign of human influence in the wilderness. Control activities outside of the wilderness are critical to addressing this threat, but may not always be successful. Where necessary, control activities in wilderness may need to occur to stop the spread of an invasive plant species in order to restore and protect the naturalness of the wilderness resource. By effectively treating the infestations, the naturalness of wilderness would be protected. This does, however, result in an effect on the untrammeled quality of wilderness. Even though the original introduction of invasive plants to the wilderness is the result of human influences, it can be argued that this is part of the natural process and that wilderness should be left "untrammeled" to evolve under these new influences. The choice is whether to protect the naturalness of wilderness at the expense of the untrammeled or not. For small area control measures such as proposed in this action this is rarely a topic of concern and eradication of the nonnative species is preferred to protect the overall wilderness resource and a wide variety of other values.

The value of wilderness includes the opportunity for solitude or unconfined recreation, and a wilderness experience is also partly dependent on the wilderness setting representing a natural and native ecosystem. Where nonnative species are present and/or are changing the plant and animal communities, this could negatively affect visitor interactions with wilderness because they are expecting an ecosystem that is largely uninfluenced by modern human activities. The use of helicopters for access to monitor visitor portals, including airstrips, cabins, camps and other locations for the presence of invasive plants or for control activities in the wilderness would have a temporary and site specific effect on the opportunity for solitude. The use of mechanical tools such as brush cutters, mowers and chainsaws would also have a temporary and localized effect on the opportunity for solitude. Where control efforts leave visible signs of human activity and where treatment is required at recurring intervals or over multiple years, these areas would not appear natural until the native vegetation restores itself to those areas. This would result in a short term impact but in a localized area of up to several acres.

The treatments that have occurred or are occurring at the present time in designated wilderness are in DENA in areas just beyond the Park Road corridor (common dandelions); in GAAR at Walker Lake (common dandelion); in GLBA at Strawberry Island (perennial sowthistle) and multiple other locations (common dandelion, oxeye daisy, mouse-ear chickweed); in LACL near cabins in the Twin Lakes area (common dandelion). Other identified infestations in designated wilderness include in GLBA beyond Bartlett Cove (annual bluegrass and common plantain), on Lone Island (shepherd's purse), and in Excursion Inlet (reed canarygrass); in KATM near Hallo Bay Lodge (pineapple weed); and in WRST in Hidden Creek Valley (common dandelion)

There is the potential for invasive plant species to affect eligible or designated wilderness in the parks in the future. Current infestations along the park road and the Parks Highway in Denali National Park are located within a short distance (about 100 feet) of designated wilderness. The road to McCarthy and the road to Nabesna in Wrangell-St. Elias National Park and Preserve also have invasive species present on the road sides. Those species that spread by natural vectors such as wind, water and wildlife, are of particular concern in this situation. For example, common dandelions are easily spread by wind; white sweetclover can be spread by water; and European mountain-ash can be spread by birds.

The other most likely places in eligible or designated wilderness for invasive plants to appear are at access portals, OHV use areas, cabins or along lake and ocean beaches. Seeds may be transported on aircraft wheels and be deposited on airstrips, gravel bars or tundra landing areas. Where OHVs are used, tires or parts of the frames could be transport mechanisms for plant parts or seeds. When aircraft or water taxis are pulled up onto beaches there is also an opportunity for seeds or plant parts to be deposited. Education of park and commercial services personnel and park visitors would help to make them observers for the monitoring efforts in parks. Checking aircraft wheels and floats, boat lines and anchors, and boot treads so that foreign plant material is not carried into the wilderness and active observation and monitoring so that invasive plants can be detected at the earliest possible time when control efforts are most effective would reduce the threat of invasive plants in the wilderness. If infestations were to become established in remote locations in wilderness, control options outlined in Alternative 1 would not likely be sufficient to prevent moderate impacts to the natural and scenic values of wilderness over the long term (decades).

4.10.1.2 Cumulative Effects:

The cumulative effects from the use of helicopters for access to eligible and designated wilderness for research (conducted by NPS or conducted by permittees), the NPS Inventory and Monitoring program, mineral evaluations (under ANILCA 1010), fire monitoring, and other park management activities has a moderate effect on wilderness resources throughout the national park units in Alaska. The use of helicopters affects the opportunity for solitude and the untrammeled character of the wilderness. There were 1,267 rotor wing flight hours flown in FY05 by the Alaska region of the NPS (Barnes pers. comm.); these hours do not include those hours flown by permittees. These hours are flown primarily during the field season months of June through September. This number is expected to stay about the same or increase slightly during the foreseeable future. The cost of fuel and rental costs for helicopters will likely continue to increase and may affect the ability of park units to be able to afford as many flight hours as they would like to have. The addition of the flight hours flown by helicopters in wilderness from implementing this alternative would have a minor effect. The total effect of this alternative and other ongoing and future effects from helicopter access would be a moderate effect on wilderness resources.

The use of mechanical tools, including chainsaws, brush cutters and mowers in wilderness is rare at the present time. There is some use of these tools in parks for trail maintenance or clearing, or for maintenance on airstrips or at public use cabins. Chainsaws may be permitted for use by subsistence users or by commercial services providers, but these uses are uncommon and are not expected to increase in the foreseeable future. Although there may be some localized minor effects, the overall regional effect of these uses on the opportunity for solitude and for untrammeled wilderness character at the present time is negligible. The additional effect from implementing this alternative is also negligible. The total cumulative effect is negligible at the regional scale.

The current acreage affected by restoration activities in wilderness is very small. There are a few limited campsites in Gates of the Arctic, Denali and Glacier Bay that are being monitored and/or treated for overuse from recreational activity. Under this alternative a small number of acres in wilderness would be treated for invasive plants, and then restored through natural revegetation and monitoring. The effect of restoration activities is negligible and will remain so if this alternative is implemented.

The cumulative effect of management use of helicopters, mechanical tools, and treatment areas to wilderness resources is moderate. The incremental increase from this alternative to manage invasive plants would result in a minor additional impact on wilderness and scenic resources and would not change the overall moderate cumulative effect.

4.10.1.3 Conclusion:

The impacts to wilderness from Alternative 1 would be minor and would overall be beneficial to wilderness and scenic resources. No impairment to wilderness or scenery would result from the implementation of alternative 1.

<u>4.10.2 Impacts from Alternative 2 – NPS Proposed IPMP</u>

4.10.2.1 Direct and Indirect Impacts to Wilderness and Scenery from Alternative 2:

Alternative 2 with a decision tree would help managers decide the most effective means of controlling an invasive plant in specific situations and would add herbicides as a possible means of treatment. The analysis below shows impacts to wilderness resources (including undeveloped, untrammeled, naturalness, and opportunity for solitude or unconfined recreation) in Alaska NPS units would be minor because the combination of manual, mechanical and herbicide treatment options would be likely to maintain the naturalness of wilderness. If an invasive species were to escape this control, then the effect on the naturalness quality of wilderness may be greater than a minor level, but that likelihood is reduced in this alternative as the decision tree would be a more effective management tool. The effects from the monitoring and control efforts themselves, including the access by helicopter and the use of mechanical means of control such as brush whips, mowers and chainsaws, in wilderness would have a minor effect on the opportunity for solitude or unconfined recreation and on the untrammeled quality of the wilderness because the control efforts would be localized and of short duration.

The effects of nonnative species on the naturalness of wilderness and the scenic quality of park areas to visitors would be the same as in Alternative 1. The addition of herbicides to the toolkit for park managers does not change the discussion about untrammeled and natural wilderness and scenic quality of park areas from the analysis in Alternative 1. However, having herbicides as an option for treatment of invasive plants would likely make the initial treatments more effective and may limit the need for multiple follow-up treatments with mechanical tools. This could make the effects of the control efforts themselves less intrusive on the opportunity for solitude in this alternative.

The use of helicopters for access to monitor for the presence of invasive plants or for control activities and the use of mechanical tools such as brush cutters, mowers and chainsaws in the wilderness would have the same effect on the opportunity for solitude as in Alternative 1. Where control efforts leave visible signs of human activity and where treatment is required at recurring intervals or over multiple years, the short term impact in a localized area of up to several acres would also be the same.

The summary provided in Alternative 1 about where treatments have occurred in designated wilderness and how invasive plants have been or would be introduced to eligible or designated wilderness is also applicable in Alterative 2. If infestations were to become established in remote locations in wilderness, having the decision tree and the additional option of limited herbicide use in this alternative would have a greater likelihood of preventing the spread of the invasive plants to larger areas and more sites in wilderness. This alternative would therefore help limit the potential larger impacts to the natural and scenic values of wilderness and other park areas.

4.10.2.2 Cumulative Effects:

The cumulative effects from the use of helicopters for access to eligible and designated wilderness for research (conducted by NPS or conducted by permittees), the NPS Inventory and Monitoring program, mineral evaluations (under ANILCA 1010), fire monitoring, and other park management activities has a moderate effect on wilderness resources throughout the national park units in Alaska. The use of helicopters affects the opportunity for solitude and the untrammeled character of the wilderness. There were 1267 rotor-wing flight hours flown in FY05 by the Alaska region of the NPS (Barnes pers. comm.); these hours do not include those hours flown by permittees. These hours are flown primarily during the field season months of June through September. This number is expected to stay about the same or increase slightly during the foreseeable future. The cost of fuel and rental costs for helicopters will likely continue to increase and may affect the ability of park units to be able to afford as many flight hours as they would like to have. The addition of the flight hours flown by helicopters in wilderness from implementing this alternative would have a minor effect. The total effect of this alternative and other ongoing and future effects from helicopter access would be a moderate effect on wilderness resources.

The use of mechanical tools, including chainsaws, brush cutters and mowers in wilderness is rare at the present time. There is some use of these tools in parks for trail maintenance or clearing, or for maintenance on airstrips or at public use cabins. Chainsaws may be permitted for use by subsistence users or by commercial services providers, but these uses are uncommon and are not expected to increase in the foreseeable future. Although there may be some localized minor effects, the overall regional effect of these uses on the opportunity for solitude and for untrammeled wilderness character at the present time is negligible. The additional effect from implementing this alternative is also negligible. The total cumulative effect is negligible at the regional scale.

The current acreage affected by restoration activities in wilderness is very small. There are a few limited campsites in Gates of the Arctic, Denali and Glacier Bay that are being monitored and/or treated for overuse from recreational activity. Under this alternative a small number of acres in wilderness would be treated for invasive plants, and then restored through natural revegetation and monitoring. The effect of restoration activities is negligible and will remain so if this alternative is implemented.

The cumulative effect of management use of helicopters, mechanical tools, and treatment areas to wilderness resources is moderate. The incremental increase from this alternative to manage invasive plants would result in a minor additional impact on wilderness resources and would not change the overall moderate cumulative effect.

4.10.2.3 Conclusion:

The impacts to wilderness from Alternative 2 would be minor and would overall be beneficial to the wilderness and scenic resources. No impairment to wilderness and park scenery would result from the implementation of this alternative.

4.11 Effects to Wildlife and Habitat

Without concerted efforts to control their colonization, establishment and spread, available scientific studies haves shown that invasive plants would outcompete native species in many areas, alter biotic communities and radically change the habitats and survival capabilities of wildlife species, particularly rare species. Some invasive plants may provide wildlife benefits but many are known to directly harm wildlife and to cause indirect effects to wildlife by lowering their competitive advantages and altering and degrading their habitat. The following summary is excerpted from the Forest Service Pacific Northwest Region EIS on Invasive Plant Management (USDA FS 2005b), which we incorporate by reference here according to CEQ regulations at 40 CFR 1502.21.

Invasive plants are known or suspected of causing the following effects to wildlife:

- Embedded seeds in animal body parts (e.g. foxtails), or entrapment (e.g. common burdock) leading to injury or death.
- Scratches leading to infection.
- Alteration of habitat structure leading to premature predation (which alters population, demography, and social breeding system).
- Change to effective population through nutritional deficiencies or direct physical mortality.
- Ingestion of plants or plant parts leading to poisoning.
- Altered food web, perhaps due to altered nutrient cycling.

- Source-sink population demography, with more demographic sinks than sources.
- Lack of proper forage quantity or nutritional value at critical life periods.
- Cascading effect of direct or indirect mortality on other species.

The invasive plant species currently found in recent surveys in and near Alaska Parks are listed in Table 3.1 and Appendix E. The characteristics of the higher risk species that make them a threat to Alaska wildlife and habitats are summarized in Appendix F. A review of available studies indicates that there are none that detail the direct impacts of the 23 invasive plants in Alaska Parks at the wildlife population level. Some studies do show several of the plants to be toxic if ingested, particularly in livestock. There are no studies on the 23 Alaska invasive plant species that directly link habitat changes with quantified reductions in animal populations. Therefore, the analyses and conclusions below are based on the best available data on the plant characteristics that have shown to be generally related to wildlife habitat declines for other invasive plants.

Based on the invasive plant characteristics provided in Appendix F, the predominant adverse effect of the 23 invasive plants on wildlife and habitats in Alaska Parks is expected to be encroachment on and replacement of native habitats with monotypic invasive plant stands that do not have the structural characteristics needed for wildlife survival. For nesting birds and small mammals this would mean loss of quality nesting and escape cover. For herbivores and omnivores, most of the invasive plants would not provide palatable, nutritious foods that would otherwise be available in native habitats. Dandelions and red clover would provide food for some animal species but would degrade habitat for other species. For predators, their prey base would be directly reduced by these habitat changes. At the wildlife population level, the number and distribution of quality breeding territories and foraging home ranges would diminish as more and more native habitat is outcompeted by invasives for space.

Impacts would occur if some animals are directly affected by plant poisons, from invasive plants such as foxglove, yellow toadflax, and white sweetclover, or by viral diseases, such as are carried by smooth brome and white sweetclover. These effects are likely to be limited to a small number of individual animals at infested sites. The invasive plant management measures proposed under Alternatives 1 and 2 and evaluated in the following sections would reduce or eliminate these types of wildlife and habitat impacts at Alaska Parks.

<u>4.11.1 Impacts from Alternative 1 – No Action</u>

4.11.1.1 Direct and Indirect Impacts on Wildlife and Habitat

The direct effects on wildlife and habitat of the invasive plant management activities proposed under Alternative 1 would be impacts that occur during, or as an immediate consequence of, invasive plant removal activities at current or future infestation locations in any of the Alaska Parks. Indirect effects would be the impacts that occur downstream, down-gradient, or on the treated site after a period of time.

Alternative 1 includes removal of invasive plant infestations by pulling, cutting, and mechanical removal. Also included are thermal weed control methods— soil solarization and spot and prescribed burning—to be used on certain infestations that are not feasible to control with manual or mechanical treatments.

The most beneficial direct effects of Alternative 1 would be removal of the infestations in:
1. areas not currently supporting native plants and wildlife habitat, therefore of little or no value to sustaining wildlife on the Parks
2. areas serving as source sites for seeds or other propagules that would cause further habitat degradation through continued invasive plant spread

A direct adverse impact would be temporary loss of protective plant cover and the potential for soil erosion and longer term site deterioration. These impacts are discussed in the soils section. Such sites would need to be replanted or otherwise revegetated with native plants to ensure the soils would not be subject to rain and wind erosion, resurgence of the original invasive plant, or colonization by other invasive plants. Reseeding with stored native plant stock should mitigate this potential.

The importance to wildlife of rapidly restoring an infested site to natural habitat depends on the extent to which the site recently supported native vegetation. In general, invasive plants in Alaska NPS units occur on disturbed sites, along roadsides, and in other developed or previously developed areas that do not provide natural habitat conditions. These disturbance factors are likely to continue to prevail in the future. Some previously disturbed sites have since recovered from that disturbance and now provide natural habitats for wildlife. Sites where invasive plant treatment is coupled with elimination or reduction in human disturbance could be restored to natural habitat conditions. Regardless of the level of continuing disturbance, removing invasive plants would at a minimum prevent seed dispersal or other dispersion mechanisms from allowing the invasives to expand the size of the localized infestation to encroach on native habitats or to colonize and proliferate on other sites.

There may be instances where an invasive plant is providing a wildlife value, for example dandelions that grow along roadsides provide a favored food source for black bears at GLBA. These same bears drawn to the abundant dandelions may result in bear-human conflicts. In these instances, park managers need to consider the full range of new plant, animal, and human interactions.

Exceptions to the general characterization of invasive plants occurring in disturbed areas are species such as white sweetclover that invade river floodplains where the disturbance or lack of native plant cover that allows rapid colonization are the result of natural processes. White sweetclover is known to be proliferating along the Matanuska, Stikine, and Nenana rivers (Conn *et al*. 2008). Removal of the infestation and management of the site would allow planting, eventual colonization by native plants, or a return to a more natural unvegetated condition.

The four species for which manual and mechanical control methods are unlikely to be effective in the near future are perennial sowthistle, oxeye daisy, reed canarygrass, and Japanese knotweed. Perennial sowthistle varies in terms of providing forage for some wild grazers but is not of high value when compared to native forage. These are areas known to have substantial bear and moose activity, but no grazing has been observed in sowthistle infested areas.

Oxeye daisy's greatest impact is on forage production in infested meadows. Wildlife species avoid grazing and walking in infested areas because the plant irritates their nose, mouth, and legs. Most animals avoid eating oxeye daisy because they prefer to eat more desirable and palatable species first. This reduces competition for oxeye daisy allowing it to crowd out other plants and decrease the land's carrying capacity (UNCE 2006).

Although it has been grown for forage, reed canarygrass has a number of chemical compounds that are known hallucinogens that have resulted in livestock poisoning. Reed canarygrass has been shown to grow in such dense stands that it displaces small mammals and waterfowl. Removal of this species is liable to improve wildlife habitat.

Japanese knotweed is edible, but no browsing is evident on the small infestations growing in SITK. The species forms monocultures that reduce biodiversity. The species reduces the food supply for juvenile salmon in spring.

Animals with large home ranges, such as moose and bear, would not depend on small infested sites for food and even less for cover, so they would not likely be adversely affected by the presence of an invasive plant infestation for forage and survival. Invasive plants would not likely constitute a portion of their diets, so to the extent native plants may have been displaced by the invasives, they would adjust their feeding locations accordingly. An exception noted above is that dandelions are preferred by black bears. Otherwise, herbivores and omnivores tend to feed on palatable native species and may avoid feeding at all on some invasives, such as yellow toadflax. This behavior encourages the survival and expansion of the invasive plant infestation. In general, larger animals in Alaska NPS units would not be affected in terms of loss of food or cover by removal of invasive plants, because most infestations are still at a small scale. An exception would be that black bears in GLBA would likely be affected by removal of dandelions. In the short term, individual animals in the vicinity of a treated site might be disturbed and leave the area while crews are conducting the treatments and for some time afterward.

Small mammals, songbirds, and other ground-nesting birds may be using an area for cover, nesting, or foraging where invasive plants constitute a more substantial portion of their home range. Some 204 bird species found at Alaska NPS units are known to nest on the ground and would therefore be more susceptible to the effects of invasive plant management activities (see Appendix D). Amphibians such as the western toad, one of only four amphibian species known to inhabit Alaska's NPS units, may also be found at these sites, particularly in the vicinity of surface water. In the short term, removal of the plants might directly, adversely affect individual small mammals or birds by disturbing and displacing them, destroying their nests, or removing escape cover and making them more susceptible to predators. Nest predators and other mammalian and avian predators could benefit with increased predation success for a short period due to removal of some portion of the small mammal and bird cover. These effects would likely be short-term, negligible impacts because the sites would likely be marginal habitat. Also, removal of individual plants, as called for in the Alternative 1 methods of invasive plant removal, would cause a low level of disturbance, if any, to the native plant portions of their habitat.

Park wide populations of mammals, birds or amphibians would not likely be affected because the infestations are few and have been confined to sites of less than an acre to a few acres. In the long term, removal of the plants and revegetation of the sites with native plant species would constitute a minor, locally beneficial impact because the survival and reproductive success of animals using the treated sites in the future might be improved. The much greater, longer-term benefit would be in preventing encroachment of major portions of wildlife habitat by invasives that would ultimately significantly degrade wildlife sustainability within the Parks' ecosystems.

An indirect effect of invasive plant removal would be sedimentation and turbidity in local watersheds down-gradient of the treated site. These impacts are discussed in the aquatic resources section. There would be negligible impacts to local fisheries because the sites and control operations are at a small scale. Therefore, there would be no indirect adverse impacts to any fish-eating mammals or birds.

Soil solarization over an infestation area would remove any marginal habitat value of the site for the short term, but would provide long term benefits to the extent that the site is revegetated with native plants. Spot burning would have the same impacts as manual removal in most instances, except that soil disturbance would be reduced or eliminated. Neither method is likely to result in killing of individual birds or mammals. Prescribed burning would present a slightly higher risk of direct mortality to individual animals if the burn is extensive.

4.11.1.2 Cumulative Impacts on Wildlife and Habitat

There are over 275 miles of roads in Alaska NPS units, with the majority located in WRST and DENA. Alaska NPS units also contain over 560 miles of OHV trails. These roads and trails have fragmented wildlife habitat, and have led to disturbance of wildlife and to occasional wildlife-human interactions. They also facilitate the spread of invasive plants. Numerous airstrips and helicopter landing pads exist in Alaska NPS units. As is the case with roads and trails, these human encroachments have reduced native habitats, are the locus of wildlife disturbance, and also facilitate the spread of invasive plants. There are 6 commercial lodges and commercial joint ventures on Alaska National Park lands, which provide lodging, meals, and visitor services, covering about 20 acres in 3 parks (DENA, KATM, and GLBA). There are approximately 1,550 acres of land in the Kantishna area of DENA that have been impacted by mining, of which 517 acres are currently being revegetated (USDI NPS 2001c). The NPS completed three environmental impacts statements to address the cumulative effects of mining in DENA, WRST, and YUCH (USDI NPS 1990a, b, and c). Finally, park buildings, campgrounds, and other facilities have disturbed vegetation in most park units and served as the focus of exotic plant infestations.

The cumulative effects of these past, present, and expected future human activities on the wildlife and habitat of Alaska's Parks are judged moderate in a setting with the millions of acres of undisturbed wildlife habitat and healthy wildlife populations. The incremental increase in impacts from the no-action alternative to manage invasive plants would result in a negligible additional impact on wildlife in terms of short-term disturbance from crews conducting invasive plant removal. Countering this would be the longer-term incremental decrease in adverse cumulative impacts due to the reduction in invasive plants in Alaska NPS units.

4.11.1.3 Conclusion:

The success of invasive plant management and beneficial effects to native plant communities under Alternative 1 would vary from park to park. The impacts of invasive plant management activities on wildlife habitat and populations would be minor overall. In parks where early detection and immediate control of invasive plants are feasible and achievable, the manual and thermal methods available under Alternative 1 would be sufficient to prevent their establishment and spread and to preserve native wildlife habitat. Where invasive plants become established to a greater extent, herbicides may be the only effective means of controlling an infestation and individual NEPA analyses would have to be conducted for each use. Continuing to manage invasive plants under Alternative 1 would help parks only partially achieve the desired condition of maintaining natural park ecosystems. This alternative would not result in impairment to wildlife and habitat in Alaska NPS units in the short-term; however, Alternative 1 methods alone would ultimately fail to contain current or future invasive plant infestations to effectively protect natural wildlife habitat and their populations.

<u>4.11.2 Impacts from Alternative 2 – NPS Proposed IPMP</u>

4.11.2.1 Direct and Indirect Impacts of Alternative 2 on Wildlife and Habitat:

The impacts of the manual and thermal methods would be the same as those described under Alternative 1. Those would be the methods of preference wherever feasible and so would be used in all of the same locations and situations where they are feasible under both Alternatives 1 and 2. Only where those methods are judged to be ineffective, would herbicides be used to manage invasive plants. So the difference in the impacts of the alternatives to wildlife and habitat is the difference between the impacts from allowing infestations that are not amenable to manual, mechanical or thermal treatments to persist (unless costly and time-consuming individual NEPA reviews are conducted for each herbicide application) as compared to the impacts from minimum-volume spot treating those infestations with herbicides.

The potential for adverse impacts from herbicides depends on the following factors:

- potential for direct toxic effects in exposed mammals and birds
- potential for toxic effects to terrestrial invertebrates that are part of the wildlife food chain
- potential for bioconcentration of the herbicides in certain organisms leading to toxic effects to wildlife at higher trophic levels feeding on those organisms
- potential for the proposed herbicide to damage nearby native plants comprising native wildlife habitat

Based on an evaluation of the information in U.S. Forest Service risk assessments, none of the herbicides proposed for use to control or eradicate invasive species would pose a serious risk to wildlife species or their habitat at any of the Alaska Parks. That evaluation indicated that effects on wildlife populations from herbicide use would be negligible to minor, short-term and localized for several reasons.

First, it is highly unlikely that any individual animals would be exposed to enough herbicide to cause any ill effects. Because of the small size of the treatment sites, it is virtually certain that no major population of any vertebrate species would be directly exposed. It is unlikely that any individual animal located in a treatment site would be directly exposed to an herbicide while it is being applied because of the proposed methods of herbicide application. These are restricted to minimum volume techniques, including backpack or handheld spray mechanisms, injection, or wicks, brushes, or sponges for direct contact with target plants or cut stumps. Any animals at these sites would almost certainly move out of the site away from applicators while the herbicides are being applied simply because of the human disturbance.

Animals would more likely be exposed to smaller residual amounts of herbicides when they reenter or move through a sprayed site some time after the applicators have left. Herbivores might ingest herbicide if they consume sprayed plants, although the herbicides are likely to render the plants unpalatable. Other animals might receive an oral dose in grooming their feathers or fur after coming in contact with sprayed plants. A predator might consume an animal that has received such a dose and thereby receive a secondary dose.

All of these potential routes of exposure have been evaluated in the Forest Service risk assessments for the herbicides proposed for NPS use. None of the herbicides have been shown likely to lead to a lethal or injurious dose by any set of exposure pathways because the herbicides in question are of low toxicity to animals.

Effects in Birds/Mammals**:** All eight active ingredients used in herbicides were found to be of low toxicity in acute and chronic exposure studies of birds or mammals, even at relatively high doses. No bird or mammal in the wild is likely to get as high a dose as the doses that were found to be of low toxicity in the controlled exposure studies. For example, for the assessment of the potential for deleterious effects in birds from exposure to aminopyralid, the no-effect level was based on a gavage (forced oral doses) study of bobwhite quail. This resulted in transitory impacts on coordination in treated birds at a dose higher than the no-effect dose used to characterize risk by the USFS.

Effects on Terrestrial Invertebrates**:** Insects and other terrestrial invertebrates are important in wildlife food chains for species such as shrews and songbirds. Testing on invertebrates is very limited for most of the herbicides. However, data that do exist indicate that none of the eight herbicide active ingredients is likely to be an important mortality factor for any terrestrial invertebrate.

Food Web Effects**:** No food web effects would result even if wildlife receive doses from multiple exposure pathways including feeding on insects or other invertebrates at treated sites. The total estimated doses that were evaluated in the Forest Service risk assessments included all potential pathways including consumption of herbicide contaminated dietary items.

***Effects from Bioconcentration*:** Bioconcentration studies for the eight herbicides have been conducted almost exclusively in fish, where bioassays indicate the relative concentration in fish tissue compared to the concentration in the water over a period of time. These bioassays have shown that none of the eight herbicides poses a risk of a high level of bioconcentration and resulting high dose in fish-eating birds or mammals.

***Wildlife Habitat*:** Because all of the herbicides are designed to kill the target plants, they are likely to also damage or kill non-target plants at the treatment sites that could comprise wildlife habitat. The minimum volume techniques proposed for use and standard application precautions would confine any such effects to the immediate vicinity of the treated plants such that resulting off-site plant damage would be minimized.

4.11.2.2 Cumulative Impacts Analysis

The same past, present and reasonably foreseeable future actions at Alaska NPS units and their effects on wildlife and habitat discussed above in section 4.11.1.2 are relevant to Alternative 2. The cumulative effects of past, present, and expected future human activities on the wildlife and thousands of acres of habitat of Alaska's NPS units are moderate in a setting with the millions of acres of undisturbed wildlife habitat and healthy wildlife populations. The incremental increase in impacts from activities on up to 860 acres until 2018 to manage invasive plants under Alternative 2 would result in a negligible additional impact on wildlife in terms of short-term disturbance from crews conducting invasive plant removal with physical methods or using spot herbicide treatments to eliminate the plants. Countering this would be the longer-term incremental decrease in adverse cumulative impacts due to the reduction in invasive plants that these other human activities and encroachments have facilitated in Alaska NPS units. This decrease is more likely to be realized because of the more effective management approach of Alternative 2.

4.11.2.3 Conclusion

The benefits of Alternative 2 to wildlife and habitat in Alaskan NPS units would be minor and localized in the near term but would prevent moderate to major and more widespread impacts in the longer term. The direct adverse impacts of Alternative 2 to wildlife and habitat in Alaskan NPS units would be no more than minor. The indirect effect of Alternative 2 should be beneficial to wildlife and habitat by more effectively curtailing the long term establishment of invasive plant species. The success of invasive plant management and beneficial effects to native plant communities under Alternative 2 would vary from park to park. In parks where early detection and immediate control are feasible and achievable, the manual and thermal methods available under Alternative 2 would be sufficient to prevent establishment and spread. Because spot treatment with herbicides is included under this Alternative, impacts to wildlife and habitats could be readily reduced or eliminated for most sites even when control is not feasible by manual and thermal methods. Managing invasive plants under Alternative 2 would help parks better achieve the desired condition of maintaining all wildlife habitats as part of the natural park ecosystems. This alternative would result in a minor beneficial effect to wildlife and habitat over the next decade because Alternative 2 methods would contain the majority of current or future invasive plant infestations. Actions under alternative 2 would not result in the impairment of wildlife habitat or populations that are key to the purposes and values for which Alaska NPS units were established.

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CHAPTER 5: CONSULTATION AND COORDINATION

5.1 Public Involvement

The NPS mailed a scoping newsletter for the plan to about 250 stakeholders in spring 2006. The public scoping meetings occurred during fall 2006 in three Alaska regional towns (Anchorage, Fairbanks, and Juneau) and in the NPS Alaska Regional Office with the Alaska Lands Act Coordinating Committee (ALACC).

The public scoping results were sent out to participating parties in October 2006 and January 2007. The issues and analyses identified in the EA are largely a result of the public and agency scoping. The title was changed from "Exotic Plant Management Plan" to "Invasive Plant Management Plan" to more accurately reflect the focus of the effort.

Central scoping issues involved the level of NEPA required for the invasive plant control plan and the potential use of chemical herbicides. If broadcast applications of herbicides or aerial spraying were contemplated, commenters thought an EIS would be required to enable greater public involvement and review of the contemplated actions. Commenters also asked for examples of successful herbicide control of invasive plants in other locations, how many applications were needed, and whether soil, water, plant, and animal conditions were monitored after applications. The ALACC group asked the NPS to clarify the feedback loops in the decision tree where a high risk invasive species persists after three years of unsuccessful physical control methods, but the chemical control could cause harm to resources or humans as well.

The NPS presented two basic alternatives: 1) a continuation of the ongoing surveys, physical control efforts, and monitoring of effectiveness with retreatment where needed; and 2) continue the ongoing monitoring and physical control methods where effective but also consider the use of herbicides where these methods fail after 3 or more years of physical controls. Commenters suggested a third alternative emphasizing partnership and leadership with adjacent landowners, concession and business operators in park areas, and volunteer groups. The NPS decided to merge the concepts of alternative 2 with this suggestion.

Public meetings were not held because no public members requested meetings and few people showed up for scoping meetings other than agency personnel. The NPS therefore decided it was not cost effective to hold public meetings and that adequate opportunity for written comments was provided. Dialogs during the public comment period were had with internal and external reviewers to clarify portions of the plan.

5.2 Intra-agency and Inter-agency Involvement

Since May of 2006, the NPS has involved Alaska NPS unit Superintendents and Chiefs of Resources Management through the Natural Resources Advisory Council. All affected Alaska National Park System units have had an opportunity to provide resources information and review and comment on draft parts of the EA.

The NPS did not have the expertise to address the potential impacts of herbicides on soils and wildlife and habitat, so eventually the agency contracted with Phil Sczerzenie of Mangi, Incorporated to complete the wildlife and habitat effects sections of the EA and arranged for Jeff Conn of the USDA Agriculture Research Service to complete soils analyses.

5.3 List of Preparers and Consultants

Table 5.1 and Table 5.2 list personnel who prepared parts and consulted on the development of this environmental assessment, respectively.

Table 5.1 List of EA Preparers (Interdisciplinary Team)

Name	Organization	Position
Bud Rice	NPS, Alaska Region, Environmental Planning and Compliance	NEPA Project Coordinator, Wetlands and Subsistence Effects Analyses
Jeff Heys	NPS, Alaska Region, Exotic Plant Management Team Leader	Project Manager, Alternatives and Vegetation Descriptions and Effects Analyses
Pat Owen	NPS, Denali National Park and Preserve	IPM Coordinator
Trey Simmons	NPS Central Alaska Network I&M Team	Aquatic Resources Biologist
Janet Clemens	NPS, Alaska Region, Cultural Resources	Cultural Resources Compliance Officer
Jay Cable	NPS, Alaska Region, Visitor Education, Safety, and Protection	Regional Safety Officer, Human Health and Safety
Jeff Conn	Agricultural Research Service, USDA, Fairbanks, AK	Research Agronomist, Description of soils and effects analyses.
Clarence Summers	NPS, Alaska Region, Subsistence Specialist	ANILCA 810 Evaluation
Phil Sczerzinie	Mangi, Inc.	Contract Wildlife Biologist, Wildlife and Habitat Effects Analyses
Judy Alderson	NPS, Alaska Region, Natural Resources	Regional Wilderness Coordinator
Staci Deming	NPS, Alaska Region, Geographic Resources	GIS Specialist
Whitney Rapp	NPS, Alaska Region Exotic Plant Management Team	GIS analyses, GLBA consultation, Response to Comments
Bobbi Simpson	NPS California EPMT Program Coordinator	Project Manager, Alternatives and Effects Analyses

Table 5.2 List of EA Consultants

Name	Organization	Position
Joan Darnell	NPS, Alaska Region, Environmental Planning and Compliance	Team Manager
Glen Yankus	NPS, Alaska Region, Environmental Planning and Compliance	Alaska Region NEPA Coordinator
Russ Kucinski	NPS, Alaska Region, Natural Resources	Team Manager
Park Contacts	Alaska National Park Offices	Chiefs of Resources Management
Kevin Meyer	NPS, Alaska Region, Natural Resources	Environmental Specialist/Regional Soils & Trails Specialist
Tom Meier	Denali National Park and Preserve	Wildlife Biologist
Carol McIntyre	Denali National Park and Preserve	Avian Wildlife Biologist
Mason Reid	Wrangell Saint-Elias National Park and Preserve	Wildlife Biologist
Lewis Sharman	Glacier Bay National Park and Preserve	Ecologist
John Quinley	NPS, Alaska Regional Office	Public Information Officer
Tim Hudson	NPS, Alaska Regional Office	Associate Director for Resources and Planning
Brenda Coleman	NPS, Alaska Regional Office	Concessions Analyst
Becky Brock	LACL/KATM	Concessions Analyst
Lisa Fox	NPS, Alaska Region, Environmental Planning and Compliance	Environmental Protection Specialist – Wildlife
Rita Beard	NPS Natural Resources Program Center	Invasive Species Coordinator

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