Bureau of Land Management
Central Yukon Field Office
Fairbanks, Alaska

Dalton Management Area Integrated Invasive Plant Strategic Plan

Environmental Assessment
May 2013

EA Number: DOI-BLM-AK-03000-2010-0051-EA
Invasive Plants Management Strategy
Project Location: Central Yukon Field Office (CYFO), Dalton Highway Corridor Management Area (DHCMA), Alaska

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ACRONYMS AND ABBREVIATIONS

ACEC	Areas of Critical Environmental Concern
ADEC	Alaska Department of Environmental Conservation
ADOTPF	Alaska Department of Transportation and Public Facilities
AKEPIC	Alaska Exotic Plant Information Clearinghouse
ANHP	Alaska Natural Heritage Program
ANILCA	Alaska National Interest Lands Conservation Act
ARS	Agricultural Research Service
ATV	All-Terrain Vehicle
AWAP	Alaska's Wildlife Action Plan
BLM	Bureau of Land Management
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWMA	Cooperative Weed Management Area
DOI	Department of Interior
DHCMA	Dalton Highway Corridor Management Area
DMA	Dalton Management Area
EA	Environmental Assessment
EDRR	Early Detection Rapid Response
EIS	Environmental Impact Statement
EFH	Essential Fish Habitat
EO	Executive Order
EPA	Environmental Protection Agency
FLPMA	Federal Land Policy and Management Act
FONSI	Finding of No Significant Impact
FWS	Fish and Wildlife Service
IPM	Integrated Pest Management
JHA	Job Hazard Analysis
MSDS	Material Safety Data Sheets
NAAQS	National Ambient Air Quality Standards and Attainment Status
NAWMA	North American Weed Management Association
NEPA	National Environmental Policy Act
NISIMS	National Invasive Species Information System
NPR-A	National Petroleum Reserve - Alaska
NPS	National Park Service
NWR	National Wildlife Refuge
OSHA	Occupational Safety and Health Administration
PEIS	Programmatic Environmental Impact Statement
PER	Programmatic Environmental Report
PPE	Personal Protective Equipment
RMP	Resource Management Plan
TAPS	Trans Alaskan Pipeline
USC	United States Code
USDA	United States Department of Agriculture

1.0 PURPOSE AND NEED

1.1 INTRODUCTION

This Environmental Assessment (EA) has been prepared to disclose and analyze the environmental consequences of invasive plant management as proposed by Central Yukon Field Office (CYFO). The EA is a BLM Field Office level analysis of potential effects that could result with the implementation of the Proposed Action. The EA will be used to assist the Bureau of Land Management (BLM) in project planning; ensuring compliance with the National Environmental Policy Act (NEPA) and making a determination whether any "significant" environmental impacts could result from the alternative actions. "Significance" is defined by NEPA and is found in regulation 40 CFR 1508.27. The EA provides evidence for determining whether to prepare an Environmental Impact Statement (EIS) or a statement of Finding of No Significant Impact (FONSI). If the field office manager determines that this project is likely to have significant impacts following the analysis in the EA, then an EIS would be prepared for the project. If not, a Decision Record may be signed for the EA approving the selected alternative, either the proposed action or another alternative. The associated Record of Decision (ROD), including a Finding of No Significant Impact (FONSI) statement, documents the reasons why implementation of the selected alternative would not result in significant environmental impacts.

The project area analyzed in this EA is the Dalton Highway Corridor Management Area (DHCMA) and adjacent BLM-managed lands (Appendix B, Map 1). The BLM manages over two million acres of land along the Dalton Highway, north of the Yukon River and south of Slope Mountain. These lands are used for a variety of purposes including subsistence activities, hunting, fishing, camping, hiking, canoeing, rafting, power boating, wildlife viewing, tourism, sightseeing, gold panning, and leasable and locatable mining.

The BLM-managed lands within the DHCMA include 14 Areas of Critical Environmental Concern (ACECs), including the Toolik Lake Research Natural Area. Several federal conservation system units lie adjacent to BLM-managed lands along the highway, such as the Arctic National Wildlife Refuge, Gates of the Arctic National Park and Preserve, Kanuti National Wildlife Refuge, and the Yukon Flats National Wildlife Refuge.

The Dalton Highway is a secondary road. Its main purpose is support of the commercial infrastructure associated with oil fields in northern Alaska. The highway was built in 1974 as a "haul road" to supply oil fields on the North Slope and support the construction and maintenance of the Trans Alaskan Pipeline (TAPS). Originally allowing only industrial traffic, it was opened for public use in 1994. Since opening to the public, the highway has become a gateway for travelers, in addition to commercial traffic.

Several species of invasive plants are common along roads and trails in interior Alaska and have spread north along the Dalton Highway. Public use and commercial traffic combined have contributed to the introduction and spread of invasive plants via several vectors including vehicle tires and undercarriage, heavy equipment, aviation and boat traffic as well as foot traffic via clothing, footwear, packs, and tents. Additionally, the transport of contaminated fill material for road maintenance and other activities may contribute to the spread of invasive plants. Invasive plants have spread northward to areas along and adjacent to the roadside. Invasive plants are found along trails, spur roads, and other heavy use areas including gravel pits, rest stops, mine sites and airstrips.

Alaska is unique among other US states in the overall abundance of exceptionally intact ecosystems. Previously, Alaska's cold climate, short growing seasons and limited human population were thought to restrict the movement of invasive plants. However, invasive plants are becoming widespread in towns and along roadways throughout the state. The accelerating increase in invasive species in the state is broadly recognized as a primary threat to the biodiversity and the processes of these ecosystems. The economy of rural Alaska is another vulnerable component that is predicated on healthy ecosystems to support subsistence species and tourism activities

The Dalton Highway, one of few road corridors in Alaska, it is among the many that harbor numerous infestations of non-native plants. These populations within the DHCMA represent a threat to a range of habitats and resources. There is potential that the infestation of invasive plants found in the DHCMA in BLM-managed lands will spread from the highway corridor into the adjacent Native-owned as well as state and federally managed lands, with the rivers corridors acting as vectors for dispersal. Removing invasive plants from roadsides and other human-impacted areas greatly reduces the chances of successful establishment in adjacent intact ecosystems in adjacent areas.

In May 2009, the BLM developed the Draft Dalton Integrated Weed Management Strategic Plan (Strategic Plan) (BLM 2009, Appendix A) in consultation with partners, affected agencies, groups and organizations. The Strategic Plan outlines the current status of invasive plants within the DHCMA, describes past control efforts, and recommends a combination of treatment strategies to control or eradicate existing and future invasive plant populations. It serves as an initial step towards addressing outreach and partnership opportunities for control and management of invasive plants within the DHCMA. When the Strategic Plan was developed in 2009, an estimated 215 acres had been identified as infested with invasive plants. Of these, 141 acres were recommended for treatment with herbicides or a combination of herbicide, manual or mechanical control. These acreages have been updated to reflect the current goals of this EA and changes in infested acreage since 2009. It is currently estimated that at least 350 acres of the DHCMA is infested with invasive plants. Of the currently estimated 350 acres of infestation, the entire acreage is recommended for control treatment; up to 300 of the 350 estimated acres may be treated with herbicide.

The Strategic Plan is the Proposed Action (Alternative A) that is being analyzed in this Environmental Assessment. This EA has been created to analyze the recommendations outlined in each Alternative, particularly the Proposed Action (Alternative A) ,and ensure that the chosen Alternative meets the following requirements:

1) Compliance with NEPA, BLM and Department of Interior (DOI) policy,
2) Identification of additional issues through public scoping and involvement,
3) Development of mitigation measures to address potentially significant environmental impacts that might result from implementation of the Strategic Plan, and
4) Incorporation of the requirements presented in these BLM documents:
    a. Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States; Programmatic Environmental Impact Statement (PEIS) (BLM 2007a), which evaluates the effects of herbicide treatments.
    b. Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Report (PER), which evaluates the effects of non-herbicide treatments (BLM 2007b).

1.2 BACKGROUND

Executive Order 13112 focuses on Prevention and Control of Invasive Species and directs all federal agencies to prevent and control introductions of invasive nonnative species in a cost-effective and environmentally sound manner that minimizes their economic, ecological, and human health impacts. The Order defines invasive plants as “non-native plants whose introduction does or is likely to cause economic or environmental harm or harm to human health” (Executive Order 13112).

Invasive plants may compromise BLM's ability to manage lands as healthy ecosystems. Infestations can directly and indirectly lead to a host of environmental effects: displacement of native plants; reduction in quality habitat and forage for wildlife; increased potential for soil erosion and reduced water quality; alteration of physical and biological properties of soil; loss of long-term riparian area function; and loss of habitat for culturally significant plants. There are also economic consequences to continuing to allow invasive plants proliferate largely unchecked. These include the high financial cost of controlling invasive plants and increased cost of maintaining transportation systems and recreational sites.

By implementing the five year Integrated Pest Management Strategies outlined in the Strategic Plan (Preferred Alternative, Appendix A) BLM proposes to manage invasive plants throughout the DHCMA (Appendix A, Map 1). Integrated Pest Management (IPM) is defined as a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks (DOI Departmental Manual 517 2007). The management techniques evaluated in this EA include:

Chemical – The application of herbicides, chemicals that kill or injure plants. Herbicides are categorized as either "selective" or "non-selective". Selective herbicides kill only a specific type of plant (e.g. broad-leaved plants only), while non-selective herbicides affect all types of plants. Herbicide application under this EA would be implemented without the use of large motorized vehicles (e.g. trucks, airplanes) and would be primarily accomplished using backpack sprayers, hand-held pumps, or similar hand-held devices. The BLM may elect to use small motorized vehicles (e.g. ATVs) to increase the speed of chemical treatment applications.

Physical (Manual or Mechanical) – Physical control involves the use of hand tools, hand-operated power tools, and other power equipment to control invasive plants. Physical removal may include: 1) cutting undesired plants at or above the ground level, 2) pulling, grubbing, or digging out root systems of undesired plants to prevent re-sprouting and re-growth, and 3) removing competing plants around desired species.

Because they are often highly competitive with native plant species, invasive species may have ecosystem-level effects on plant community composition and diversity. This can lead to alteration of landscape-level vegetation community structure and function. With the predicted warming climate and greater levels of both anthropogenic and natural disturbance, boreal habitats are likely to become increasingly susceptible to invasive plants.

> "Substantial warming has occurred at high northern latitudes over the last half-century. Sea ice is retreating, permafrost is thawing, and Arctic summers are now warmer than at any other time in the last 400 years. Most climate models predict that high latitudes will experience a much larger rise in temperature than the rest of the globe over the coming century. Across the state, length of summer season is projected to increase, and winters conversely are projected to shorten. Striking increases in growing season length are projected across the south-central, interior, and northern regions of the state (UAF 2008).

There is some evidence that climate change will favor increased spread of invasive plant in the future. Seasonal patterns of precipitation and temperature appear to be shifting in a manner that favors some invasive species (Tausch 2008). For example, a warming climate could lead to an upward elevational and latitudinal migration of plant species formerly restricted to warmer areas (Tausch 2008). The rapidity of predicted climate change may be such that, on a regional level, native plants are lost from their lower-elevations and southern areas more rapidly than migration north occurs. This could ultimately result in communities with reduced biodiversity. These communities may be more susceptible to invasive plant encroachment since invasive plants may be better adapted to the new climate. Fire frequency and intensity is another factor resulting from the climatic shift and non-native plant infestations. Fine fuels contributed to plant communities by invasive plants have been shown in other regions to increase fire frequency and enhance invasive plant infestation.

Twenty-eight invasive plants have been documented within the DHCMA (Table 1-1). Of these plants:
- Eleven species are considered highly invasive, exist only in a few isolated places and are potentially eradicable;
- Eight species are highly to moderately invasive, are relatively well established and must be controlled to prevent movement into native ecosystems;
- Nine species, though relatively well established on the roadside, are not considered a threat to native ecosystems and are not identified for eradication or control.

The eighteen species that are identified for eradication and/or control in Table 1-1 represent a variety of plant types (grasses and forbs), life cycles (annuals, biennials, and perennials), reproductive strategies (seeds, rhizomes and/or stolons), and life forms (prostrate or erect).

Table 1-1. Invasive plant species of concern found within the Dalton Management Area (AKEPIC 2005)

Common name	Scientific name	Sites	Area (acres)	Goal	Recommended Control
Yellow toadflax	*Linaria vulgaris*	2	<1	Eradicate	Hand weed
Common tansy	*Tanacetum vulgare*	2	<1	Eradicate	Hand weed/spray
Ox-eye daisy	*Leucanthemum vulgare*	5	2	Eradicate	Hand weed/spray
Perennial sowthistle	*Sonchus arvensis*	1	<1	Eradicate	Hand weed
Birdsfoot trefoil	*Lotus corniculatus*	4	<1	Eradicate	Hand weed
Iceland poppy	*Papaver nudicanle*	1	<1	Eradicate	Hand weed
Purple sand spurry	*Spergularia rubra*	1	<1	Eradicate	Hand weed
Spreading bluegrass	*Poa pratensis var. irrigata*	2	0.1	Eradicate	Hand weed
Common pepperweed	*Lepidium densiflorum*	11	<1	Eradicate	Hand weed
Bird vetch	*Vicia cracca*	28	7	Eradicate	Mechanical/herbicide
Herb sophia	*Descurainia sophia*	2	2	Eradicate	Hand weed
Meadow foxtail	*Alopecurus pratensis*	5	<1	Eradicate	Hand weed
Smooth brome	*Bromus inermus*	7	1	Control	Cut/hand weed
Narrowleaf hawkweed	*Hieracium umbellatum*	13	12	Control	Spray
White/yellow sweetclover	*Melilotus officinalis*	142	41	Control	Spray/hand weed
Alfalfa	*Medicago sativa* ssp. *sativa*	8	1	Control	Hand weed
Alsike clover	*Trifolium hybridum*	10	10	Control	Hand weed
Narrowleaf hawksbeard	*Crepis tectorum*	27	6	Control	Possible spray
Foxtail barley	*Hordeum jubatum*	80	72	Control	Hand weed/spray
Shepherd's purse	*Capsella bursa-pastoris*	5	2	Monitor	No action
Lamb's quarters	*Chenopodium album*	7	2	Monitor	No action
Bluegrass	*Poa pratensis var. pratensis*	3	4	Monitor	No action
Prostrate knotweed	*Polygonum aviculare*	32	6	Monitor	No action
Dandelion	*Taraxacum officinale*	40	11	Monitor	No action
Pineapple weed	*Matricaria discoidea*	34	9	Monitor	No action
Common plantain	*Plantago major*	35	11	Monitor	No action
European stickweed	*Lappula squarrosa*	0	0	Monitor	Look for
Slender wheatgrass	*Agropyron …*	0	0	Monitor	Look for
Spotted knapweed	*Centaurea stoebe*	0	0	Monitor	Look for
Canada thistle	*Cirsium arvense*	0	0	Monitor	Look for

Five of the target species are nitrogen fixing: white sweetclover, alfalfa, alsike clover, birdsfoot trefoil, and bird vetch. Boreal forest and tundra communities are naturally nitrogen poor ecosystems.

The addition of nitrogen has the potential to change ecosystem processes by accelerating microbial decomposition, altering plant communities, and changing plant succession.

The spread of invasive plants from the highway right-of-way into habitats along the Dalton Highway have been documented (Grondquist 2008). Wildfire scars adjacent to roads have been shown to be especially vulnerable to infestation (Villano and Mulder 2008) (Appendix B Maps 2 through 5). With approximately 1,269,000 acres having burned in the Dalton Highway Corridor over the past decade, a substantial area may be susceptible to invasive plant infestation (BLM 2009, Appendix A). This is of concern because they have the potential to out-compete other primary successional plants, altering the course of post-fire vegetation regrowth (Spellman and Wurtz 2010).

Some interior Alaska glacial floodplains are known to be vulnerable to invasive plant establishment (Conn et al. 2011). To identify vectors that may pose a threat to the Kanuti National Wildlife Refuge (KNWR), an ACEC downstream, Wurtz et al. (2008) surveyed floodplains at bridges along the Dalton Highway that had white sweet clover infestations on the adjacent roadside. Of the ten river crossings surveyed, six had white sweet clover on the roadside immediately adjacent to the crossing; however, the plant was not found on any of the floodplain surfaces in the vicinity of the bridges. Two vectors, the South Fork of the Koyukuk River and the Jim River 3, have been identified as posing a potential threat to the KNWR due to their upstream proximity to the conservation units (Wurtz 2008).To date, BLM invasive plant management efforts within the DHCMA have been largely centered on river crossings. Other efforts to mitigate the infestation on lands managed by Native corporations, BLM, NPS, FWS and the State of Alaska, have focused on halting the northward spread of the target species. BLM efforts have aimed to halt the northward spread of target species, including but not limited to white sweetclover, oxeye daisy, yellow toadflax, perennial sowthistle, yellow alfalfa, bird vetch, and common tansy.

Although no formal treatment plan has been implemented to date, since 2004 the BLM has made an effort to slow or halt the spread of invasive plants within the DHCMA. Previously conducted inventory, monitoring and control protocols have adhered to recommendations of the North American Weed Management Association (NAWMA). Monitoring efforts have been conducted from 2005 to present by the BLM and Alaska Natural Heritage Program, University of Alaska Anchorage (AKNHP). Partner agencies and groups have contributed to the effort since 2006. Partners have included Friends of Alaska National Wildlife Refuges, Fish and Wildlife Service (FWS), National Park Service (NPS), Committee for Noxious and Invasive Plant Management (CNIPM) as well as contacts in Alaska Department of Transportation and Public Facilities (ADOTPF) and the Alyeska Pipeline Service Company.

Methods of control have to date included annual manual and mechanical treatments aimed at target species (Appendix A, Map 6). The BLM National Invasive Species Information System (NISIMS) became the standard for inventory, monitoring and mapping in 2012. Adoption of the Preferred Alternative, as outlined in Appendix A of this Environmental Assessment, would spur the implementation of a concerted invasive species control action plan aimed at current known infestations of invasive plants.

Integrated Pest Management (IPM) is the invasive plant management strategy described in the Preferred Alternative (Appendix A). IPM is a comprehensive approach to the management of invasive plants, which employs a combination of treatment methods (e.g., manual, mechanical, chemical)as opposed to the traditional single control action approach. This comprehensive strategy is expected to provide better controls over invasive plant spread than any one action might provide, as well as minimize adverse impacts to non-target organisms. Additionally, IPM calls for the utilization of a cooperative, interagency approach to monitoring, early detection and rapid response, as well as public outreach and education.

1.3 NEED FOR THE PROPOSED ACTION

The need for implementation of the actions outlined in the Preferred Alternative is based on information from invasive plant monitoring in the DHCMA since 2005. This data clearly indicates that there has been both increase in 1) the number of invasive plant species (AKEPIC 2013, Appendix A) and 2) the area infested by these species (http://aknhp.uaa.alaska.edu/maps/akepic/). Prevention of further establishment and spread of invasive species in the area is of importance since invasive vegetation can reduce soil productivity, accelerate erosion, affect water quality and quantity, alter fire regimes, change nutrient cycling, alter wilderness characteristics, degrade wildlife and affect recreational opportunities. Continued introduction and spread is expected as a result of future and on-going surface-disturbing activities associated with oil and natural gas development (e.g. pad, road, and pipeline construction) as well as mining and transportation activities.

The percentage of land infested by invasive plants in the DHCMA is relatively low compared to other highways around the state, thus presenting the opportunity to effectively eradicate both new and existing infestations. Currently documented weed-infestation is estimated to be approximately 350 acres. However, much of the DHCMA has not been inventoried for noxious and invasive species; thus, the actual number of acres treatment has not been well established. The area treated by manually removing invasive plants has varied broadly over the years, but has averaged approximately 50 acres annually.

The spread of many invasive plants across Alaska suggests that issues associated with invasive plants will extend into the future. Given the current rate of spread, it can be expected that, without intervention, infestations will continue to expand north along the Dalton Highway, exceeding agency response rate. Of particular concern is the potential for spread away from the BLM managed areas centered on the road system and into natural, undisturbed areas. Specifically, the threat of spread away from the road system, along river corridors, and into adjacent Federal Conservation Units is an issue of high importance. The numerous potential ecosystem-level effects of key invasive species in the DHCMA (including an overview of species-specific impacts on native communities, ecosystem processes and wildlife habitat) are detailed in Table 4-2 of this EA.

At the current level of infestation strong efforts dedicated to prevention, early detection, and rapid response to relatively small-scale infestations is feasible in this region. The underlying premise of the Proposed Action is that the risk of allowing invasive species to move away from disturbed areas and into river systems is likely greater than risks associated with careful applications of approved herbicides. Given the high economic cost of controlling invasive plants and the associated damage to other resources, it is recommended that a comprehensive weed management strategy be implemented now.

Reducing the number of infested acres of invasive plants would meet the goal of sustaining biological communities as directed by the BLM Operating Plan 2004-2008 which was developed by the Resource Advisory Council to the BLM-Alaska. To achieve this goal the CYFO proposes to implement Alternative A (a 5-year Action Plan fully described in the Draft Dalton Management Area Integrated Invasive Plant Strategic Plan, Appendix A).

The Strategic Plan was written in accordance with the Federal Land Policy and Management Act of 1976 (FLPMA), which directs the BLM to manage public lands "in a manner that will protect the quality of scientific, scenic, historic, ecological, environmental, air and atmospheric, water resources, and archeological value". The Strategic Plan also outlines the best management practices for surface disturbances, roads, vehicles, special recreation uses, and prescribed fire, designed specifically to eliminate or minimize impacts from noxious and invasive weeds.

The Strategic Plan is written in accordance with Executive Order 13112-Invasive Species, directs federal agencies to prevent the introduction of invasive species and provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause. Several other federal acts address for management and control of invasive plants. Additionally, two weed control acts, the Carlson-Foley Act of 1968 and the Plant Protection Act of 2000 (Public Law 106-224) authorize: 1) management of undesirable plants on federal lands, 2) BLM to management of noxious weeds and 3) coordination with other federal and state agencies in activities to eradicate, suppress, control, prevent, or retard the spread of any noxious weeds on federal lands. Finally, the Federal Noxious Weed Act of 1974 lead to the establishment and funding of an undesirable plant management program, implementation of cooperative agreements with state agencies, and establishment of integrated management systems to control undesirable plant species.

1.4 PURPOSES OF THE PROPOSED ACTION

The purpose of the Proposed Action is to prevent the introduction of new invasive species and control the further spread of invasive plants within the DHCMA. The goal of the proposed action is to protect fish habitat, wildlife habitat and other resource values in the area. The specific objective is to apply control methods on up to 350 acres (including up to 300 acres treated with herbicides) of the known 350 acres of invasive plant infested land in the DHCMA over the course of the next five years. The currently recorded areas of infestation are located within the DHCMA between the Yukon River Bridge (MP 56) and the Hammond River (MP 190).

1.5 DECISION TO BE MADE

The BLM will decide what actions will be implemented in relation to invasive plant control in the DHCMA. Actions decided upon include: 1) whether herbicides will be used as a control method; 2) treatment methodologies for specific plant species of concern given herbicides are used; and 3) the treatment methodologies for plant species of concern if herbicides given herbicides are not used as a control method. The selected Alternative from this EA will be implemented immediately following official approval and will be adhered to for a five year term.

1.6 PUBLIC INVOLVEMENT

Public involvement has been emphasized in the process of creating this EA. Scoping involved obtaining internal and external input on issues related to the Proposed Action and Alternatives from resource specialists and the public. The purpose of the scoping process was to identify t issues to be addressed in the EA, identify alternatives and identify potentially significant issues relating to the Proposed Action.

The BLM engaged in extensive community outreach to potentially affected communities, communities of interest, to adjacent land managers and owners, and to other stakeholders/interests. A full list of stakeholders is listed in Appendix C. At the beginning of the planning process, the BLM mailed a scoping letter and informational flyer (Appendices C and D, respectively) to 336 post office box holders in ten communities and approximately 150 email addresses for other stakeholders, organizations, native and village corporations, and agencies, explaining the issue the Proposed Action, and the EA process. The BLM offered to hold a series of scoping meetings in communities to provide opportunities to learn more about the Proposed Action and the EA process, as well as to identify issues and develop alternatives. Nine out of the thirteen communities contacted requested a public meeting.

Between April 28, and July 8, 2010, eight scoping meetings were conducted in Fairbanks, Wiseman, Allakaket, Koyukuk, Bettles/Evansville (joint meeting), Hughes, Huslia, and Anaktuvuk Pass. The four communities that did not request meetings included: Alatna, Rampart, Stevens Village and Tanana. Total number of participants at the eight meetings was 124.

Most communities were unaware of invasive plant issues in general and in the DHCMA in particular. Area residents were interested to learn more about how invasive plant species are introduced and spread within the region and more importantly, how they are impacting native flora and fauna. Some meeting participants shared their concern the lack of data indicating that invasive plants are an environmental or economic issue in Alaska. Comments, questions and concerns about current conditions pointed to a need for continued and expanded outreach and education to help communities understand the core issues.

During the scoping period, participants were asked to help develop alternatives to manage invasive plants in the DHCMA and provide comments on the Preferred Alternative. Most comments were modifications of methods outlined in the Preferred Alternative. Participants in the scoping meetings voiced support for and concern with proposed techniques. In general, attendees were in support of controlling or eradicating invasive plants. Some people supported use of herbicides while others were uncertain or apprehensive about herbicides. Participants also shared their observations of invasive plant infestations within the region, mainly white sweetclover.

The single written comment received was from the Kanuti National Wildlife Refuge (NWR). They commented that the manual control approach used to-date cannot be sustained and will not be successful in the long term without use of more effective control measures to address the more densely-infested areas along the highway. These roadside infestations at intersections with the river flowing into the Kanuti NWR are potential vectors for transporting invasive plants into the refuge. They also stated that more aggressive measures, such as herbicides combined with mowing and reseeding with native plants, would be needed to keep the river crossings and nearby areas weed free. They encouraged the BLM to be aggressive in the consideration of all available methods of control.

1.7 ISSUES

The Council on Environmental Quality (CEQ) regulations state: "NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail" (40 CFR 1500.1(b)). 40 CFR 1500.4(g) directs that the scoping process should be used "not only to identify significant environmental issues deserving of study but also to deemphasize insignificant issues narrowing the scope of the EIS process accordingly." Significant issues directly influence the initiation, development, and technical design of the proposal; are disclosed in the analysis; and were used to develop alternatives to the proposed action. Issues are significant because of the extent of their geographic distribution, the duration of their effects, or the intensity of interest or resource conflict.

Non-significant issues are identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, or other higher level decision; 3) unrelated to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The CEQ NEPA regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review … (Sec. 1506.3)".

Through internal (within the BLM) and external (other federal, state and local agencies, tribal entities, organizations, and private citizens) scoping, the following issues were identified and addressed in this EA:

- the impacts of invasive plants on ecosystem processes, flora and fauna;
- the effects of invasive plants on rivers, lakes, and ponds;
- cumulative impacts of climate change and invasive plants on the landscape
- herbicide application and herbicide drift effects on the ecosystem (e.g. flora, fauna, and humans)
- other control method effects on the ecosystem (e.g. trampling native vegetation)

Key issues identified during the scoping process for the National Programmatic Vegetation EIS (PEIS) (BLM 2007a) are applicable to this local analysis and are incorporated either by tiering and/or by directly addressing specific issues of concern. At a national level, the BLM analyzed each potential issue and designated each as either "significant" or "non-significant". The following issues addressed in the National Vegetation PEIS (BLM 2007a) are relevant to invasive plant control in the DHCMA:

- the effects of treatment on invasive plants and native vegetation,
- the effects of herbicides on soil productivity and surface/groundwater quality
- the effects of herbicide use on subsistence

1.8 RELATIONSHIP TO STATUTES, REGULATIONS, AND POLICIES

The EA was prepared in accordance with NEPA (42 United States Code (USC) 4321 et seq.), the CEQ regulations (40 Code of Federal Regulations (CFR) 1500 through 1508) for implementing NEPA, and DOI NEPA regulations in 43 CFR 46. The EA will determine whether significant impacts would occur as a result of the proposed project and if an EIS or FONSI would be required. Other applicable statutes, regulations and policies that establish standards and provide guidance on environmental and natural resources management and planning include, but are not limited to:

<u>Federal Statutes</u>

- Alaska National Interest Lands Conservation Act (ANILCA) of 1980 PL 96-487 (94 Stat. 2371)
- Bald and Golden Eagle Protection Act (1940) as amended
- Carlson-Foley Act (1968)
- Clean Air Act (42 USC 7401, et seq., as amended)
- Clean Water Act of 1977 and the Water Quality Act of 1987 (33 USC 1251 9, et seq., as amended)
- Endangered Species Act of 1973 (16 USC 1531-1543)
- Federal Insecticide, Fungicide and Rodenticide Act (EPA)
- Federal Noxious Weed Act (1974) as amended by Sec. 15, Management of Undesirable Plants on Federal Lands, 1990
- Fish and Wildlife Coordination Act (16 USC 661, et seq.)
- FLPMA
- Magnuson-Stevens Fishery Conservation and Management Act of 1996 (PL 94-265)
- Migratory Bird Treaty Act (16 USC 701, et seq.)
- NEPA
- Toxic Substances Control Act (15 USC 2601, et seq., as amended)

<u>BLM Manuals</u>

- BLM Manual 9014 – *Use of Biological Control Agents of Pests on Public Lands* – This manual outlines policy, defines responsibilities, and provides guidance for the release, maintenance, and collections of biological control agents for integrated pest management programs on the lands administered by the BLM.
- BLM Manual 9220 – *Integrated Pest Management* – This manual outlines policy, defines responsibilities, and provides guidance for implementing integrated pest management programs on lands administered by the BLM.
- BLM Manual 9011 and Manual Handbook H-9011-1 - *Chemical Pest Control* – This manual and handbook outline policy and provide guidance for conduction pest control programs on public land.

- BLM Manual 9015 – *Integrated Weed Management* – This manual addresses the BLM's policy relating to the management and coordination of noxious weed activities among activities of the BLM, organizations, and individuals.

<u>Regulations</u>

- Essential Fish Habitat, 50 CFR Part 600.910(a)
- Protection of Historic Properties (36 CFR Part 800)

<u>Executive Orders</u>

- EO 11312, Invasive, Nonnative Species
- EO 11514, Protection and Enhancement of Environmental Quality (amended by EO 11991)
- EO 11988, Floodplain Management
- EO 11990, Protection of Wetlands
- EO 12088, Federal Compliance with Pollution Control Standards
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
- EO 13045, Protection of Children from Environmental Health Risks and Safety Risk
- EO 13175, Consultation and Coordination with Indian Tribal Governments
- EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds
- EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management

Applicable authorities are addressed in various sections throughout this EA when relevant to particular environmental resources and conditions.

Not all of the actions described in the Proposed Action (e.g. education and outreach efforts) will require NEPA analysis or be limited by other legal constraints. However, several aspects of the treatments outlined in the Proposed Alternative are likely to have legal limitations, in particular herbicide application. The EA was written with the purpose of analyzing the potential impacts to the environment from actions outlined in the Strategic Plan.

1.9 PLAN CONFORMANCE

The Proposed Action and Alternatives are in conformance with the Utility Corridor Resource Management Plan (RMP), the Central Yukon RMP, and the National Vegetation EIS (BLM 2007a). Although the Proposed Action and Alternatives are not specifically mentioned in the RMPs, they are consistent with the objectives, goals, and decisions of the approved plans.

The Utility Corridor RMP (BLM 1989) emphasizes wildlife habitat protection of crucial areas, maintenance and improvement. Crucial habitat is absolutely necessary to maintain viable populations of fish and wildlife. The RMP also states that vegetative cover and diversity would be maintained. Management of invasive plants would contribute towards protection of wildlife habitat and native vegetation diversity.

The Central Yukon RMP (BLM 1986) defines a variety of management prescriptions, including prescriptions for maintaining existing water quality, protecting crucial terrestrial and aquatic wildlife habitat, and providing for subsistence resources. Management of invasive plants would be beneficial for all of these prescription goals.

The National Vegetation EIS (PEIS) (BLM, 2007a) is a comprehensive document which specifies that 14 allowable herbicides in Alaska after site-specific evaluation (See PEIS Record of Decision, Table 1, pp 2-3). All of the herbicide active ingredients proposed for use in the Preferred Alternative (Appendix A) are approved in the PEIS and by the Alaska Department of Environmental

Conservation (ADEC). The ROD in the PEIS approved the use of 18 herbicide active ingredients as well as the use of a scientific protocol to guide the analytical methodology for consideration of the use or non-use of herbicides by the BLM. The Vegetation Treatments in 17 Western States, Environmental Report (PER) (BLM 2007b) is referenced in this EA to address the general environmental effects associated with of using non-herbicide treatment methods, including mechanical, manual, and biological control methods.

1.10 SUMMARY

The background, purpose and need of the proposed project have been summarized in this Chapter as well as related issues, specifically elements of the human environment that could be effected by the implementation of the proposed project. The Proposed Action Alternative, the No Action Alternative, and the No Herbicide Use Alternative, are presented in Chapter 2. The potential environmental impacts or consequences resulting from the implementation of each alternative are then analyzed in Chapter 3.

2.0 PROPOSED ACTION AND ALTERNATIVES

This EA provides a description of the proposed alternatives which will enable reviewers to compare and contrast the environmental effects associated with each of the three alternatives presented. The Proposed Action "Control Including Herbicide Use" (Alternative A), No Herbicide Use (Alternative B) and the No Action (Alternative C) are presented in this chapter as well as options which have been eliminated from consideration.

The Proposed Action is in accordance with the BLM Integrated Weed Management Manual 9015 (BLM 1992) and was derived primarily from the following documents:

- Partners Against Weeds: An Action Plan for the Bureau of Land Management (BLM 1996)
- Pulling Together: National Strategy for Invasive Plant Management (BLM 1998)

The BLM is required by various laws, regulations, and policies to control invasive species as a means of maintaining ecosystem health, rendering the No Action Alternative an unsuitable management option for the DHCMA. The No Action Alternative is presented based on CEQ recommendation that it is retained for the purpose of comparison to other two alternatives.

The alternatives in this EA stem from the Approved Alternative (Alternative 2) in the National Vegetation PEIS (BLM 2007) and were identified by the BLM through internal and external scoping. Each of the following control methods, as described in the PEIS, were considered when developing the alternatives presented in this EA:

1) Continued present Herbicide use – Under this alternative the BLM would continue to use 20 herbicide active ingredients currently approved for use in 14 western states
2) Preferred (Approved) Alternative: Expand herbicide use and allow for use of new herbicides in 17 western states - This alternative represents the treatment of vegetation using 18 herbicide active ingredients in 17 western states (including Alaska).
3) No use of herbicides - Under this alternative, the BLM would not be able to treat vegetation using herbicides and would not be able to use new chemicals that are developed in the future. The BLM would be able to treat vegetation using fire, and mechanical, manual, and biological control methods.
4) No aerial application of herbicides - This alternative is similar to the Preferred Alternative in that it represents the treatment of vegetation using herbicides in 17 western states, including Alaska, and use of the same active ingredients as allowed under the Preferred Alternative. Under this alternative, however, only ground-based techniques would be used to apply herbicides (no aerial applications of herbicides would be allowed) to would reduce the risk of spray drift impacting non-target areas.

5) No use of sulfonylurea and other acetolactate synthase-inhibiting active ingredients would occur. Under this alternative, the BLM would not use sulfonylurea and other acetolactate synthase-inhibiting active ingredients approved in the earlier RODs, which are chlorsulfuron, imazapyr, metsulfuron methyl, and sulfometuron methyl.

2.1 ALTERNATIVE A – CONTROL INCLUDING HERBICIDE USE

The Proposed Action is to control invasive plant infestations within the DHCMA by applying an Integrated Pest Management approach, which includes a combination of physical and chemical control methods. The plan would be implemented upon official approval and over the course of five years. The specifics of implementing this Preferred Alternative are provided in the five-year Draft Dalton Management Area Integrated Invasive Plant Strategic Plan (Appendix A) and summarized in this section.

Although both physical and chemical control methods would be utilized under this Alternative, the focus of this section is the evaluation of herbicide use to control invasive plants. More detail on physical, both manual and mechanical, control methods is provided in Alternative B "Control Without Herbicide Use" (Section 2.2). Physical removal methods would be considered prior to herbicide application and used where economically and logistically feasible and effective under both Alternatives A and B.

The chemical control methods and the toxicology and risk assessments presented in Alternative A are adopted from the National Vegetation PEIS (BLM 2007a)The PEIS presents an analysis of the human and ecosystem effects of using herbicides on public lands in the Western United States The PEIS approved the following 15 active ingredients (the chemical or biological component of a given herbicide that kills or controls the target pest): 2,4-D, bromacil, chlorsulfuron, clopyralid, dicamba, diuron, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, tebuthiuron, triclopyr, and diquat. A subset of nine of these herbicides has been selected for potential use in the DHCMA (Table 2-1).

The Draft Dalton Management Area Integrated Invasive Plant Strategic Plan (Appendix A), which defines the actions for the Preferred Alternative, includes guidelines for the:

- development of Best Management Practices (BMPs) and mitigation measures for implementing treatments,
- development of BMPs for land use actions (mitigation) conducted by or permitted by the BLM,
- documentation of control method effectiveness,
- implementation of public education initiatives to teach methods of preventing invasive plant infestation,.
- implementation of a treatment program to halt or slow the spread of invasive plant in the DHCMA,
- implementation of a plan to reduce or eradicate invasive plant in the DHCMA, and the
- continuation of an invasive species inventory, monitoring and mapping effort.

Short-term goals for the Preferred Alternative include using Integrated Pest Management (IPM) strategies to:

- reduce the extent of larger infestations,
- prevent expansion of existing infestations, and

- detect new species early and respond rapidly to eradicate using an Early Detection Rapid Response (EDRR) approach.

Long-term goals for the Preferred Alternative include the:
- eradication of larger infestations
- continuation of monitoring to detect new species

Neither the implementation of a public education and prevention program or the formation of an organized Cooperative Weed Management Area (WMU) as described in the Draft Strategic Plan (Appendix A) require analysis in this EA.

Proposed Treatment Methods under Alternative A

The Proposed Action includes treatments for both slowing the spread of and eradicating invasive plants in the DHCMA. Over the course of the next five years, control of invasive plants may include treatment of up to 350 acres of the estimated 350 acres of infestation; up to 300 of the estimated 350 infested acres may be treated chemically. Annual treatment of the area would include continued efforts to manually control ~50 acres of infested area.

The Proposed Action is limited to control efforts that target areas within the currently documented infestations in the DHCMA. The Proposed Action would apply to infestations 1) that currently exist but which have not been accounted for in the current estimate of 350 acres of infestation and 2) new infestations discovered after the implementation of the Proposed Action. Proposed herbicide treatments in the DHCMA would occur predominantly in human-disturbed areas immediately along the Dalton Highway; however, a few treatments of highly vulnerable areas may be conducted off the highway as necessary (Appendix A, Map 6).

Control areas would include stream crossings (with appropriate buffer zones around riparian areas if herbicides are used), roads, trails, airstrips, and pullouts. The priority sites for treatment would be associated with drainages which intersect the Dalton Highway between the Yukon River Bridge and the Marion Creek Administration Site. Known infestations of invasive plants occur near or at the intersection of the following waterways with the Dalton Highway: the Kanuti River, Bonanza Creek (including Fish Creek), the Koyukuk River (including Tramway Bar, Rosie Creek and Slate Creek), the Jim River (including Prospect Creek and Douglas Creek), the Dall River, the Ray River, and the Yukon River. Waterways which flow from the Dalton Corridor and into adjacent Federal Conservation Units will be priority areas of invasive plant control efforts.

Manual methods include hand-pulling and the use of hand-operated tools to dig, cut, clear, remove, thin, or prune invasive species. The use of mulch, weed barrier, geotextiles and other materials to inhibit the growth of vegetation may also be used.

Mechanical methods would involve the use of power tools including mowers, tillers, motorized brush cutters and weed trimmers.

Herbicide methods would involve the use of chemicals to eliminate and/or hinder the spread of invasive plants by disrupting their physiological processes.

A list of the herbicides proposed for use under this EA is listed in Table 2-1 with descriptions of herbicide-specific plant growth inhibition actions, and methods of application. These herbicides are a subset of the approved herbicides in the PEIS. Some of the trade-name herbicide products presented in Table 2-1 are combinations of PEIS-approved herbicides. All herbicides that are considered in

Alternative A are registered under the Environmental Protection Agency (EPA) regulations and approved for use in Alaska through the National Vegetation PEIS and by the ADEC. Notably, some herbicide products listed here contain ingredients in addition to the herbicide active ingredients called adjuvants. Adjuvants, including colorants or surfactants, are regularly included in herbicide products to enhance its performance and/or application (Tu et al. 2001). In some cases adjuvants are pre-mixed into the marketed product while in other cases they are purchased separately and combined with the herbicide active ingredient as prescribed as prescribed by the manufacturer.

Table 2-1. Herbicide active ingredients (trade names), target plants, growth inhibition actions and application methods proposed for the DHCMA.

Herbicide active ingredient (trade names)	**Target plant group/ DHCMA target species**	**Plant growth inhibition action**	**Methods of application**
2,4-D	Broadleaf plants, woody plants, aquatic invasive plants, and non-flowering plants Target species: *yellow and white sweetclover*	Plant-growth regulator that stimulates nucleic acid and protein synthesis and affects enzyme activity, respiration, and cell division; regulator is absorbed by plant leaves, stems, and roots and moves throughout the plant, accumulating in the growing tips	Ground spraying, lawn spreaders, foliar spray.
Chlorsulfuron (Glean, Telar)	Broadleaf plants and some annual grasses Target species: *narrowleaf hawkweed, yellow and white sweetclover*	Absorbed by the leaves and roots and moves rapidly through the plan; prevents the plant from producing an essential amino acid	Ground spraying, hand-held sprayer
Clopyralid (Transline)	Annual and perennial broadleaf herbs, especially knapweeds, thistles, and other members of the sunflower, legume, and knotweed families Target species: *oxeye daisy, bird vetch*	Absorbed by the leaves and roots of the invasive plant; moves rapidly through the plant; affects plant cell respiration and growth	Ground spraying
Dicamba (Banvel, Yukon)	Annual and perennial broadleaf herbs, brush and vines, especially legumes. Target species: *yellow and white sweetclover*	Acts like a naturally occurring plant hormone causing uncontrolled growth in plants; at sufficiently high levels of exposure, the abnormal growth is so severe that the plant dies	Ground spraying; spot treatment
Glyphosate (Roundup, Rodeo)	Grasses, herbaceous plants including deep-rooted perennial invasive plants,	Absorbed by leaves and rapidly moves through the plant; prevents the plant	Ground spraying, hand-held sprayer.

Herbicide active ingredient (trade names)	Target plant group/ DHCMA target species	Plant growth inhibition action	Methods of application
	brush, some broadleaf trees and shrubs, and some conifers; does not control all broadleaf woody plants Target species: *yellow and white sweetclover, foxtail barley*	from producing an essential amino acid; reducing the production of plant proteins, and inhibiting plant growth	
Imazapyr (Arsenal)	Annual and perennial grass, broad-leaved weeds, brush, vines, and deciduous trees Target species: *oxeye daisy, yellow and white sweetclover*	Absorbed by leaves and roots; moves rapidly through plants; disrupts photosynthesis and interferes with cell growth and DNA synthesis	Ground foliage spray.
Metsulfuron methyl (Ally, Cimarron, Escort)	Woody plants, annual and perennial broadleaf plants, and annual grassy invasive plants; Target species: *common tansy, oxeye daisy, yellow and white sweetclover, narrowleaf hawksbeard*	Absorbed through the roots and foliage; moves rapidly through the plants; inhibits cell division in the roots and shoots, stopping growth	Ground spraying; hand-held sprayer
Sulfometuron methyl (Landmark, Oust)	Annual and perennial grasses and broad-leaved herbs Target species: *yellow and white sweetclover*	Absorbed through the roots and foliage; blocks cell division in the active growing regions of stem and root tips	Foliar spray
Triclopyr (Garlon 3A/4)	Woody plants and broadleaf plants Target species: *oxeye daisy*	Disturbs plant growth; absorbed by green bark, leaves and roots and moves throughout the plant; accumulates in the meristem (growth region) of the plant	Ground foliage spray.

Sources: BLM 2007a, BLM 2009, Appendix A

The standard operating procedures (SOPs) measures for applying herbicides outlined in the Strategic Plan (Appendix 5 of Appendix A) would be applied under this Alternative, as would the SOPs from the National Vegetation PEIS in Appendix B of the Record of Decision. The herbicides listed in Table 2-1 would only be applied for the uses specified in Table 2-1 and at application rates equal to or less than those specified by the manufacturer.

Herbicides would be stored in compliance with Occupational Safety and Health Administration (OSHA) regulations (29 CFR) and all other State and Federal regulations. All actions and protective equipment would be in compliance with manufacturer and product specific Material Safety Data

Sheets (MSDS). An Alaska Pesticide Use License with the proper certification would be required for personnel applying herbicides.

Implementing Appropriate Control Methods
Each of the invasive plant species that have been found in the DHCMA have been evaluated using a decision tree (Appendix II of Appendix A) designed to determine the best control methods for a given species. This decision tree was used to identify the appropriate control action based on: 1) the potential for eradication, 2) the invasiveness risk, and 3) whether or not a given infestation site had been previously altered by human activity. For each invasive species known to occur in the DHCMA, the recommended control action deduced from decision tree analysis is listed in Table 1-1 (Appendix III of Appendix A, BLM 2009).

This Alternative focuses on herbicide application using a backpack or manual application to target individual plants or patches of plants, thus allowing for controlled localization of herbicide effects. However, the use of ATV-mounted boom sprayers to treat continuous infestations of invasive plants along the Dalton Highway is also considered under this Alternative. A more detailed description of species-specific control methods for each target invasive species is provided in the Strategic Plan (Appendix IV of Appendix A, Recommended Strategies per Species). For example:

> ***Vicia cracca* – bird vetch**
> **Status –** This plant species has been found in multiple locations (Map 4) on both altered and unaltered land.
>
> **Goal –** Due to the size of the infestations and this species potential to spread (through seeds and rhizomes), cover short native vegetation (< 3 feet tall), fix nitrogen (altering natural nutrient status), and form dense mats, this species should be eradicated.
>
> **Preferred management actions on altered and unaltered land –** The seed bank life of *Vicia cracca* is 5 years, which has positive implications for eradication. Sites should be visited before flower initiation, which can occur from early to late July. After estimating density and size of infestation, all plants should be mown or pulled and sprayed. The site should be revisited every six weeks and the treatment repeated, after infestation measures are recorded, until winter. The area within at least a 150 foot radius and any disturbed areas within a half mile should be scouted for new plants. After five years of treatment, when the seed bank should be free of *Vicia cracca* seeds, the plants should be sprayed while they are actively growing and before flowering with 1 pint/acre of clopyralid (Transline) with an approved adjuvant (0.25% v/v) to kill the adult plants.

Monitoring
Monitoring is essential to ensure appropriate application of control treatments as well as successful implementation of best management practices, standard operating procedures, and mitigation measures. Monitoring will occur regardless of which alternative is selected from this EA, but will follow more stringent guidelines under Alternatives A and B. The Draft Strategic Plan provides an overview of annual monitoring, inventory and evaluation activities which would be conducted if the Proposed Action is approved. Additionally, the PEIS includes a detailed discussion of treatment monitoring which would be adhered to under the Proposed Action (BLM 2007a).

Site Rehabilitation
Following the proposed chemical and manual treatment applications described under Alternative A, site rehabilitation may be conducted. Rehabilitation measures may include the seeding (using "weed-

free" seeds) of treated areas. Reseeding areas where invasive plant removal treatments are applied can reduce the potential for re-colonization by invasive plants.

2.1.1. ALTERNATIVE A – DESIGN FEATURES

In order to reduce or eliminate adverse effects of the Proposed Action the following standards will be adhered to under the Preferred Alternative which includes the use of herbicides to control invasive plants in the DHCMA.

The following list of design features would be strictly adhered to under the proposed action. The list is a compilation of Standard Operating Procedures (SOPs) and Best Management Practices (BMPs) in relation to herbicide application which were identified in the BLM National Vegetation Programmatic Environmental Impact Statement (PEIS), the Draft Dalton Management Area Integrated Invasive Plant Strategic Plan (Appendix A) and by Field Office specialists.

1) Chemical control methods would only be used when they are the minimum method necessary to control invasive plants that currently are, or threaten to, spread into native vegetation communities in undisturbed areas.
2) The herbicides would be applied using "minimum tools" such as backpack pumps and hand sprayers.
3) Chemical control would be conducted carefully to maximize effectiveness and minimize impact of herbicides, degradate adjuvants, inert ingredients, and tank mixtures on non-target species.
4) The amount of herbicide applied and the size of the area treated would be minimized to the greatest possible extent.
5) The herbicide product label would be referred to when planning revegetation to ensure that new vegetation would not be harmed.
6) EPA-approved herbicides would be used and stored according to the product label instructions to avoid harming organisms and/or the environment.
7) Known risks from the "Environmental Hazards" section of the herbicide label would be reviewed, understood, and conformed to for all applications.
8) A copy of the Material Safety Data Sheets (MSDSs) for the herbicides used would be kept at work sites.
9) Only licensed applicators would apply herbicides.
10) If utilized during control treatments, OHVs would be cleaned to remove invasive plant seeds.
11) Herbicide treatment applicators would be turned off both at the completion of and between herbicide spray "runs".
12) Drift reduction agents and other precautionary methods would be used, as appropriate, to reduce the drift hazard to non-target species and to minimize the potential effect on agricultural activity and nearby residents/landowners (e.g. not applying herbicides when winds exceed >10 mph or when a serious rainfall event is imminent).
13) Careful effort would be taken to avoid accidental direct spray and spill conditions that could potentially expose honeybee and pollinator populations.
14) A spill contingency plan would be prepared in advance of herbicide treatment application.
15) Records of each application (including the active ingredient, formulation, application rate, date, time, and location) would be kept.
16) Posted notification of treated areas, including re-entry and/or rest times, would be used where appropriate.
17) Herbicides would not be applied within 200 feet of any surface water body (temporary, flowing or standing). Distance to water bodies would be measured, marked, and approved prior to application to ensure compliance with this standard.
18) Herbicides would not be applied within 0.5 miles of the community of Wiseman.

19) To protect Essential Fish Habitat in water bodies inhabited by salmon, herbicides would be applied no closer to the water than 200 feet beyond the outer edge of the floodplain.
20) Pesticide application would not be allowed within 200 feet of any drinking water well. Application distance may be extended for specific well sites during formulation of the Pesticide Use Plan.
21) Buffer distances, measured horizontally on a line perpendicular to the water body beginning at the water line, would be marked, and approved prior to application to ensure compliance with this standard. Secondary buffer zones may be required if the slope adjacent to the stream or water body is greater than 5%. This buffer also applies to ephemeral streams (a stream or portion of a stream that flows only in direct response to precipitation).
22) Water quality monitoring would be implemented to determine whether current buffers are adequate to protect water quality and aquatic resources.
23) Input from consultation with Native entities, community leaders and local villages and settlements would be incorporated into project planning.
24) Site characteristics, environmental conditions, and herbicide application equipment would be evaluated with the goal of minimizing damage to non-target vegetation.
25) Pre-treatment surveys for sensitive habitat and special status species would be conducted within and adjacent to proposed treatment areas.
26) Prior to and during herbicide application sites would be surveyed for animal inhabitants, including migratory birds and their active nests, to avoid impacting animals or active nests.
27) Herbicide application treatment would be implemented during periods of low human use, when feasible (USDI BLM 1988e) and adjacent landowners would be notified of all applications prior to treatment.
28) Where deemed appropriate and advantageous, herbicide-treated areas would be re-seeded with native species. Seeding must be conducted using only "weed-free" seed per BLM policy.

The following is a list of supplementary design features which would be implemented under either Alternative A or B but would not require NEPA analysis. Outreach and education efforts would increase public awareness of the environmental and economic costs associated with invasive plants as well as activities could contribute to the introduction and spread of invasive plants.

1) The Dalton Highway Cooperative Weed Management Area (CWMA), including the BLM and other stakeholders in the region, would be organized.
2) Organized education efforts would be used to increase awareness of invasive plants and activities that contribute to their introduction and spread.
3) Education efforts would help increase local and tribal awareness of the potential threat of invasive plants to subsistence resources.
4) Educational materials would be provided at trailheads and other entry points into natural areas to educate the public on the need to prevent the spread of weeds.
5) Stock users would be encouraged to tie and/or hold stock in such a way as to minimize soil disturbance and loss of native vegetation.

2.2 ALTERNATIVE B - CONTROL WITHOUT HERBICIDE USE

Under Alternative B, actions would be implemented as outlined in Alternative A and described fully in the Strategic Plan (Appendix A), except that the use of herbicides as a control method for invasive plants would not be implemented. Mechanical and manual treatment of target species would be the only control methods employed. The same invasive species that are listed for herbicide and/or physical removal treatment in the Strategic Plan (Table 1-1, Appendices III and IV of Appendix A) and the Preferred Alternative would be treated under this Alternative; however treatment would be limited to manual and/or mechanical removal methods. All aspects of the Strategic Plan implementation of manual and mechanical control would be adhered to under this Alternative, as would guidelines provided in the PEIS and PER.

2.3 ALTERNATIVE C - NO ACTION

Under the No Action Alternative, the BLM would not formally implement the guidelines provided in the Strategic Plan (Appendix A) in relation to management of invasive plants along the Dalton Highway. All inventory, monitoring and control efforts would continue to be conducted in a basically unstructured and opportunistic fashion. The long-term effort dedicated to manual removal of invasive plants for ~50 acres of infestation would continue under the No Action Alternative in addition to sporadic monitoring and inventory efforts. The No Action Alternative violates BLM policy (IM-AK-2010-001) and the BLM Integrated Weed Management Manual 9015, and would not meet the Purpose and Need described in this Environmental Assessment.

2.4 ALTERNATIVES CONSIDERED BUT NOT ANALYZED

This section includes descriptions of alternative actions identified through internal agency and public scoping that were considered but eliminated from further study because; they either did not meet the purpose and need of this project or the treatments proposed are not recommended or proven to be effective at this time.

Prescribed Fire

While fire is not proposed as a management tool for invasive plants at this time, experimental research into the benefits of using fire as a means of control may be conducted within the DHCMA.

Biological control agents

Classical biological control agents (insects, pathogens, nematodes, mites) can be introduced to an invasive plant infestation to directly damage plant tissue. Although invasive plants do not die quickly, increasing plant stress allows native plants to compete better. Biological control does not eradicate invasive plants and is commonly used in conjunction with herbicide applications. Biological control agents are best used on large, well established infestation where short term control is not a management objective. Although there are several linear and continuous infestations along the Dalton Highway, there is a lack of research on biological control agents on the specific invasive species in the DHCMA. Due to the lack of research, this method is not analyzed in this EA, but may be a tool in the future. Analysis of impacts would be conducted prior to implementation. Additionally a *Biological Control Agent Release Proposal* must be approved prior to any releases to the environment.

Other

Use of other materials (e.g. geotextiles, bark or sawdust) may be implemented as physical control methods. Common household chemicals, particularly as vinegar or salt, are relatively unstudied and will not be used as control methods.

2.4 COMPARISON OF ALTERNATIVES

Table 2-2 provides a comparison of the potential environmental impacts associated with each alternative presented in this EA. Potential impacts are provided according to affected resources. The Environmental Effects sections of this EA in Chapter 4 contain detailed discussions of these potential impacts by resource topic. Refer to Table 4-1 for explanations of impact levels.

Table 2-2. Comparison of environmental effects on resources in the DHCMA under each selected alternative.

Resource	Alternative A: Proposed Action	Alterative B: Proposed Action without Herbicides	Alternative C: No Action
Vegetation	Up to 350 acres would be treated annually (including up to 300 acres treated with herbicides). Alternative A would result in effective control of invasive plant infestations and benefit native plant vegetation and ecosystem integrity. The minor, short-term adverse impacts on vegetation from herbicide use would be outweighed by the long-term benefits to native vegetation. The use of herbicides would benefit native plant communities by decreasing the growth, seed production, and competitiveness of target invasive plants, and aiding in the reestablishment of native species.	Physical control methods could occur on up to 350 acres of vegetation annually. Implementation of this control approach would require significantly more man-power and mechanical tool utilization since manual and mechanical methods are work intensive and slow. To date, efforts to control invasive plants have only impacted ~50 acres annually. Where physical control methods are successful in managing invasive plant infestations, the impacts on native vegetation would be long-term, negligible and beneficial. Where physical control methods are not successful in managing invasive species infestations, the adverse impacts on native vegetation could be long-term.	Without the implementation of the Strategic Plan, there could long-term and adverse impacts on vegetation as invasive plant infestations would continue to grow in size and density, potentially moving from current areas of infestation and into natural areas, increasing the probability of further dispersal.
Soils	The effects of herbicides on soils would be minor to moderate, long-term and beneficial as soil function and biodiversity are restored. Use of herbicides would result in temporary changes in soil microorganisms. Once an herbicide contacts the soil, its fate and effects depend on herbicide chemistry, soil properties, and environmental conditions; the effects would be different for each herbicide and each soil/environment.	Minor, short- term, effects on soils would occur where control of invasive plants where plant infestations are dug up, however most control efforts would be conducted on soils that were previously disturbed by human activity. There would be long-term effects from the continued spread of invasive plants as in Alternative C.	Direct and indirect, long-term, minor to no adverse impacts on soils. Biotic and abiotic properties of soil could be altered by invasive plant which would continue to spread and potentially invade natural areas in the DHCMA.
Fish and Wildlife	The benefits to wildlife and habitat would be minor and localized in the near term	The impacts of invasive plant management activities on wildlife habitat and	Alternative C would have long-term, adverse, moderate impacts on

Resource	Alternative A: Proposed Action	Alterative B: Proposed Action without Herbicides	Alternative C: No Action
	but moderate and more widespread in the longer term because treatment methods would help control current or future invasive plant infestations into natural areas. The adverse impacts to wildlife and habitat would be no more than minor as animals may be exposed to small residual amounts of herbicides. The impacts to fish and aquatic organisms would be minor and on balance beneficial, provided that appropriate measures, including buffer zones around waterways, are taken. It is necessary to carefully consider the potential toxic effects of each herbicide.	populations would be generally beneficial and negligible to minor overall in the long-term. Similar effects would be apparent for fish and aquatic habitats. Where physical removal is effective, Alternative B would be sufficient to prevent establishment and spread and to preserve native wildlife habitat. Where physical removal is not effective herbicides may be the only effective means of controlling an infestation. Management of invasive plants under Alternative B would only partially achieve the desired condition of maintaining natural habitat. Lack of chemical control would likely allow some infestations to expand and colonize in native habitats.	wildlife. The predominant adverse effect of invasive plants on wildlife in the DHCMA is expected to be encroachment on native habitats. There is the potential for unchecked infestations become monocultures and replace of natural habitats. Invasive plant dominated stands would likely not have the capacity to support wildlife populations. Wildlife population numbers could be affected by reduced breeding territory availability and altered foraging home ranges.
Air Quality	Negligible, short- term, adverse impacts on air quality due to possible herbicide spray drift during treatment of invasive plants; drift would be minimal with mitigation based on BLM manuals and regulations for applying herbicides.	There would be no impacts on air quality under Alternative B.	Same as Alternative B
Water Resources	Alternative A would result in effective control of invasive plant infestations and benefit water resources and ecosystem integrity by preventing the establishment of riparian invasive plants with which can alter water quality due to flooding caused by infestations blocking channels or culverts. Some minor, short-term, adverse impacts from herbicide use could include degradation of water quality and harm to aquatic habitats, therefore buffers around waterways should be established.	Where physical control methods are successful, the impacts on water resources would be long-term, beneficial, and minor to moderate due to improved water quality and aquatic habitat. Where physical control methods are not successful in managing invasive plant infestations, the impacts on water resources could be long-term, adverse and moderate.	Long-term, moderate and adverse impacts on water resources as invasive plant infestations would continue to grow in size and density, have potential changes on riparian ecosystems, and cause related changes to hydrology. The results could include poor water quality, reduced structural and habitat diversity, increased soil erosion, run-off and bank instability, reduced ability to perform natural ecological functions, and lower resilience to natural disturbances such as floods.

Resource	Alternative A: Proposed Action	Alterative B: Proposed Action without Herbicides	Alternative C: No Action
Socioeconomics	Long-term, moderate and beneficial impacts in reducing the longer term cost to manage invasive plants and reducing losses associated with productive uses of affected lands. Any potentially adverse impact that may be associated with herbicide use would be minor and could be further reduced through effective mitigation.	Minor and long-term beneficial effects on socioeconomic resources. Reduction of overall long term costs associated with invasive plant management in the DHCMA, as well as reducing future losses associated with diminished productivity as a result of invasive plant infestation.	Substantial adverse effects on both the resident populations, especially subsistence communities, as well as the local economy in general. Impacts under this alternative would be expected to be adverse, moderate and long-term. Otherwise healthy and economically productive areas may be lost to the local economy. Without efforts to eradicate or control existing and future infestation, costs associated with any future management efforts would be expected to increase, as would the overall economic damage associated with forgone opportunities on affected lands.
Subsistence	Long-term, moderate and beneficial impact on subsistence practices, as well as on subsistence resource populations. Some potentially minor, adverse impacts may be associated with herbicide uses, but these can be mitigated via best management practices, public education, and consultation with the affected subsistence users.	Minor to moderate beneficial impact to subsistence users and resources where non-chemical control of invasive plants that threaten existing subsistence resources is effective.	The absence of strategic management would likely have minor to moderate adverse effects on subsistence resources. Over the long-term, impacts would be expected to become increasingly adverse, altering individual practices and uses due to changes in response to altered subsistence resource availability and accessibility.
Health and Human Safety	Treating invasive plants with herbicides using approved application methods as well as notifying the public and limiting traffic in areas where work is occurring would result in low overall risk of injuries to workers or the public. Risks to human safety would be largely limited to exposure to road traffic and vehicle accidents. These risks would be short-term, adverse and minor.	Crews working along the roadsides to manually or mechanically remove plants are at some risk in relation to vehicle accidents. The risk to human safety using manual removal treatments would be short-term, minor and adverse.	Same as Alternative B.

3.0 AFFECTED ENVIRONMENT

Resources in the DHCMA have the potential to be affected by the decision implemented under this EA in relation to invasive plant management. Resources discussed in this section are vegetation, soils, fish, wildlife, water resources, socioeconomics, subsistence, and human health and safety.

3.1 VEGETATION

Invasive plants are discussed in Section 1.2. Maps 2-5 in Appendix B depict locations of documented infestations. For each invasive plant species the recommended control methods are listed the Draft Strategic Plan Document (Appendix A).

The ecosystems along the Dalton Highway change with latitude; the southern area is largely boreal forest, followed by dry, tundra-covered hills and mountains where the road traverses the Brooks Range, and wet tussock-tundra is the dominant community north of the Brooks Range. The flora in the DHCMA is typical of Alaska's Interior and North Slope. The major plant communities are bottomland mixed forest, upland mixed forest, lowland mixed forest, lowland coniferous forest, tall shrub scrub, low shrub scrub, shrub bogs and bogs. A detailed description of vegetation types within the DHCMA can be found in the Chapter 3 (Affected Environment) of the Utility Corridor RMP (BLM 1989) and the Central Yukon RMP (BLM 1986).

Invasive plant species in the DHCMA most often occur in disturbed sites along roadways, trails, airstrips, and in communities, most often those classified as fill importation. No correlation has been observed between invasive plant occurrence in these sites and adjacent plant communities or vegetation classifications. Invasive plants have been recorded within natural fire boundaries along the Dalton Highway (Villano 2008), and on riverine gravel bars (Wurtz et al. 2008, Grondquist 2008).

Soil acidity is identified as an important factor explaining the distribution of non-native plant in some boreal forests (Rose and Hermanutz 2004). The upland soils of interior Alaska, including soils along roadsides, are generally acidic with pH values ranging 4.5 to 5.6 (Van Cleve et al., 1983). Due to the fact that the optimum pH for white sweetclover growth and N-fixation is neutral to basic (Smith et al., 1986; Sparrow et al., 1993), infestations along these interior Alaska roads would not be expected, including the Dalton Highway. However, the Dalton Highway roadside pH is more basic than other infested road corridors in interior Alaska (i.e. Steese and Taylor Highways) (J. Johnstone, http://www.lter.uaf.edu/data_b.cfm). Further research in needed to determine the specific biotic and abiotic factors that have made the Dalton region susceptible to nonnative plant establishment (Villano 2008). In addition, more basic mineral soil pH in the Dalton region may partially explain why roadside populations in the field were highest and why non-native plant movement from roadways into burned areas was greatest in the Dalton region (Villano 2008).

No federally listed or proposed threatened or endangered plant or animal species or habitats important to threatened or endangered species occur within the DHCMA. The BLM designates certain native species that occur on BLM lands as Sensitive and can make management decisions based on the conservation status of Sensitive Species (BLM 2010a). The Sensitive Species List includes federal candidate and proposed species, species that have been de-listed from the Endangered Species Act (ESA) during the past five years, and other species or distinct population segments that meet specific criteria in BLM Manual 6840. The BLM also designates a Watch List designed to identify species for which there is insufficient data to satisfy eligibility criteria, but whose status merits re-evaluation in the future after additional and/or more accurate data collection.

Table 3-1 lists vascular plants that occur along the DHCMA that the BLM Alaska identifies as sensitive or has placed on the watch list (BLM 2010a). Of the seven below-listed plant species documented in the DHCMA, four do not occur near areas occupied by invasive plants. The only known BLM listed sensitive plant which is known to occur within the DHCMA has only been documented far to the north (MP 291) of the current invasive plant infestations.

Table 3-1. BLM Listed Sensitive Plant populations documented in the DHCMA.

Common Name	Scientific Name	BLM Sensitive or Watch List	Populations occur near invasive plant areas?
Alaska starwort	*Stellaria alaskana*	Watch	Yes
Alpine smelowskia	*Smelowskia porsildii*	Watch	No
Arctic pennycress	*Thlaspi arcticum*	Watch	Yes
Low sandwort	*Arenaria longipendiculata*	Watch	Yes
Muir's fleabane	*Erigeron murii*	Sensitive	No
Rocky Mountain cinquefoil	*Potentilla rubricaulis*	Watch	No
Yukon aster	*Symphyotrichum yukonensis*	Watch	Yes

3.2 SOILS

A brief description of the soils found along the Dalton Highway between the Yukon River and the northern extent of BLM-managed lands at Dalton Highway Milepost 300 in the DHCMA is presented in the following paragraph. Information is summarized from discussion in the Renewal of the Federal Grant for the Trans-Alaska Pipeline System Right-of-Way Environmental Impact Statement (BLM TAPS 2002) unless otherwise noted.

In general, the DHCMA is an area where frost action dominates soil processes. Therefore, soil development in the DHCMA is strongly influenced by climate. The cold climate of this region inhibits organic soil decomposition since microbial communities are limited by a short growing season and low soil temperatures inhibit biological and chemical activity. Freeze-thaw processes physically disrupt the soil horizons (BLM 1989).

Permafrost is prevalent in the DHCMA. Permafrost is commonly classified as continuous (covering from 90% to100% of an area), discontinuous (50 to 90% coverage), sporadic (10 to 50% coverage), or isolated patches (up to 10% coverage) (Brown et al. 1997). The area south of Wiseman in the Middle Fork Koyukuk River drainage is underlain by discontinuous permafrost. The upper Middle Fork Koyukuk River drainage north to Dalton Highway Milepost 300 is underlain by continuous permafrost (Kreig and Reger 1982). Permafrost may be absent or discontinuous beneath major active streams. There is an active layer of soil overlaying the permafrost that undergoes freezing and thawing each year. The depth of the active layer (1-15 feet) is influenced by local climate, vegetation and snow cover, slope, and soil moisture conditions. (TAPS Owners 2001a in BLM TAPS EIS 2002).Thawing of the permafrost and poor drainage can cause operating areas to be wet with unconsolidated soil, resulting in the ground being more susceptible to erosion. Drying of these areas can lead to extremely dusty surface conditions.

Windblown silt is a key component in soil formation on the uplands near the Yukon River. Formation of the soils on the uplands to the north of the Yukon River, in the physiographic region often referred to as the Kokrine-Hodzana Highlands (Wahrhaftig 1965), depend on the distance from the river. Windblown silt is less prevalent in areas further north of the Yukon River. Soil formation on hilltops occurs mainly through weathering of bedrock. Weathered coarse-grained rock debris and a minor component of windblown silt from the hills are transported by mass wasting to the lower hillsides.

Thicker organic horizons are present in tussock meadows. Further north in the Koyukuk drainage, coarse-grained glacial and glaciofluvial sediments are distributed near the main channels of the Middle Fork Koyukuk and the South Fork Koyukuk Rivers. Soils outside the floodplain are made up of fine-grained silt and clay covering coarse-grained glacial till (Hamilton 1986). The Atigun Pass area is composed largely of exposed bedrock and coarse material. Unsorted coarse material is common in the soils near the toes of steep slopes in the Atigun River and Dietrich River valleys. Coarse-grained sand and gravel are believed to underlie these same valleys. Silt and sand deposits are present in the Atigun River floodplain (Kreig and Reger 1982). Soils of glacier-scoured basins (e.g. Galbraith Lake) are composed of boulders and larger cobble overlain with silt and clay.

Soils in the DMA are described in further detail on pages 3-4 and 3-5 of the Utility Corridor Proposed Resource Management Plan and Final Environmental Impact Statement (BLM 1989). Detailed soil surveys are not available for the area encompassed by this action.

3.3 FISH AND WILDLIFE

Wildlife

The Dalton Highway transects the northern boreal forest, the Brooks Range, and the tundra of the North Slope and Arctic Coastal Plain. Wildlife within the DHCMA includes moose, several herds of caribou, Dall sheep, brown and black bear, muskox, and several species of furbearer, small game, waterfowl, raptors, songbirds and other birds. A detailed description of fish and wildlife within the DHCMA can be found in Chapter 3 (Affected Environment) of the Utility Corridor RMP (BLM 1989) and the Central Yukon RMP (BLM 1986).

Many of the 158 bird species recorded in these habitats are detected along the highway during the breeding season. Migratory birds arrive and begin mating from late March to mid-May and depart beginning in late July through mid-July through mid-September. The period when most species are present and highest active nesting and brooding occurs is from early May through July. Six bird species documented with ranges that include the DHCMA are listed on the BLM-Alaska Sensitive Species List: short-eared owl, trumpeter swan, golden eagle, olive-sided flycatcher, blackpoll warbler and rusty blackbird. The BLM-Alaska Sensitive Species List includes one mammal, the Alaskan tiny shrew, whose range includes the DHCMA.

Fish

The BLM Utility Corridor Resource Management Plan (RMP) encompasses numerous streams and lakes in the DHCMA. The RMP identifies 22 species of fish found in the planning area including anadromous species such as chinook, chum and coho salmon as well as burbot, grayling, pike, lake trout, Arctic char, Dolly Varden and several whitefish species. These fish are utilized by subsistence users and recreational fishermen as well as commercial and sport fisheries. Table 3-2 provides a list of streams and lakes within the DHCMA with known regionally important fishery resources.

Table 3-2. Fish species which inhabit the streams and lakes of the DHCMA.

River/Creek/Lake name w/distance from the start of the Dalton Highway	Fish species inhabiting streams and lakes of the Dalton Highway Corridor Management Area
Yukon River MP 56	Chinook, coho and chum salmon have been documented as present in the Yukon River at the Dalton Highway bridge crossing (ADF&G 2011a). Arctic grayling, burbot, round whitefish, slimy sculpin, longnose sucker, sheefish, and northern pike, arctic lamprey, Bering cisco, broad whitefish, least cisco, humpback whitefish, are all present in this river.
Ray River	The Ray River flows into the Yukon River about a mile downstream of the Yukon River

River/Creek/Lake name w/distance from the start of the Dalton Highway	Fish species inhabiting streams and lakes of the Dalton Highway Corridor Management Area
MP 70	bridge. The road parallels, but does not cross, the river near MP 69. Chinook and chum salmon have been documented as spawning in this river (ADF&G 2011a). Arctic grayling, burbot, round whitefish, slimy sculpin, longnose sucker, sheefish, and northern pike occur in the Ray River. No Name Creek (aka North Fork of Ray River) is a tributary to the Ray River. The Dalton Highway crosses this stream at MP 80.
Kanuti River MP 106	This is the first tributary of the Koyukuk River crossed by the highway. Arctic grayling, burbot, round whitefish, slimy sculpin, and northern pike occur here. The Kanuti River flows through the Kanuti National Wildlife Refuge and joins the Koyukuk River about 80 miles downstream.
Fish Creek MP 115	Arctic grayling, longnose sucker, slimy sculpin, and round whitefish are present. Fish Creek joins Bonanza Creek and flows about 30 miles before reaching the South Fork of the Koyukuk River. There is a small parking turnout on the northeast side of the bridge. The stream is small, generally clear in summer, and offers good fishing for Arctic grayling.
Bonanza Creek - South Fork MP 125 mi and North Fork MP 126	These creeks contain Arctic grayling, burbot, round whitefish, slimy sculpin, lake (humpback) whitefish, longnose sucker, and northern pike. There is a good turnout on the southeast side of the bridge on the South Fork with room for a few campsites. The North Fork has a small turnout on the northeast side of the bridge. Both forks join within ¼ mile downstream of their crossing of the Dalton Highway.
Prospect Creek MP 135	Arctic grayling, northern pike, slimy sculpin, longnose sucker, and round whitefish are present. Chinook salmon spawn and rear in this creek (ADF&G 2011a). Prospect Creek flows into the Jim River within three miles downstream of its' Dalton Highway road crossing.
Jim River MP 140 (Bridge #1), MP 141 mi (Bridge #2), MP 144 (Bridge #3).	Arctic grayling, burbot, round whitefish, slimy sculpin, humpback whitefish, longnose sucker, and northern pike have been documented in the Jim River. Chinook salmon use this river for rearing and spawning habitat while chum salmon are known spawners in this system (ADF&G 2011a). This river is one of the most productive fisheries stream crossed by the Dalton Highway. The Jim River and Prospect Creek join and flow into the South Fork of the Koyukuk River. The road parallels the river for approximately 8 miles from Bridge Number 3 to the junction of the Bettles winter access road near Alyeska's Pump Station Number 5 (Prospect Camp).
Douglas Creek MP 142	Arctic grayling and slimy sculpin inhabit this creek. Juvenile Chinook salmon use this system for rearing habitat (ADF&G 2011a).
Grayling Lake MP 150	This 80-acre lake is relatively shallow, but constitutes an important spawning and rearing area for Arctic grayling. The outlet stream enters the Jim River.
South Fork Koyukuk River MP 156	Chinook salmon use this river for rearing and spawning habitat while chum salmon are known spawners in this system (ADF&G 2011a). Arctic grayling, longnose sucker, slimy sculpin, and round whitefish are present in the vicinity of the bridge. The South Fork joins the Koyukuk River between Bettles and Allakaket, approximately 75 miles downstream of

River/Creek/Lake name w/distance from the start of the Dalton Highway	Fish species inhabiting streams and lakes of the Dalton Highway Corridor Management Area
	the MP 156 bridge.
Unnamed stream MP 167	Chinook salmon rearing habitat is documented in this tributary to the Middle Fork Koyukuk River.
Rosie Creek MP 169	Chinook salmon use this creek downstream of the Dalton Highway as rearing habitat (ADF&G 2011a). Arctic grayling, Dolly Varden, slimy sculpin, and round whitefish are also present in this system.
Slate Creek MP 175	This stream enters the Middle Fork Koyukuk River at Coldfoot. Dolly Varden, Arctic grayling, slimy sculpin, and round whitefish are present. Chinook and chum salmon have been reported in this stream (ADF&G 2011a).
Marion Creek MP 180	Arctic grayling, small Dolly Varden, slimy sculpin, and round whitefish are present in the creek. Chinook salmon use this creek as rearing habitat while chum salmon are known spawners in this system (ADF&G 2011a).
Minnie Creek MP 187	Dolly Varden, Arctic grayling, long nose sucker, slimy sculpin, burbot, and round whitefish are present in this small stream. Chinook salmon use this creek as rearing habitat (ADF&G 2011a).
Middle Fork Koyukuk River-- Three bridge crossings from MP 189 to MP 204	Chinook and chum salmon, and sheefish are catalogued as present in this system (ADF&G 2011a)., Dolly Varden, Arctic grayling, long nose sucker, slimy sculpin and round whitefish are present in the Middle Fork Koyukuk. The river flows south to join the North Fork of the Koyukuk River. Fish from many of the smaller tributary streams may use the Middle Fork for overwintering.
Hammond River MP 190	Dolly Varden, Arctic grayling, slimy sculpin, and round whitefish occur in this river. Chum salmon are catalogued as rearing and Chinook salmon are listed as present (ADF&G 2011a).
Bettles River MP 208	Chum salmon are catalogued as present (ADF&G 2011a). Grayling, round whitefish, and longnose sucker have been documented in this river (ADF&G 2011b).
Dietrich River	Dolly Varden, Arctic grayling, burbot, long nose sucker, slimy sculpin, and round whitefish occur in this river. The Dietrich River parallels the Dalton Highway from Chandalar Shelf near Dalton Highway MP 235 until it joins the Bettles River near Dalton Highway MP 208 to form the Middle Fork Koyukuk River. The river is braided and travels through a broad floodplain.
Atigun River - bridge crossings at MP 253 & 271	Arctic grayling, Dolly Varden, burbot, slimy sculpin, and round whitefish are present. Arctic grayling are distributed throughout the upper Atigun River and many of its tributaries. Several miles of stream are accessible from the Dalton Highway as far north as the bridge at 271 mile.
Tee Lake	This lake is located near the Dalton Highway adjacent to the access road to Pump Station

River/Creek/Lake name w/distance from the start of the Dalton Highway	Fish species inhabiting streams and lakes of the Dalton Highway Corridor Management Area
MP 270	Number 4. Present here are Arctic grayling, burbot, slimy sculpin, round whitefish, Dolly Varden and lake trout.
Galbraith Lake MP 275	Arctic grayling, Dolly Varden, lake trout, burbot, and whitefish are all present. Water is slightly turbid, and maximum depth has been measured at 23 feet in this 1,030 acre lake. Lake trout are occasionally present in the lower portion of the inlet stream in the fall.
Toolik Lake MP 284	Present are Arctic grayling, lake trout, burbot, slimy sculpin, and round whitefish (ARC LTER 2011). The lake drains north into the Kuparuk River. The University of Alaska operates an Arctic biology field research station at Toolik Lake, located at the termination of the access road. Maximum depth is about 77 feet and area is 358 acres. Inlet and outlet streams are present.
Kuparuk River MP 289	Arctic grayling and slimy sculpin are present (USDI 2010).
Oksrukuyik Creek MP 298	Arctic grayling, burbot, Dolly Varden, lake trout, broad whitefish and slimy sculpin are present (USDI 2010). This stream, which drains the Campsite Lakes 5 miles south of the road, also crosses the road at 310 mile just north of Pump Station Number 3.

3.5 WATER RESOURCES

In general, the headwaters of all the major watersheds in the DHCMA are located in the Brooks Range or its foothills. Exceptions to this are those rivers in the southern portion of the DHCMA with headwaters located in the Kokrine-Hodzana Highlands. Drainages north of the continental divide flow north into the Beaufort Sea (Arctic Ocean). Those drainages south of the continental divide flow into the Yukon River and eventually the Bering Sea. Table 3-3 lists the major rivers found, at least partially, within the boundaries of the BLM-managed lands along the Dalton Highway. There is an abundance of rivers, streams, and wetlands in the DHCMA and most NIP locations occur in wetlands or near surface water.

Table 3-3. Major rivers in the DHCMA.

South of the Continental Divide (drain into the Yukon River)	North of the Continental Divide (drain into the Beaufort Sea)	
Yukon	Anaktuvuk	Killik
Ray	Atigun	Kurupa
Jim	Canning	Kuparuk
Dall	Colville	Nanushuk
Kanuti	Chandler	Oolamnagavik
Fish Creek	Ivishak	Sagavanirktok
South Fork Koyukuk	Itkillik	Shaviovik
Middle Fork Koyukuk	Kadleroshilik	Toolik
Chandalar	Kavik	

Source: BLM 1989

Many of Alaska's lakes and streams are frozen, or partially frozen, for five-six months of the year. In late April and May, "breakup" is when the snow melts, and the lakes and streams thaw. A typical Alaska stream experiences low flow from December through March, peak flow during breakup in May-June, lower summer flows in July and August, secondary peak flows produced by rainfall in September-October, and declining flows in November.

Watershed condition in the DHCMA is good to excellent. Erosion is not a problem except in areas where the vegetation cover is disturbed or stream channel morphology is altered. When the vegetation cover is disturbed and the ground ice (where present) melts, many of the fine grained soil particles erode, resulting in silt pollution of nearby streams and lakes. Erosion is most prevalent along roads and trails, at construction sites, and mining operations.

Surface water quantity and quality varies with the season. Generally, maximum discharge occurs during spring breakup which usually happens during the latter part of May south of the Brooks Range and during the middle of June north of the Brooks Range. Stream discharge rates peak during snow melt and summer rains. The presence of permafrost decreases infiltration, increasing runoff peaks but reducing base flow rates. In the fall and winter, much of the precipitation and runoff are in a frozen state, and stream flow declines. Seasonal snowpack is the most important annual water storage component in the hydrologic cycle. River icings also store considerable quantities of water.

Water quality is generally good except during high water events and downstream from some construction projects and placer mining operations. Total dissolved solids vary considerably with the flows. Chemical quality tends to be better during the summer when the flows are higher and the impurities are diluted. Smaller streams usually have better water quality than larger rivers. Waters south of the continental divide are of the calcium bicarbonate type.

Consumptive water use is probably greatest in the Sagavanirktok watershed and is estimated at less than 100,000 gallons per day (BLM 1989). Water use here is primarily from surface water due to the difficulties maintaining wells in permafrost materials. Elsewhere in the DHCMA, water use is unknown but is probably minimal due to the small number of users.

3.6 SOCIOECONOMICS

The analysis of socioeconomic impacts identifies those aspects of the social and economic environment that are sensitive to change and that may be affected by actions associated with the alternatives proposed here. Specifically, this assessment considers how actions included by each of the alternatives might affect individuals, communities, and the economy of the region surrounding and including the DHCMA. This section addresses those socioeconomic elements within this context that may be affected by implementation of the alternatives.

Covering an approximate area of more than 3,100 square miles, the DHCMA extends approximately five miles to the east and west of the Dalton Highway, running north from the Yukon River to the south of Slope Mountain (MP 302). The southern and middle portions of the DHCMA are included in the unincorporated Yukon - Koyukuk Census Area. Portions of the DHCMA to the north are part of the incorporated North Slope Borough.

Demographics

A part of Alaska's Interior, the Yukon - Koyukuk Census Area covers approximately 145,899 square miles (93,375,360 acres). Of that acreage, 3,540,000 acres are within the DHCMA. With an estimated 2009 population of 5,627, the area has a population density of less than one person per square mile (Census, 2010). Of the total census area population, one third, or 1,912 residents, live in the four largest communities, Galena, Fort Yukon, Nenana, and McGrath, none of which are located in the

DHCMA. Two small Yukon - Koyukuk communities, Wiseman, population 16, and Coldfoot, population 13, are located within the DHCMA (Alaska, 2010). In 2000, the residents of Yukon - Koyukuk Census Area were living in a total of 2,309 households with an average household size of 2.81 persons. American Indian and Alaskan Native populations accounted for approximately 70.9 percent of the total population, or 4,644 individuals (Census, 2008).

The North Slope Borough (NSB) includes an area of approximately 88,817 square miles (56,842,880 acres). Of that acreage, 436,000 acres (11% of total NSB) is within the DHCMA. The estimated population for the borough in 2009 was 6,752 residents. All of those residents live outside of the DHCMA. By contrast with the State of Alaska, with a population density of 1.1 persons per square mile, the population density of the NSB was less than one person per square mile (Census, 2010). Both the NSB and the Yukon - Koyukuk Census Area have lost population since the 2000 census. The NSB contained a total of 2,109 households in 2000, with an average household size of 3.45. Of the total population, 5,050 residents, or 68.4 percent, identified as American Indian or Alaska Native (Census, 2008).

Regional Economy

The economies of the Yukon - Koyukuk Census Area and the North Slope Borough are characterized by a mixture of market based and subsistence practices. Major activities include hunting, fishing, resource harvesting, small scale agriculture (primarily as family gardens) and the major oil production facility at Prudhoe Bay. With a sparse population and relatively undeveloped resources, the Yukon – Koyukuk Census Area is heavily dependent on government employment, which accounts for approximately 66 percent of the area's wage and salary income. Private sector employment is primarily associated with Alaska Native organizations. Subsistence practices continue to be important both culturally and as a primary source of economic maintenance. Oil production at Prudhoe Bay has been declining, but it remains an important industry in the North Slope Borough, employing more non-residents than the borough's total population and providing opportunities for businesses that support oil field operations. The North Slope Borough also serves as a sea and air transportation hub (Alaska, 2010).

In May 2010, the two areas (Koyukuk and North Slope) had a combined labor force of 8,289 with a combined unemployment rate of 8.9 percent. Annual unemployment rates for the Yukon-Koyukuk Census Area have been consistently high, ranging from 13.3 percent in 2007 to 15.7 percent in 2009. By contrast, the North Slope Borough has experienced substantially lower, unemployment rates, ranging from 5.2 percent in 2007 to 4.7 percent in 2009 (BLS 2010). Per capita personal income for Yukon - Koyukuk residents in 2008 was $31,187, approximately 78 percent of the national average, $40,166. For North Slope residents, per capita income was $66,664 which is 166 percent of the national average (BEA 2010). Labor force and income characteristics for both the Yukon - Koyukuk Census Area and the North Slope Borough are presented in Table 3-4.

Table 3-4. Labor force and income data, Yukon-Koyukuk and Borough of North Slope.

	Labor Force (May 2010)[1]	Unemployment Rate[1]	Per Capita Income[2]	Median Income (Household)[3]	Percent below poverty[3]
Yukon-Koyukuk	3,171	14.8%	$31,187	$33,900	24.9%
North Slope	5,118	5.3%	$66,664	$72,499	11.4%

1. BLS 2010, 2. Source: BEA 2010 3. Source: Census 2010

Economics of Non-native Invasive Plants

Management and control of invasive plants on non-agricultural land involve a number of agencies, organizations and individuals, including: federal, state and local agencies; nongovernmental organizations, and; businesses and private landowners in both natural and disturbed areas. They impact the natural environment by displacing native species, resulting in damage to economically valuable plants and animals, as well as industry and the local economy (USGAO 2005). Estimates of the economic costs associated with controlling invasive plants and the damage they can cause to property and natural resources are estimated at $34.5 billion annually across the United States (Olson 2006).

Within the State of Alaska, statewide inventories have identified over 27,000 infestations of invasive plants, including over 800 infestations along the Dalton Highway (BLM 2008). The Yukon - Koyukuk Census area is among the top jurisdictions in Alaska in terms of number recorded, with 72 species listed as of 2010 (UGA 2010). Invasive plants are invading healthy, productive rangelands, forestlands and riparian areas affecting recreation areas, public lands, National Parks, State Parks, roadsides, streambanks, federal, state, and private lands. Economic effects associated with invasive plants include the destruction of wildlife habitat, reduced opportunities for hunting, fishing, camping and other recreational activities, reduced plant and animal diversity and estimated costs in the millions of dollars for treatment and lost productivity of the land for private landowners (BLM 2008).

3.7 SUBSISTENCE

A detailed description of subsistence resources within the DHCMA can be found in Chapter 3 (Affected Environment) of the Utility Corridor RMP on pages 3-12 (Fisheries) and 3-28 (Subsistence) (BLM 1989) and the Central Yukon RMP beginning on pages 132 (BLM 1986).

The Alaska National Interest Lands Conservation Act (ANILCA), Title VIII, provides a priority to rural residents of Alaska for subsistence uses. Subsistence living patterns and resource use practices are an integral part of the history of Alaska and persist throughout the state as a fundamental part of contemporary culture. Subsistence harvests represent a major component of the economy and social welfare of most rural regions, especially the interior regions in and surrounding the DHCMA (Wolfe and Walker 1987).

Subsistence preference is given to all rural residents. Federally qualified rural populations in and adjacent to the DHCMA include the communities of Coldfoot, Wiseman, Allakaket, Alatna, Evansville, Bettles, Hughes, Huslia, Koyukuk, Rampart, Tanana, and Stevens Village (USDI 2010). Rural settlements in the DHCMA and surrounding vicinity are presented in Table 3-5.

Table 3-5. Rural settlements in the DHCMA and vicinity.

Village	2009 Population	Native Populations
Allakaket	100	Athabascan
Alatna	22	Kobuk Eskimos
Bettles	19	Mixed native and non-native
Coldfoot	13	Non-native population
Evansville (Bettles Field)	13	Athabascan and Inupiat Eskimos.
Hughes (Hut'odleekkaakk')	83	Koyukon Athabascan
Huslia	265	Athabascan
Koyukuk	105	Koyukon Athabascan
Rampart	12	Koyukon Athabascan
Stevens Village	64	Kutchin Natives
Wiseman	16	Mixed native and non-native

Source: ADCRA, 2010

3.8 HUMAN HEALTH AND SAFETY

Environments along the DHCMA are generally clean with the greatest threats to human health and safety occurring from automobile accidents, slips-trips-and-falls, and wildlife encounters (mostly bear and moose, but also stinging insects). Another threat to human health and safety is from diseases from impure or infected water. Giardia, West Nile virus, and avian influenza are issues in Alaska. The BLM follows the National protocol for Integrated Pest Management and any use of chemicals to control pests is carefully screened. Only trained applicators are allowed to spray chemicals with appropriate personal protective equipment (PPE).

There are no known violations of federal or state law in the DHCMA related to air (ADEC, no date-a) or water quality (ADEC 2010). One air pollutant that may be a problem is particulate matter (PM10), or dust (ADEC, no date-b). Dust is a widespread problem in Alaska. The ADEC, Division of Air Quality receives as many complaints about dust as complaints about other air pollution problems. Over 50 villages have expressed concerns about dust, including Stevens Village. Twelve villages, including Stevens, either have or are conducting PM10 monitoring. EPA's retention of a PM10 standard is a good opportunity to reduce dust emissions.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This section describes the environmental effects associated with the alternatives and presents the analysis of the direct, indirect, and cumulative impacts. The following resources have been determined to have impacts as a result of Alternative A (Proposed Action), Alternative B (No Herbicide), and Alternative C (No Action): environmental, socioeconomic, subsistence, and human health and safety. The analysis includes the identification of adverse environmental effects that cannot be avoided but can be mitigated.

Potential impacts are described in terms of type (beneficial or adverse), context, duration, and significance. The following general definitions were used to evaluate impacts associated with project alternatives.

4.1.1 Duration of Impact

Impacts would occur only during the time that project activities are being conducted. In the interim between these activities, resource conditions would return to pre-activity conditions. Short-term impacts would extend beyond the time of project activities, but would not last more than one year. Long-term impacts would likely last more than one year and can potentially continue indefinitely, in which case they could also be described as permanent.

4.1.2 Context

Context is the setting within which an impact is analyzed. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Localized impacts are those that affect the resource only on the project site or its immediate surroundings and would not extend to the whole town or into the region. Regional impacts would affect the resource on a regional level, extending well beyond the immediate project site.

4.1.3 Intensity of Impact

The impact intensity designations used in this document represent an estimation of the degree to which a resource would be beneficially or adversely affected by an action. Impact intensities are quantified as negligible, minor, moderate, or major as defined in Table 4-1.

4.1.4 Cumulative Effects

A cumulative impact is an impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of which agency (federal or non-federal), organization, or person undertakes such other actions. Cumulative impact s can result from individually minor, but collectively significant, actions taking place over a period of time.

Table 4-1. Impact intensity level definitions.

Negligible	Minor	Moderate	Major
Minimal impact on the resource would occur; any change that might occur would be barely perceptible and not be easily measurable.	Change in a resource would occur, but no substantial resource impact would result; the change in the resource would be detectable but would not alter the condition or appearance of the resource.	Noticeable change in a resource would occur and this change would alter the condition or appearance of the resource, but the integrity of the resource would remain intact.	Substantial impact or change in a resource area would occur that is easily defined and highly noticeable and that measurably alters the condition or appearance of the resource; the integrity of the resource may not remain intact.

Cumulative impacts are considered for all alternatives and are presented at the end of each impact topic discussion analysis. To determine potential cumulative impacts, projects in the vicinity of the proposed project site were identified. Potential projects identified as cumulative actions included any planning or development activity that was currently being implemented or that would be implemented in the reasonably foreseeable future.

These cumulative actions are evaluated in the cumulative impact analysis in conjunction with the impacts of each alternative to determine if they would have any additive effects on natural resources, socioeconomics, subsistence, and human health and safety. Because some of these cumulative actions are in the early planning stages, the evaluation of cumulative effects was based on a general description of the project. Known past, current and reasonably foreseeable future projects and actions in the vicinity of the project area are described below.

Past and Present Projects and Actions

The Dalton Highway was built in 1974 as a “haul road” to resupply oil fields on the North Slope and to maintain the Trans Alaskan Pipeline. Originally meant only for industrial traffic, the Dalton Highway was opened for public use in 1995. The Utility Corridor was withdrawn by Public Land Order 5150 on December 30, 1971 to protect the route of the Trans-Alaska Pipeline. The Utility Corridor RMP, completed in 1991, provides specific management guidance for the Utility Corridor. Within the corridor, all lands were opened to mineral location and leasing except for certain areas, such as the “inner corridor”. Notably, a winter ice trail is constructed from the Dalton Highway to the community of Bettles at MP 136 each year. The trail follows the old Prospect Camp access road to the Jim River and crosses BLM-managed lands.

There are active mineral extraction activities ongoing in the DHCMA. Gravel is mined to maintain the road and other infrastructure including airstrips. As a result there are approximately 50 gravel pits connected to the Dalton Highway by varying lengths of spur roads. Mining activity, including placer mining, alters vegetation and soil as well as water quality. Mines are connected to the Dalton Highway by varying lengths of spur roads, and are often set in remote areas some distance from the highway. Mineral extraction related disturbance and traffic can lead to increased introduction and spread of invasive plants.

Finally, several licensed hunting guides are permitted to guide within the DHCMA. These guides as well as other users utilize airstrips and boat launches in the DHCMA to access to other, often remote, areas.

Future Projects and Actions
Utility Corridor – There are plans for one large natural gas pipeline going out of state and one smaller gas pipeline in-state, which could be installed in undisturbed areas and may not follow the existing corridor.

Doyon Ltd. has been permitted by the BLM to develop an ice road from the Five Mile airstrip at MP 60 on the Dalton Highway to Stevens Village for exploration on corporation lands. Construction and use of the ice road is expected to begin in the fall of 2012. A 20 m by 10 m patch of well-established Canada thistle (Creeping Thistle) was detected at the Stevens Village airstrip 2011. Treatments there began 2012 and repeated treatments are anticipated.

Currently oil and gas development potential is being explored within inholdings within and near the Yukon Flats Wildlife Refuge. These development areas would likely be accessed from either the Dalton or Elliott Highways, which would involve the construction of new road spurs and/or pipelines.

The State of Alaska, Department of Transportation and Public Facilities, is proposing the Foothills West Transportation project, also known as the Umiat Road. The future uses of the road could include access to oil and gas fields at Umiat and Gubik, access to the State-owned airport at Umiat, facilitation of access to the National Petroleum Reserve-Alaska (NPR-A), and support of potential future oil and gas pipelines. The proposed route would leave the Dalton Highway at ~MP 275. Alternative routes are being considered that would leave the Dalton Highway north of milepost 301, which would avoid BLM-managed lands. At a minimum, assuming the construction goes forward as proposed, there would be commercial and industrial traffic leaving the Dalton and traveling to Umiat. Additionally, a road to the village of Ambler has been proposed. This project is in the study phase and no proposed route has been formally considered to date. However, this proposed road is of interest since one potential route includes the existing Bettles Ice Road track.

4.2 VEGETATION

4.2.1 Impact of Alternative A

Impact Analysis
Alternative A involves implementation of both physical and chemical (herbicide) treatments in an effort to control invasive plant infestations. For small infestations (generally ≤ 1 acre) and/or where physical removal is likely to be an effective treatment, infestations will be physically treated. For larger infestations (generally ≥ 1 acre) and/or where physical removal of invasive plants is likely to be ineffective, infestations would be chemically treated. The effects of physical removal of invasive species implemented under this this alternative would be similar to the effects described in Alternative B but less pronounced since a combination of chemical and mechanical treatment would

be applied. Although implementation of Alternative A would include both physical and chemical control treatments of invasive plant infestations, this section (Section 4.2.1) focuses on the potential impacts of herbicide application on adjacent native vegetation whereas while the next section (Section 4.2.2) is focused on potential impacts of physical treatments.

At the end of the 2012 growing season, the estimated area of invasive weed infestation was approximately 350 acres. The vast majority of the area infested with invasive plants is located in areas subject to current or recent (past 40 years) human disturbance, particularly areas disturbed by the use of heavy equipment including roadsides and gravel pits. The draft Strategic Plan, completed before the 2009 summer field season, recommended herbicide application as the most effective treatment method.

Under Alternative A up to 300 acres could be treated by a combination of chemical and physical control methods, with adjustments to the treatment plan to adapt to newly discovered treatment requirements over the course of the five year implementation of this plan. Repeated treatment using both chemical and mechanical methods may be required based on treatment success and plant biology (e.g. longevity of seed viability and resistance to chemical treatment).

Herbicide application would in most cases lead to plants exhibiting reduced vigor, abnormal growth, or mortality. Plant response to herbicide exposure is a function of plant sensitivity to a given herbicide and the degree to which the plant is exposed to the herbicide. Where herbicides are used to control invasive plants, interspersed and adjacent non-target plants may be subject to exposure to herbicide as a result of: 1) direct contact from herbicide spraying, 2) runoff, 3) wind transport, and 4) accidental spills. Despite the potential for some impact of herbicide application to adjacent and interspersed non-target plant populations there would not be a substantial impact on larger-scale plant populations, plant community structure, or ecological processes. The impacts to non-target plants will be minimized by strictly following the manufacturer's recommendations, BLM Standard Operating Procedures, and BLM Mitigation Measures and project-specific mitigation measures outlined in Section 2.1.1.

The impacts of herbicides on plants are not entirely predictable. For example, invasive plants may re-sprout or re-seed rapidly in response to herbicide application; showing an increase in vigor rather than the expected detrimental effects. Treatment success may therefore be a function of multiple factors and may require the use of a combination of control methods as well as repeated treatments. Although it is well-documented that resistance to a given herbicide may increase over the course of multiple applications, it is not expected to occur as a result of the implementation of Alternative A since herbicide application levels will be relatively low and there is no history of herbicide application in the proposed treatment area.

The degree to which non-target plants interspersed with invasive weeds are affected will vary, depending on the method of herbicide application (either hand-spray of targeted individual plants or broadcast spray of selected areas) and the given native species' sensitivity to the applied herbicide. In order to minimize the re-establishment of invasive weeds following herbicide treatment it may be advantageous to re-seed treated areas with native species. A continuous or near-continuous cover of native plants is likely to reduce the ability of invasive weeds to become re-established as a result of competitive interactions for water, light, and nutrients. Seeding must be conducted using only "weed-free" seed per BLM policy. As described in the Draft Strategic Plan (Appendix A), the planting of native grasses and forbs in disturbed areas, such as along the Dalton Highway, would be conducted in conjunction with weed treatments as appropriate.

The active ingredients in herbicides considered for use under Alternative A vary in plant selectivity (i.e. the degree to which the active ingredient targets certain plant families while having little to no effect on others). For instance, the herbicide glyphosate is non-selective and will have detrimental effects on all species contacted. Most grasses are resistant to chlorsulfuron, clopyralid, triclopyr, and 2,4-D and most conifers are resistant to imazapyr and metsulfuron. It is recommended that, prior to control implementation, the herbicide applied to control invasive plant species in the proposed area should be shown to have the least possible impact on native plant species located adjacent to an invasive species infestation. It is also recommended that the herbicide applied to the area is shown not to persist in the soil to the detriment of re-seeded species planted after the herbicide treatment course.

Maintenance of and upgrades to the Dalton Highway may lead to further removal of native vegetation, leading to new areas susceptible to invasive plant infestation. Cooperative partnerships with the Alaska Department of Transportation and the Cooperative Weed Management Area, which would be created under Alternative A, will help mitigate the occurrence of new infestations. The partnerships will re-establishment of native roadside vegetation through re-seeding efforts in newly disturbed areas.

To date, there is no evidence that BLM listed rare plant species grow interspersed with invasive plants in the DHMCA. The only designated rare species listed in the DHCMA is Muir's fleabane. This species has been recorded at one location in the DHCMA, which is not in the vicinity of the currently proposed herbicide treatment area.

However, several potentially rare plant species listed on the BLM Watch List do occur near the proposed treatment area (Table 3-1). In order to minimize adverse impacts to Watch List species, pre-treatment surveys for potentially these plants and their habitats should be conducted within and adjacent to proposed treatment areas. Impact to watch list plant species would be minimized by; 1) designating buffer zones around sensitive plants, 2) managing herbicide drift where sensitive plants are known to occur, 3) choosing herbicide formulations that are not easily carried by insects, and 4) choosing herbicides that degrade quickly and will not persist in ecosystem processes for long periods.

None of the proposed herbicides are considered to be insecticidal, however there is some evidence that 2,4-D and Dicamba could adversely affect exposed pollinators, including honeybees and other insects. Careful effort to direct spray streams directly at target vegetation and to minimize drift should minimize exposure of honeybee and pollinator populations. Notably, preliminary results from a study conducted in interior Alaska suggest that the presence of invasive white sweetclover results in increased pollinator abundance and richness as well as decreased pollinator visitation to nearby native plants (Schneller *in prep*).

Cumulative Effects

The primary human impacts to vegetation in the DHCMA are vegetation clearing, access route construction and maintenance, mineral material development, and infrastructure construction and maintenance. Additional impacts include irregular disturbance by visitors through trampling and recreational activities such as camping. Human activity leads to the creation of disturbed areas which increases the probability of current and future infestation by invasive plants. Once infested, disturbed areas become vectors for invasive plant spread into other areas.

In 2009 it was documented that an estimated 215 acres within the DHCMA were infested with medium- to high-risk invasive plants. Physical removal of invasive plants has been conducted annually in the DHCMA on < 25% of the infested area. At the end of the 2012 growing season it was estimated that 350 acres of the DHCMA were infested with invasive weeds. Weed control efforts have been centered on road intersections with waterways, since waterways can be vectors for invasive plant spread away from anthropogenic disturbances.

In the DHCMA, past and ongoing human impacts to native vegetation adjacent to the human-disturbed areas currently infested with invasive weeds ranges from minor to moderate. The impacts of herbicide application to the areas currently infested may be relatively minor compared to the scale of other human impacts (e.g. road maintenance and construction, mineral extraction) on the proposed treatment area. Implementation of Alternative A would be beneficial despite some relatively minor negative effects, since it would lead to the reduction or elimination of invasive weed infestations.

Conclusion

Implementation of Alternative A would likely result in the effective control of invasive plant infestations in the proposed treatment area. Removal of invasive plants may, in the long-term, help preserve native vegetation communities and ecosystem integrity by preventing large-scale spread from their current locations in human-disturbed areas to undisturbed naturally vegetated areas. The short-term adverse impacts to adjacent native vegetation, sensitive plant species, and pollinators would be outweighed by the moderate, long-term benefits to native vegetation.

4.2.2 Impact of Alternative B

Impact Analysis

This Alternative entails implementation of physical control methods only; it does not include chemical control of invasive plants. Physical control methods, including pulling and cutting, would be employed on up to 300 acres of the currently estimated 350 acres in the DHCMA infested by invasive plants.

Mechanical cutting or hand-pulling can be an effective control method for some invasive plant species. Cutting in currently infested areas will also result in damage to or mortality of non-target plants interspersed within invasive plant infested areas. However, most of the infested areas that would be selected for cutting treatment are in areas that are subject to periodic vegetation disturbance (particularly roadsides and active mineral extraction sites). Therefore the disturbance associated with cutting invasive plants will not further impact non-target species to a significant extent. Notably, most of the non-target native species growing interspersed with invasive weeds are perennial and capable of re-sprouting from rootstocks. Cutting of invasive plants in currently infested areas would have little to no effect on native vegetation in previously undisturbed areas.

The other physical removal methodology that would be employed under this Alternative is digging and pulling so that the entire plant, including the root system, is removed. This method of removal can very effective for some common species in this region, for example *Melilotus alba*, and can prevent both re-sprouting and seed spread. Plants should be manually removed prior to seed maturation to prevent the spread of seeds in treated areas. This activity has little to no effect on either interspersed non-target species in infested areas or on adjacent native plant communities.

For some invasive species in the DHCMA, physical removal of invasive plants may not be an effective method of control. Particularly for species capable of producing new shoots from below-ground rootstocks such as one common invasive in this region, *Vicia cracca*. For these species, physical control can stimulate re-sprouting, growth and ultimately the vigor of invasive plant infestations. Manual and mechanical methods can also be unfeasible due to large population sizes and individual plant morphology.

Sensitive plants are unlikely to be affected by physical control of invasive plants. There is no evidence that rare or sensitive plants grow interspersed with invasive plants.

<u>Cumulative Effects</u>
The primary past, present and reasonably foreseeable anthropogenic impacts to vegetation in the DHCMA are the same as for Alternative A.

The impacts of physical removal of invasive plants on non-target species and adjacent native vegetation communities from the cumulative case are minor to moderate. The impacts of physical control methods to native vegetation would be minor relative to the other human disturbances in the infested areas, posing a negligible additional impact to ecosystem processes while benefiting the effort to reduce invasive plant spread. The additional effect of implementation of Alternative B to other past, present, and future impacts to vegetation would is negligible relative to background disturbance levels.

<u>Conclusion</u>
Where physical control methods are successful in managing invasive plant infestations, the short-term impacts on interspersed and adjacent native vegetation would be minor while the long-term control of the species would likely benefit native ecosystem processes by reducing the spread of the species into areas not subject to human disturbance. Where physical control methods are not successful in managing invasive plant infestations, the long-term impacts on native vegetation resources could be long-term, adverse and moderate.

4.2.3 Impact of Alternative C

<u>Impact Analysis</u>
Under Alternative C, there would be no strategic management or control of invasive plants in the DHCMA. Control efforts in the region would continue to be conducted in a less targeted fashion, similar to those conducted to date. The highest-risk invasive plant species are likely to continue to spread if left largely uncontrolled. If invasive species move from infestations which are currently largely localized to human-disturbed areas, and into natural vegetation communities in undisturbed areas, there could be a significant impact to native vegetation communities. For thorough accounts of the impacts from individual invasive species on native vegetation refer to *Invasive Plants of Alaska* (AKEPIC 2013). If invasive species in the DHCMA spread from their current distribution, and substantial infestations occur in natural native vegetative communities any of the below-listed repercussions of invasive plant infestations could occur. The following paragraphs outline some of the potential issues associated with invasive species.

Largely uncontrolled infestations of invasive plants could result in moderately adverse impacts to native vegetation. In other regions, invasive species have been shown to have the capacity to displace native plant communities by forming dense monocultures and outcompeting native plants for moisture, light, and nutrients. These changes have been shown to alter plant community composition and diversity. Some invasive plant species alter soil nutrient composition (particularly nitrogen-fixing species) and moisture availability, thereby altering native plant community composition. Disturbance regimes and the rate and composition of plant succession following disturbance can be affected by invasive plants. The presence of invasive plants, may alter native plant-pollinator networks; increased pollinator abundance and richness as well as decreased pollinator visitation to nearby native plants has been recorded at sites with white sweetclover (Schneller *in prep*).

BLM sensitive plants could be threatened by competition with invasive plants if substantial encroachment into native vegetation by invasive plants occurs. Encroachment on sensitive species habitat by invasive species could result in reductions in population size and vigor, and possibly local extirpation.

Cumulative Effects

The primary anthropogenic impacts from past, present and reasonable foreseeable actions in the DHCMA are the same as for Alternative A.

The impacts of uncontrolled invasive plant infestations under Alternative C would be multiplicative depending on the disturbance level maintained in the vicinity of the infestations. In this area, disturbed areas such as roads, trails, and cleared areas generally provide the conditions for invasive plant establishment and spread while undisturbed native plant communities appear to be limiting invasive plant expansion.

However, it is important to note that boreal habitats, such as those in the DHCMA, may become more susceptible to invasive plant species infestations under conditions of climate change (see Section 1.2). Climate change may favor invasive plants if the amount and seasonal distribution of precipitation and seasonal temperature patterns shift in a manner conducive to invasive plant growth. If invasive plants are able to successfully move into areas not affected by human disturbances, invasive plants could alter the plant composition of ecosystems and change their structure and function over large landscape areas. This encroachment on native communities may happen more rapidly in the Arctic and Subarctic regions where climate change appears to happening at an accelerated rate compared to other regions. It is possible that invasive plants may also be better adapted than native species to the new environmental conditions resulting from climate change, thus outcompeting native plants and changing vegetation community composition and type. If invasive plants are not controlled and climate change favors invasive species encroachment on native vegetation communities, adoption of this alternative would be potentially detrimental to native vegetation.

The impacts on vegetation from past, present, and reasonably foreseeable actions are minor to moderate. Adverse impacts of Alternative C on vegetation from not managing invasive plants would be moderate. The additive effects of Alternative C to the cumulative case impacts on vegetation would result in no more than moderate overall impacts.

Conclusion

The effects of Alternative C on undisturbed native vegetation would be direct, long-term, moderate and adverse as invasive plant infestations would continue to grow in size and density. Ongoing uncontrolled infestation and future environmental conditions will increase the probability of dispersal into new disturbed areas and may lead to displacement of native plants.

4.3 SOILS

4.3.1 Impact of Alternative A

Impact Analysis

Alternative A involves use of manual, mechanical, and herbicide treatments to control invasive plants. It is expected that non-chemical means would be employed on small infestations species where this method can be effective. For larger infestations or for invasive plants where manual and mechanical control are ineffective, herbicides would be used. The effects on soils from manual and mechanical control methods that may be employed in this alternative are discussed under Alternative B in section 4.3.2; 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 applications.

Herbicide applications inevitably result in contact with soils, either intentionally for systemic treatments, or unintentionally as spills, overspray, spray drift, or windblown dust. In addition to direct application, transmission to soil may occur when an herbicide is transported through the plant from sprayed aboveground portions to roots, where it may be released into soil. Also, some herbicides remain active in plant tissue and can be released into the soil during plant decay and result in residual herbicide activity.

Herbicides may reach the soil directly during spray operations, can be translocated downward into roots, 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 F describes the fate and effects of herbicides that could be used in Alternative A. Solubility in water has an effect on how much of the soil the herbicide comes into contact with and how likely it would leach. Various models have been developed to evaluate herbicide chemistry simultaneously with site specific soil and environmental data to determine the amount of leaching that could occur. For example, glyphosate is highly soluble in water, but when it reaches the soil it is tightly bound 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. Many herbicides are degraded by microorganisms. Temporary increases in the populations of specific micro-organisms that degrade the particular herbicide can be expected.

Overall under Alternative A, up to 300 acres would be treated annually by herbicides or a combination of herbicide and physical control; this acreage would be expected to decrease over time as invasive plants are eradicated or controlled.

Cumulative Effects

Three hundred and fifty acres on DHCMA land have currently been documented to be infested with medium to high risk invasive plants. Physical plant control methods have been used to control invasive plants on ~50 acres in the DHCMA. These control efforts have caused minor impacts to soils through compaction and profile disturbance caused by pulling, although these control efforts have been conducted primarily on human-constructed roadsides.

Other effects to soils from human activities in the DHCMA from road construction and use, installation of pipeline and other utility infrastructure, mining, all-terrain vehicle (ATV) trails, recreational facilities such as campsites and day-use areas, and other facilities and uses have had substantial impacts to soils in those locations. Some of the pristine soil acreage has been lost to human activities in the DHCMA. 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, but generally located in high productivity areas, and therefore moderate. Adverse impacts from invasive plants and physical control actions, including access to invaded sites, would be minor to soils because effects would be localized and relatively short-term. The additive effects of Alternative A to other past, ongoing, and future impacts to soils would result in no more than moderate adverse overall cumulative impacts to soils.

Conclusion
Effects on soil from manual and mechanical control methods would be due to trampling and physical changes to soil properties and would depend on the area and intensity of disturbance and soil susceptibility. These effects would be reduced in area and intensity under Alternative A as compared to Alternative B as herbicides treatments would be implemented as well. The effects of herbicides on soils would be minor, short-term, and adverse due to the small number of acres involved with the proposed herbicides and also minor to moderate, long-term and beneficial as soil function and biodiversity are restored.

4.3.2 Impact of Alternative B

Impact Analysis
Alternative B would only use manual and mechanical treatments to control invasive plants. Because soils are a complex system, any change in physical or biological properties caused by measures to control them may result in changes. It is known that manual and mechanical control of invasive plants can have several impacts on soils. However, as the majority of invasive plants are located in disturbed roadside, habitats on roadbed materials and in adjacent habitats formerly disturbed by heavy equipment, any additional disturbance of soils by treatment of invasive plants would be minimal.

The effectiveness of manual and mechanical invasive plant control and effects on soil depends on a number of factors including: 1) if the species is annual or perennial, and whether it would resprout after removal of aboveground growth; 2) the size of the infestation; 3) the density of plants in the infestation; 4) the type of plant control method used; 6) the number of people removing plants; 5) whether a seedbank or propagule bank exists; and 6) soil compaction and disturbance.

Manual and mechanical control methods are most effective when invasive plants are annuals in a small area that can be easily pulled and do not resprout. If such an infestation is found and weeded before seeds are produced, a small number of people can eradicate the infestation. If the infestation has already produced a seed or propagule bank, control teams would need to perform weeding over many years. If there are substantial infestations of invasive plants into native plant communities, manual and mechanical 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 significant damage to soil-dependent ecosystem processes would likely occur.

Without the use of herbicides, it is possible that invasive plants could continue to rapidly spread in human disturbed areas and into adjacent native undisturbed vegetation communities. Spread into naturally vegetation areas could result in substantial effects on soil quality through changes in organic matter content, diversity and abundance of soil organisms, and nutrient and water availability.

Cumulative Effects
Three hundred and fifty acres on DHCMA land have been documented to be infested with medium to high risk invasive plants. Non-chemical plant control methods have been used to control invasive plants on ~50 acres in the DHCMA, which is < 25% of the acres affected by invasive plants. These plant control efforts have caused minor impacts to soils through compaction and profile disturbance caused by pulling, but these impacts have been conducted in areas already disturbed by human activity.

Other effects to soils from human activities in the DHCMA from road construction and use, installation of pipeline and other utility infrastructure, mining, all-terrain vehicle (ATV) trails, recreational facilities such as campsites and day-use areas, and other facilities and uses have had substantial impacts to soils in those locations. Some of the pristine soil acreage has been lost to human activities in the DHCMA. 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 from invasive plants and physical control actions, including access to invaded sites, would be minor to soils because effects would be localized and relatively short-term. However, there would also be long-term moderate effects from the continued spread of invasive plants. The additive effects of Alternative B to other past, ongoing, and future impacts to soils would result in no more than moderate adverse overall cumulative impacts to soils.

Conclusion

Alternative B would result in moderate, short- term, adverse effects on soils where manual and mechanical control of invasive plants would compact soil surfaces or dig up plant infestations, and long-term effects from the continued spread of invasive plants. At large, high density sites with difficult to control invasive plants, attempted physical control could result in long-term impacts to soil due to compaction and disturbance to organic layers and the soil profiles.

4.3.3 Impact of Alternative C

Impact Analysis

Under Alternative C, there would be no strategic management or control of invasive plants in the DHCMA. Control efforts in the region would continue to be conducted in a less targeted fashion, similar to those conducted to date. Although infestations in the DHCMA have not yet occurred to the same extent as they have in other regions of Alaska or elsewhere, it is likely that some of the documented problems in other regions will occur in the DHCMA if the problem goes unchecked and invasive plants spread into undisturbed native vegetation communities in undisturbed areas. These potential impacts are outlined in the following paragraphs.

Invasive plants can impact soil function and reduce soil biodiversity. The amount of moisture in the soil can be altered if infiltration is reduced and runoff is increased on sites dominated by invasive plants (BLM 2007a). Many invasive plants have relatively sparse canopies, which allow for greater evaporation from the exposed soil than more dense native vegetative cover. Sites infested with invasive plants often have more extreme soil temperatures that can alter soil moisture regimes. Invasive plants may alter soil nutrient availability for native species, alter soil constituents (e.g. soil fungi and bacteria), and slow the rate of natural plant succession (BLM 2007a).

Research indicates that some invasive plants may increase biomass, net primary production, and nitrogen (N) availability; as well alter N fixation rates. Furthermore, and the litter of some species may decomposes more slowly than native plants (Ehrenfeld 2003). Effects on nutrient cycling by invasive plants in this region have not been closely studied, but it’s worth noting that two of the primary invasive species in the DHCMA are nitrogen fixing plants (*Melilotus officinalis* and *Vicia cracca*) and could thus impact nutrient cycling dynamics in infested areas. While these patterns exist in many places, opposite patterns also exist; the influence of some invasive plants on nutrient cycles depends upon the plant community and soil type.

To date, no studies related to the allelopathy by invasive species found in Alaska have been conducted. However, in other regions studies have found that some invasive plants exude chemicals from their roots, a type of allelopathy which negatively influences native plant species, either directly inhibiting them (by reducing seed germination, establishment, or plant growth), or indirectly through changes to the soil biota (Hierro and Callaway 2003).

Invasive plants can also influence all major groups of soil organisms in areas that they invade. One study observed invasive plants to have an influence on the entire soil food-web structure, with invaded areas having lower species richness and lower numbers of fungi and invertebrates, but greater numbers of bacteria (Belnap and Phillips 2001). The species compositional changes that occur in soils as a result of plant invasions can depend upon the pre-existing vegetation type, which often have different soil food-web structures even when not invaded. Additionally, even though the soil biotic community may change, it may only take a few specific taxa to ensure normal ecosystem function (e.g., rates of decomposition, N mineralization, plant biomass production, and soil nutrient cycling), so a changed soil biotic community does not necessarily result in a changed ecosystem.

Cumulative Effects
Three hundred and fifty acres on DHCMA land have been documented to be infested with medium to high risk invasive plants. Physical control methods have been used to control invasive plants on ~50 acres in the DHCMA. These plant control efforts have caused minor impacts to soils through compaction and profile disturbance caused by pulling, however most of the physical control has been conducted along human-constructed roadsides.

Other effects to soils from human activities in the DHCMA from road construction and use, installation of pipeline and other utility infrastructure, mining, all-terrain vehicle (ATV) trails, recreational facilities such as campsites and day-use areas, and other facilities and uses have had substantial impacts to soils in those locations. Compared to the millions of acres of pristine lands and soils unaltered by human activities, the human disturbed areas represent a small percentage; however, the effects of invasive plant spread could be long-term, moderate, and generally located in human disturbed sites, and therefore low.

Boreal habitats may become increasingly susceptible to invasive plant infestations with climate change. There is some speculation that future climate change will favor some species of invasive plants. Highly competitive invasive plants could alter the plant composition of ecosystems and change soil structure and function over large landscape areas to a greater degree with climate change. Invasive plants may also be better adapted than native species to the new environmental conditions resulting from climate change. The effects of climate change on invasive plant spread may be most pronounced under this alternative under which no invasive plant control would occur.

Adverse impacts from not controlling invasive plants would be minor to moderate to soils because effects would be long-term. The additive effects of Alternative C to other past, ongoing, and future impacts to soils would result in no more than moderate adverse overall cumulative impacts to soils.

Conclusion
The effects of Alternative C on soils would be long-term, minor to moderate, and adverse as biotic and abiotic properties of the soil could be altered by invasive plants that would continue to grow and invade areas in the DHCMA.

4.4 FISH AND WILDLIFE

4.4.1 Impact of Alternative A

Wildlife
The impacts of manual and mechanical methods under Alternative A would be the same as those described under Alternative B in the following subsection. The proposed herbicide treatment will be largely localized to areas subject to ongoing human disturbance, largely roadside areas, which are not the primary habitat for most wildlife in the area. However some minor adverse impacts of manual and

mechanical methods would include temporary loss of protective plant cover and the potential for soil erosion and longer term site deterioration.

Physical removal methods would generally be considered prior to herbicide application and used where economically and logistically feasible and effective under both Alternatives A and B. The choice of whether to use herbicides is determined based on the balance of the risks of allowing infestations not amenable to physical treatments to persist compared to the risks to wildlife and habitat associated with minimum-volume spot treating those infestations with herbicides.

Depending on the specific herbicide utilized and the method of application, adverse effects related to herbicide use are a function of 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 USDA Forest Service herbicide risk assessments and other relevant literature on the chemicals, none of the herbicides proposed for use (Table 2-1) to control or eradicate invasive species would pose a serious risk to wildlife species or their habitat adjacent to the target locations to be treated under this programmatic EA. 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 animal would be exposed to enough herbicide to cause any ill effects. Because of the small size of the treatment sites, it is unlikely that a major population of 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 during the herbicide application process because the proposed methods of herbicide application are restricted to minimum volume techniques, including backpack or handheld spray mechanisms, or controlled boom applications using ATVs or truck mounted tanks. Any animals at these sites would move out of the site away from applicators while the herbicides are being applied due to the human disturbance.

Animals would more likely be exposed to smaller residual amounts of herbicides when they re-enter or move through a sprayed site sometime 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 BLM use. None of the herbicides has 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

All nine herbicide active ingredients were found to be of low toxicity in acute and chronic exposure studies of birds even at relatively high doses. No bird 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.

Effects in Mammals
All nine herbicide active ingredients were found to be of low toxicity in acute and chronic exposure studies of mammals even at relatively high doses. No 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 studies.

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 nine 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 receives 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 nine 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 nine herbicides poses a risk of a high level of bioconcentration and resulting high dose in fish-eating birds or mammals. There is no evidence of bioconcentration of any of the proposed herbicides in honey produced for human consumption in agricultural areas.

Non-Target Vegetation
Though 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. The treatment sites are located in previously disturbed areas, usually along roadsides. Depending on the treatment method however, the minimum volume techniques proposed for use and standard application precautions would confine any such effects to the immediate vicinity of the treated plants. Precautions based on wind and temperature conditions would be such that off-site drift and resulting off-site plant damage would be minimized.

A summary of the reviews of studies supporting these findings for each of the nine herbicides were extracted from the US Forest Service risk assessments and are presented in Appendix G.

Fish and Aquatic Species Impacts from Alternative A
Provided that herbicide applications near streams and lakes are limited to areas away from waterways and communities and carefully conducted, the analysis below shows impacts of Alternative A to fish in the Dalton Management Area would be minor. Overall, the impact of Alternative A, which includes a decision tree that prioritizes manual removal, should be beneficial to aquatic resources and fish by preventing the establishment of invasive riparian plant species with known harmful effects.

Several of the proposed herbicides in Alternative A have acute toxic effects on aquatic taxa, including amphibians, therefore their use in or near aquatic ecosystems could have harmful, though probably temporary, effects. 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. The known information (gleaned from the U.S. Forest Service risk assessments and other sources) about relative toxicity of the proposed herbicides to aquatic taxa is summarized in the following paragraphs:

2,4-D

In its Risk Assessment of 2,4-D, the USDA Forest Service (2006) 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". In general, 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 (USDA Forest Service 2006). Over the range of 2,4-D acid/salt application rates used in Forest Service programs (0.5-4 lb a.e./acre), adverse effects on fish, amphibians, and aquatic invertebrates are likely only in the event of an accidental spill. With regard to 2,4-D esters, however, adverse effects on aquatic animals (fish, invertebrates, amphibians) are plausible in association with runoff (all application rates) and would be expected in direct application for plant control and in cases of relatively large accidental spills.

Chlorsulfuron

According to the Forest Service risk analysis, detectable damage to aquatic macrophytes is plausible at typical application rates of chlorsulfuron. There is a large range of sensitivities to chlorsulfuron 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).

Clopyralid

Data regarding the toxicity to aquatic taxa of clopyralid are very limited (USFS 2004b). 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 an EPA analysis based on these limited data no adverse effects of clopyralid on aquatic taxa would be expected at normal application rates.

Dicamba

Acute toxicity studies in fish indicate that Dicamba is relatively non-toxic, with 24 to 96-hour LC_{50} values in the range of 28–516 mg/L, although salmonids appear to be more sensitive than other freshwater fish to the acute toxicity of Dicamba. Amphibians seem to have sensitivity to Dicamba that is similar to that of fish with 24- to 96-hour LC_{50} values in the range of 166 to 220 mg/L. Some aquatic invertebrates appear to be somewhat more sensitive than fish and amphibians to the acute toxicity of Dicamba, with lower ranges of EC_{50} values of about 4 to 10 mg/L. Some but not all aquatic plants are much more sensitive to Dicamba than aquatic animals, with LC_{50} values of about 0.06 mg/L. Other aquatic plants are much more tolerant, with reported NOEC values of up to 100 mg/L. (USDA Forest Service, 2004)

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 C. 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, but more toxic formulations should 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 the less toxic formulation would be used where there is a potential for runoff or drift of the glyphosate to water. Information is from USDA Forest Service (2003a).

Imazapyr

Imazapyr does not appear to be very toxic to aquatic fish or invertebrates. For tolerant species of fish, an NOEC of 100 mg/L, supported by a large number of studies submitted to U.S. EPA is used to assess risks associated with acute exposures. For sensitive species, the lowest LC_{50} value encountered in the open literature, 2.71 mg/L, is used. Three longer term studies in fish suggest no substantial differences between the acute and chronic toxicity of Imazapyr, with a life-cycle NOEC of about 100 mg/L. No chronic toxicity studies are available on the presumably sensitive species and the 2.71 mg/L concentration use for acute exposure is also applied to chronic exposures for sensitive species. Aquatic invertebrates do not appear to be any more sensitive to Imazapyr than fish. An NOEC value of 100 mg/L from both an acute study and a life cycle study in daphnids is used to characterize risks of both acute and chronic exposures. There is no basis for identifying tolerant and sensitive species of aquatic invertebrates (USDA Forest Service 2004c).

Metsulfuron methyl

Metsulfuron methyl has a low order of toxicity to fish. Mortality is not likely to occur in fish exposed to metsulfuron methyl concentrations less than or equal to1000 mg/L. For acute exposures in fish, the NOEC of 10 mg/L in rainbow trout is used for the most sensitive species and the NOEC of 1000 mg/L in bluegill sunfish is used for the most tolerant species. Toxicity values for chronic toxicity may be based on the available egg-and-fry/early life stage studies; only one study of chronic exposure in fish, a 90-day exposure of rainbow trout, yielding and NOEC of 4.5 mg/L. This value is used directly as a longer term NOEC in sensitive species because the rainbow trout appears to be a relatively sensitive species in acute toxicity assays. Using the relative potency for acute exposures of 100 (rainbow trout 100-times more sensitive than bluegill sunfish), an NOEC for tolerant species is estimated at 450 mg/L. Similarly, aquatic invertebrates do not appear to be sensitive to metsulfuron methyl. Since the only studies identified in aquatic invertebrates were in a single species, data obtained in *Daphnia magna* are used for both the sensitive and tolerant species. For acute exposure, a 48-hour NOEC for immobility of 420 mg/L is used. For chronic exposures, the NOEC of 17 mg/L for growth inhibition is used, although higher chronic NOECs, ranging from 100 to150 mg/L, have been reported for survival, reproduction and immobility.

Sulfometuron methyl

The results of studies in fish suggest that frank toxic effects are not likely to be observed at concentrations less than or equal to 150 mg/L. Sulfometuron methyl also appears to be relatively non-toxic to aquatic invertebrates, based on acute bioassays in daphnids, crayfish, and field-collected species of other aquatic invertebrates. The most sensitive aquatic species tested appears to be the African clawed frog. In acute and chronic exposure studies, exposure to sulfometuron methyl produced alterations in limb development, organogensis, and metamorphosis. Aquatic plants appear more sensitive than aquatic animals to the effects of sulfometuron methyl, although there appear to be substantial differences in sensitivity among species of macrophytes and unicellular algae. The macrophytes, however, appear to be generally more sensitive. There are no published or unpublished data regarding the toxicity of sulfometuron methyl to aquatic bacteria or fungi. By analogy to the effects on terrestrial bacteria and aquatic algae, it seems plausible that aquatic bacteria and fungi will be sensitive to the effects of sulfometuron methyl (USDA Forest Service 2004)

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). The sublethal effects of Garlon 4 on a salmonid (rainbow trout) have been assayed: at concentrations of 0.32-0.43 mg/L, about a factor of 2 below the 96-hour LC_{50}, fish were lethargic. At levels 0.1 mg/L, fish were hypersensitive over 4-day periods of exposure. This is reasonably consistent with the threshold for behavioral changes in rainbow trout for Garlon 4 of 0.6 mg/L. The corresponding threshold for behavioral changes to Garlon 3A was 200 mg/L is consistent with the relative acute lethal potencies of these two agents. Subchronic toxicity data are available only on the triethylamine salt of triclopyr and only in fathead minnows. The survival of fathead minnows (embryo-larval stages) was significantly reduced at 253 mg/L compared with control animals. At 162 mg/L, there was a slight decrease in body length.

Effects on Fish and Aquatic Species

There would be negligible direct toxic impacts to fish from herbicide applications under Alternative A because the small size of the treatment sites, the precautions that would be taken to prevent runoff in rainwater, the lack of offsite drift from the backpack, hand, or ground-based boom sprayers that would be used, and the generally rapid degradation of the herbicides after application would ensure that no herbicide concentrations that might be toxic would occur in any nearby lakes, streams or rivers. Fish would not be indirectly adversely affected by habitat alterations because native riparian vegetation would not be treated and lack of drift or runoff would minimize any unintended impacts to riparian plants should they occur near a treatment site. Additionally, design features of the proposed action preclude the use of 2,4-D esters within certain distances of water and recommends that 2,4-D esters are only used in situations where other herbicides are not effective.

Effects on Essential Fish Habitat

In 1996, the Sustainable Fisheries Act amended the Magnuson-Stevens Fishery Conservation and Management Act to require the description and identification of Essential Fish Habitat (EFH) in Fishery Management Plans (FMPs), adverse impacts on EFH, and actions to conserve and enhance EFH. National Marine Fisheries Service (NMFS) developed guidelines to assist Fishery Management Councils in fulfilling the requirements set forth by the Act. EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat, “waters” includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; “substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle. (Source: Appendix G Final Essential Fish Habitat EIS – April 2005 G-10) EFH exists in rivers and streams of the Dalton Corridor inhabited by chum, Chinook, and coho salmon.

Potential Adverse Impacts
There are three basic ways that herbicides can adversely affect EFH. These are 1) a direct toxicological impact on the health or performance of exposed fish, 2) an indirect impairment of the productivity of aquatic ecosystems, and 3) a loss of aquatic vegetation that provides physical shelter for fish. Fish kills are rare when herbicides are used according to their labels. For fish, most effects from pesticide exposures are sub lethal. Sub lethal effects are a concern if they impair the physiological or behavioral performance of individual animals in ways that will decrease their growth or survival, alter migratory behavior, or reduce reproductive success. In addition to early development and growth, key physiological systems affected include the endocrine, immune, nervous, and reproductive systems. Many herbicides have been shown to impair one or more of these physiological processes in fish (Moore and Waring 2001). In general, however, the sub lethal impacts of herbicides on fish health are poorly understood. Accordingly, this is a focus of recent and ongoing National Oceanic and Atmospheric Administration (NOAA) research (Scholz et al. 2000, Van Dolah et al.1997). Some herbicides are toxic to aquatic plants that provide shelter for various fish species. A loss of aquatic vegetation could damage nursery habitat or other sensitive habitats.

The effects of herbicides on ecosystem structure and function can be key factors in determining the cascading impacts of those chemicals on fish and other aquatic organisms at higher trophic levels (Preston 2002). This includes impacts on primary producers (Hoagland et al., 1996) and aquatic microorganisms (DeLorenzo et al., 2001), as well as on macroinvertebrates that are prey species for fish. Overall, herbicides could have an adverse impact on fish habitat if they reduce the productivity of aquatic ecosystems.

Recommended Conservation Measures
The following recommended conservation measures are options to avoid adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. To protect Essential Fish Habitat in water bodies inhabited by salmon, herbicides will be applied no closer to the water than 200 feet beyond the outer edge of the floodplain. Buffer distances shall be measured, marked, and approved prior to application to ensure compliance with this standard. The buffer shall be measured horizontally on a line perpendicular to the water body. Secondary buffer zones may be required if the slope adjacent to the stream or water body is greater than 5%.

2. Implement water quality monitoring to determine whether current buffers are adequate to protect water quality and aquatic resources.

<u>Cumulative Effects</u>
The cumulative effects of past, present, and expected future human activities on the wildlife and habitat of the Dalton Highway corridor are substantial and moderate given the millions of acres of relatively undisturbed wildlife habitat and healthy wildlife populations. The incremental increase in impacts from activities to manage invasive plants under Alternative A would result in a negligible additional impact on wildlife in terms of short-term disturbance from crews conducting invasive plant removal or using backpack or spot herbicide treatments to eliminate the plants. Countering this would be the long-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. This decrease is more likely to be realized because of the more effective management approach of Alternative A.

The cumulative effects of past, present, and expected future human activities on fish and aquatic organisms are substantial and potentially moderate. The incremental increase from the implementation of Alternative A to manage invasive plants would result in a minor additional impact on fish and aquatic organisms along the Dalton Highway.

Conclusion

The benefits of Alternative A to wildlife and habitat would be minor, beneficial, and localized in the near term but moderate, beneficial, and more widespread in the longer term. The adverse impacts of Alternative A to wildlife and habitat would be no more than minor as animals may be exposed to small residual amounts of herbicides. Overall, the impact of Alternative A, which includes a decision tree that prioritizes manual removal, should be beneficial to wildlife and habitat by preventing the long term establishment of invasive plant species. The success of invasive plant management and beneficial effects to native plant communities under Alternative A would vary from location to location along Dalton highway. Where early detection and immediate control are feasible and achievable, the manual and mechanical methods available under Alternative A 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 reduced or eliminated for most sites even when control by manual and mechanical methods is not feasible.

Managing invasive plants under Alternative A would help the BLM better achieve the desired condition of maintaining all wildlife habitats as part of natural ecosystems. If invasive plant infestations become so large that they can be effectively managed only with the use of broadcast applications of herbicides, those infestations would present a greater and greater problem as far as uncontrolled expansion and degradation of wildlife habitat.

Elimination of invasive plants would allow establishment or reestablishment of native plants. Where riparian plants are involved, reestablishing native riparian plants would provide higher quality stream, lake, or riverside habitat for fish and aquatic invertebrates as well.

The impacts to fish/aquatic organisms from Alternative A 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.

4.4.2 Impact of Alternative B

Impact Analysis

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

The most beneficial direct effects of Alternative B 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 DHCMA
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. Such sites would need to be replanted or otherwise re-vegetated 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 occur on disturbed sites, along roadsides, and in other developed or previously developed areas that do not provide high quality habitat. These disturbance factors are likely to continue to prevail in the future. Sites where invasive plant treatment is coupled with elimination or reduction in human disturbance could be restored to high quality habitat. Roadside environments would likely continue to provide marginal habitats. Regardless of the level of continuing disturbance, removing invasive plants would at a minimum prevent seed dispersal or other dispersion mechanisms from allowing the invasive plants to expand the size of the localized infestation to encroach on native habitats or to colonize and proliferate on other sites.

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 (USDA Forest Service 2006). In instances where little or no native vegetated wildlife habitat exists initially, removal of the infestation and management of the site would allow planting or eventual colonization by native plants, or a return to a more natural unvegetated condition. In other instances, the invasive plant may have colonized and be outcompeting established native plants for growing space, thus eventually displacing them, thereby diminishing the value of the plant cover as wildlife habitat.

The two species for which manual and mechanical control methods are unlikely to be effective in the near future are perennial sowthistle and oxeye daisy. Perennial sowthistle varies in terms of providing forage for some wild grazers but is not of high value when compared to native forage.

Oxeye daisy's greatest impact is on forage production in infested meadows. Wildlife avoids 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. With the loss of desirable forage, oxeye daisy fills in, decreasing the land's carrying capacity and reducing wildlife habitat (UNCE 2006).

Animals with large home ranges, such as moose and bear, would not depend on small infested sites for food and even less likely 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 significant portion of their diets, so to the extent native plants may have been displaced by the invasive plants, they would adjust their feeding range accordingly. Otherwise, herbivores and omnivores tend to feed on palatable native species and may avoid feeding at all on some invasive plants, such as yellow toadflax. This behavior ensures the survival and expansion of the invasive plant infestation. In general, larger animals 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. 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 some more substantial portion of their home range. Amphibians such as the wood frog may also be found at these sites, particularly in the surface water. In the short term, removal of the plants might directly, adversely affect individual small mammals or birds by disturbing them in the process of treatment. Treatment effects would likely be short-term, negligible impacts because the sites comprise marginal habitats at best and would not likely be supporting many individual animals or nests.

In general, populations of mammals, birds or amphibians would not likely be affected because the infestations are located along the highly disturbed road margin which is not prime habitat for most animal species. 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 would be better ensured. The much greater, longer-term benefit would be in preventing encroachment on major portions of wildlife habitat by invasive plants that would ultimately significantly degrade wildlife sustainability within the native ecosystems.

An indirect effect of invasive plant removal would be sedimentation and turbidity in local watersheds down-gradient of treated sites. 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.

Fish Impacts from Alternative B

As long as periodic physical removal proves sufficient over the long term to keep invasive plant infestations from becoming established, the effects of Alternative B 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 B.

Under Alternative B aquatic resources and water quality are not likely to be adversely affected along the Dalton Highway, provided that the BLM continues 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 Alternative B would be ineffective in protecting aquatic resources. Given increasing levels of visitation, a warming climate, limited staff, and millions of acres to patrol, the most likely scenario is that Alternative B would 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 and fish.

Effects on Essential Fish Habitat

Under this Alternative, EFH would not be affected because the infestations are few and largely confined to sites of less than an acre to a few acres that are located along the highly disturbed road margin. The adverse impacts of manual and mechanical methods would include temporary loss of protective plant cover and the potential for soil erosion and longer term site deterioration. Conditions would stabilize once the site is revegetated. In the long-term, removal of invasive plants and revegetation of the sites with native plant species would prevent encroachment on major portions of aquatic habitat by invasive plants. Those measures would enhance sustainability of salmon resources within the native ecosystems.

Cumulative Effects

The affected area is the Dalton Highway corridor and downstream environs. Roads and trails, campsites and other amenities in the DHCMA have further fragmented wildlife habitat apart from the major effect of the Dalton Highway itself, and have led to disturbance of wildlife and to occasional wildlife-human interactions. They also facilitate the spread of invasive plants. 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.

The cumulative effects of these past, present, and expected future human activities on the wildlife and habitat along the Dalton highway are substantial and moderate given the millions of acres of undisturbed wildlife habitat and healthy wildlife populations. The incremental increase in impacts from Alternative B to manage invasive plants would result in a negligible additional impact on wildlife and aquatic resources due to 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 that these other human activities and encroachments have facilitated in Alaska.

Conclusion

The success of invasive plant management and beneficial effects to native plant communities under Alternative B would vary from location to location in the DHCMA. The impacts of invasive plant management activities on wildlife habitat and populations would be generally beneficial and negligible to minor overall in the long-term. Impacts to fish and aquatic habitats would also be beneficial and negligible to minor locally. Elimination of invasive plants would allow establishment or reestablishment of native plants which would provide higher quality wildlife habitat: for food, cover and nesting sites. Where riparian plants are involved, reestablishing native riparian plants would provide higher quality stream, lake, or riverside habitat for fish and aquatic invertebrates as well.

Where early detection and immediate control of invasive plants are feasible and achievable, the control methods available under Alternative B would be sufficient to prevent their establishment and spread and to preserve native wildlife habitat. Where invasive plants become established to an extent greater than that, herbicides may be the only effective means of controlling an infestation. Continuing to manage invasive plants under Alternative B would only partially achieve the desired condition of maintaining all wildlife habitats as part of the natural ecosystems. Certain known invasive plant infestations can be effectively managed only with the use of herbicides and those would present a greater and greater problem from infestation expansion and additional colonization where the infestations remain in place. Alternative B methods alone would ultimately fail to contain current or future invasive plant infestations to protect natural wildlife habitat and their populations.

4.4.3 Impact of Alternative C

Impact Analysis

Under Alternative C, there would be no strategic management or control of invasive plants in the DHCMA. Control efforts in the region would continue to be conducted in a less targeted fashion, similar to those conducted to date. Without strategic efforts to control their colonization, establishment and spread, invasive plants could compete with native plants, alter biotic communities, and change the habitats and survival capabilities of wildlife species.

Wildlife and Habitat Effects of Invasive Plants

Studies of the impacts of invasive plants on wildlife and habitats in the U.S. to date have been limited to a number of widespread and aggressive species such as purple loosestrife and salt cedar. Other

invasive plants have not been so well studied but are expected to be major factors in wildlife habitat losses by virtue of their outcompeting and supplanting native plants in certain environments.
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. In 1998, then Secretary of the Interior Bruce Babbitt spoke about invasive alien species at the "Science in Wildland Plant Management" Symposium (Babbitt 1998) and summarized the rapid spread and adverse impacts of invasive plants, particularly to wildlife and habitats on public lands, "[Invasive plants] infest 100 million acres in the U.S., spread at 14 percent per year, and -- on public lands -- consume 4,600 acres of wildlife habitat per day. They diminish or cause the extinction of native plants and animals, a third of all listed species".

In summary, in other regions invasive plants are known or suspected of causing the following effects to wildlife and/or wildlife habitat:

- Changes to forage location, quantity and/or quality.
- Changes to the timing of forage availability
- Embedded seeds in animal body parts (e.g. foxtails), or entrapment (e.g. common burdock) leading to injury or death.
- Alteration of habitat structure and cascading effects on tropic dynamics
- Change to wildlife populations as a result of nutritional deficiencies or direct physical mortality.
- Altered food web structure, perhaps due to altered nutrient cycling.
- Source-sink population demography, with more demographic sinks than sources.

Invasive plants in Alaska are not yet the established problem they are in much of the lower 48 States and Hawaii. As would be expected from experience with invasive plants elsewhere, they have begun to appear in disturbed areas, particularly on roadsides and other areas where humans and their vehicles and equipment serve as vectors for seed dispersal. The invasive plant species currently of concern in the DHCMA are listed in Appendix III of Appendix A. Characteristics of 10 species that make them a potential threat to Alaska wildlife and habitats are summarized in Table 4-2.

A review of available studies indicates that there are none that detail the direct impacts of invasive plants in Alaska at the wildlife population level. Available studies indicate that habitat impacts can at best be inferred by observations of the loss of native plants in locations where they are outcompeted for sunlight or nutrients or where there is allelopathy that favors the invasive plant. However, there are no studies on Alaska invasive plant species that directly link habitat changes with quantified reductions in animal populations. Therefore, the conclusions drawn here 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.
While further study is needed to determine the actual impacts on wildlife and wildlife habitat in Alaska, it is worth noting that there is some evidence of reduced willow seedling success in areas infested with white sweetclover (Spellman and Wurtz 2010). This is of particular concern since willow is a primary forage species for moose in Alaska.

Table 4-2. Potential ecosystem effects of Alaska invasive plants found in the DHCMA.

Invasive plant	Impact on community composition, structure, and interactions[1]	Impact on ecosystem processes[1]	Wildlife and habitat effects data from other sources
Bird vetch	The plant can overgrow herbaceous vegetation and climb over shrubs, such as alder and willow. It has a symbiotic relationship with certain soil bacteria (*Rhizobium*). It is highly palatable to grazing and browsing animals. Flowers are visited by native bees and may alter pollination ecology of the surrounding area (Aarssen et al. 1986; Klebesadel 1980).	Bird vetch alters edaphic conditions due to fixation of atmospheric nitrogen.	Bird vetch climbs fencing, trees, bushes, and other vegetation, competing for sunlight, space, and moisture. It spreads along roadsides, trails, and other disturbed areas. [2]
Common dandelion	Dandelion competes with native plants for moisture and nutrients. It is commonly eaten by moose and bears. This species is important source of nectar and pollen for bees in Alaska (Esser 1993). Its presence may therefore alter pollination ecologies of co-occurring plants. It is also an alternate host for a number of viruses (Royer and Dickinson, 1999).	Dandelion is one of the earliest colonizers after disturbances and likely causes modest impacts in natural succession. It may achieve a peak in dominance within two to three years (Auchmoody and Walters 1988). In Alaska it often establishes in existing herbaceous layer, changing the density of the layer. It also can form a new herbaceous layer on nearly mineral soil along banks and roadsides.	
Lambs-quarters	Lambs-quarters has been observed in naturally disturbed areas but is generally limited to human-disturbed areas in Alaska. In other regions it has little or no effect on native plant communities.	It is unlikely that measurable impacts to ecosystem processes occur due to lambs-quarters presence. This plant invades disturbed habitats such as roadsides and abandoned fields and is common on logged-over lands, especially on burned slash-piles. It does not usually invade native plant communities.[5]	Lambs-quarters is a naturalized annual herb found in disturbed soils across Canada. This plant can cause sickness and death in livestock if large quantities are ingested. The plants can accumulate both nitrates and soluble oxalates.
Narrow-leaf hawk's-beard	Unknown	Unknown	Often found on disturbed soil; waste places, riverbars, or roadsides. Thrives in dry, coarse soil. Competes with seedlings, forages, cereals

Invasive plant	Impact on community composition, structure, and interactions[1]	Impact on ecosystem processes[1]	Wildlife and habitat effects data from other sources
			and oilseeds. The most serious infestations of this plant occur in weak crop stands. Spreads into riparian areas.
Oxeye daisy	Oxeye daisy forms dense colonies, decreasing overall vascular plant diversity. It can quickly replace up to 50% of the grass species in pastures. Grazing animals generally avoid it. Moreover, the plant contains polyacetylenes and thiophenes that are generally highly toxic to insect herbivores. Oxeye daisy can host chrysanthemum stunt, aster yellows, tomato aspermy viruses, and several nematode species (Royer and Dickinson 1999). There is no known allelopathy potential.	Heavy infestations can cause soil erosion. [2]	Common on roadsides, disturbed areas, beach meadows, and landscaped areas. Frequently a component of wildflower seed mixes. Forms dense colonies, is unpalatable to grazing animals and insects, and hosts several plant viruses. Oxeye daisy appears to be having little impact on natural processes. However, in other natural areas plant has been observed to invade and modify communities.
Perennial sowthistle	At high densities *Sonchus arvensis* has drastically reduced water resources and possibly decreased number of plants in communities (Butterfield et al., 1996). It is also a host of number of plant pests. This plant is acceptable feed for rabbits and other foraging animals (Noxious Weed Control Board, 2003).	Perennial sowthistle may modify or retard the successional establishment of native species (Butterfield et al. 1996).	Commonly found in waste areas, meadows, woods, lawns, roadsides, beaches, ditches, and river and lake shores. Can drastically reduce crop yields in agric areas by competing with desired plants for nutrients. [2]
Reed canarygrass	This grass form dense, persistent, monotypic stands in wetlands; these stands exclude and displace other plants. It grows too densely to provide adequate cover for small mammals and waterfowl. When in flower, it may cause hay fever and allergies.	It promotes silt deposition and the consequent constriction of waterways and irrigation canals. Reed canarygrass may alter soil hydrology.	Highly variable species preferring moist sites. Begins growing early in the season. Forms dense, persistent, monospecific matted stands. Difficult to impossible to eradicate once established. Spreads within sites by creeping rhizomes, effectively excluding all other vegetation. Found along roadsides, ditches, wetlands, riparian areas, beaches, and growing into lakes. [2]
Smooth brome (grass)	Smooth brome is a highly competitive. It forms a dense sod that often excludes other species, thus contributing to the reduction of species diversity in natural areas (Butterfield et al. 1996; Rutledge and McLendon 1996). Smooth brome is an	Smooth brome may inhibit natural succession processes (Densmore et al. 2001; Rutledge and McLendon 1996).	Sather (1987) says the following, "it forms a dense sod that often appears to exclude other species, thus contributing to the reduction of species diversity in natural areas."

Invasive plant	Impact on community composition, structure, and interactions[1]	Impact on ecosystem processes[1]	Wildlife and habitat effects data from other sources
	alternate host for the viral diseases of crops (Royer and Dickinson, 1999; Sather, 1987). It has high palatability for grazing animals (USDA, 2002). In south Alaska hybridizes with *B. inermis* ssp. *pumpelliana* occur (Hultén, 1968).		
White sweetclover	White sweetclover alters plant-pollinator networks in Alaska (Schneller and Carlson, *in prep*). It has been shown to degrade natural grassland communities by overtopping and shading native species. Sweetclover is associated with over 28 viral diseases (Royer and Dickinson 1999). It is also reported as being allelopathic (USDA 2002).	This species alters edaphic conditions due to nitrogen fixation (USDA 2002).	Rapidly colonizes open waste areas, and spreads quickly along riparian areas and riverbanks. Already growing along several major Alaskan rivers. Plants have been shown to affect willow seedling establishment; willow is a primary browse species for moose (Spellman and Wurtz 2010).
Yellow toadflax	Yellow toadflax is a persistent invader, capable of forming dense colonies; it can suppress native grasses and other perennials, mainly by intense competition for limited soil water. This species contains a poisonous glucoside that is reported to be unpalatable and moderately poisonous to livestock. Toadflax is an alternate host for tobacco mosaic virus.	This toadflax species and others do affect the abiotic processes in the ecosystems where they are found. Specifically, the Yellow Toadflax increases erosion where it invades and probably changes the soil characteristics in other ways too.	Common in roadsides, waste areas, lake shores, beach meadows, pastures, and edges of forests. A persistent, invader, capable of forming dense colonies. Toxic to grazing animals. Found in high quality areas with no known disturbance for last 100 years. Potential to invade and modify/replace existing native communities.

Effects of Invasive Plants on Aquatic Animals

Below are brief descriptions of the effects that invasive riparian pla nt species could have on aquatic resources in the vicinity of the DHCMA. 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 the DHCMA, though not all are riparian obligates. These include white sweet clover, smooth brome, yellow toadflax, reed canarygrass, and common tansy. 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 been found along a number of Alaskan rivers including the Stikine, Matanuska and Nenana Rivers south of Fairbanks. It is a nitrogen fixing plant with the capacity to potentially 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. White sweetclover is pervasive in Fairbanks and common along the Dalton Highway. It 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 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 (*Bromus inermis*) is commonly found in riparian zones, and is often used for stream bank and stream bottom stabilization. It is a 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.

Reed canarygrass (*Phalaris arundinacea*) is likely to become a serious problem in some Alaskan locations, but has not yet been recorded in the DHCMA. 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.

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.

Therefore, the No Action Alternative could cause long term minor to moderate adverse impacts to fish because of decline and loss of quality fish habitats locally where invasive plants begin to establish and on a widespread basis as invasive plants displace native riparian species across the landscape.

Effects on Essential Fish Habitat

Under this Alternative, all aquatic habitat, including EFH, could be affected. As discussed in this (fish) and other sections of the EA, the effects of Alternative C would be direct, long-term, minor to moderate and adverse as invasive plant infestations would cause potential changes to riparian ecosystems, stream hydrology and fish habitat.

<u>Cumulative Effects</u>
Past, present, and future actions, such as construction of the highway and utility corridor, recreation, and mining activities impact wildlife by disturbing and displacing animals, and destroying and reducing habitat. Taking No Action to control non-native invasive plants under Alternative C would allow these species and other potential invasive plant species to secure a foothold and expand along the Dalton Highway. These secure and expanding populations would be a source of colonization of other sites elsewhere in Alaska. Native habitats in these locations would diminish as they would elsewhere in Alaska where the plants are not controlled.

The impacts of past, present, and future cumulative actions on wildlife would be minor to moderate and adverse. Impacts of Alternative C on wildlife from allowing invasive plants to spread with no control would be moderate and adverse. The additive effects of Alternative C to other past, ongoing, and future impacts to water resources would result in no more than moderate overall adverse impacts to wildlife.

<u>Conclusion</u>
Alternative C may have long-term, adverse, moderate impacts on wildlife. Based on the invasive plant characteristics listed in Table 4-2, the predominant adverse effect of the invasive plants on wildlife in the vicinity of Dalton highway 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 invasive plants for space. Implementing Alternative C could have long term minor to moderate adverse impacts to fish because of decline and loss of quality fish habitats locally where invasive plants begin to establish and on a widespread basis as invasive plants displace native riparian species across the landscape.

Impacts would occur if some animals are directly affected by plant poisons, from invasive plants such as 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 A and B and evaluated in the previous sections would reduce or eliminate these types of wildlife and habitat impacts in the DHCMA.

4.5 WATER RESOURCES

4.5.1 Impact of Alternative A

Impact Analysis

A number of invasive plants in the DHCMA have been found in wetlands, floodplains, and riparian areas. These include white sweet clover, perennial sowthistle, yellow toadflax, smooth brome grass, and common tansy. Of these, several are known or are likely to have detrimental and long-lasting effects on aquatic ecosystems. Under Alternative A, a combination of manual and mechanical control, as well as herbicides would be used to control invasive plants. Impacts to water resources from manual and mechanical treatments are discussed under Alternative B. Provided that herbicide applications near streams, lakes, floodplains, and wetlands are limited and carefully conducted, the analysis below shows impacts of Alternative A to water resources in the DHCMA would be minor. Any herbicides used would be formulated for aquatic applications and applied within the strict policy of the BLM. Overall, the impact of Alternative A should be beneficial to water resources by preventing the establishment of riparian invasive plants with known harmful effects. Effects on water quality should be minimal given the limited area and duration of the herbicide applications and the generally short half-lives of these herbicides in natural waters.

The BLM currently uses four herbicide active ingredients formulated for use in riparian and aquatic habitats: 2,4-D, glyphosate, imazapyr, and triclopyr. The remaining herbicides available to the BLM, or proposed for use, are not formulated for aquatic use. A general analysis is presented here of how herbicides could affect water resources. For a more detailed description of the effects of individual herbicides, refer to Section 4-29 of the EIS (BLM, 2007a).

Herbicides applied near or in wet areas would have negligible impacts on surface water quality because they will be applied at concentrations that are lower than or meet label requirements. There would be low risk to drinking water in areas treated with glyphosate or imazapyr, even if these herbicides were accidentally spilled in streams, ponds, or lakes used by humans. The risk to drinking water associated with 2,4-D or triclopyr applications, however, would be moderate to high (BLM, 2007a).

Applications of herbicides near aquatic systems would not directly modify water quantity. However, indirect impacts to water quantity could occur if non-target native vegetation is removed and resulted in reduce plant uptake of water, thereby increasing the amount of available water.

Herbicides applied in terrestrial settings have the potential to reach surface and ground water. The four primary means of off-site movement of herbicides are runoff, drift, misapplication/ spills, and leaching. Surface water could be affected by any of these means, while groundwater potentially would be affected only by leaching. Herbicides must be relatively persistent in the environment to leach or runoff (non-persistent herbicides do not stay active long enough to create a risk). If an herbicide has a high soil adsorption, it is more likely to migrate with soil movement. If an herbicide has low soil adsorption, it is likely to leach through the soil. An herbicide that is highly soluble in water is likely to leach; with low solubility, it is likely to run off.

Herbicide drift can degrade surface water quality. Herbicides can reach water through the airborne movement of herbicide beyond the treatment area. Herbicides formulated for terrestrial application are more likely to affect water quality than those formulated for aquatic application. Three factors contribute to drift: 1) application technique; 2) weather conditions; and 3) applicator error. Spot and localized applications, as are proposed in this alternative, are not likely to result in drift because these applications are targeted to specific plants, and less herbicide is applied. Other herbicide application methods in this alternative have a higher risk of drift. The potential for spray drift to impact perennial and intermittent streams would also be low because minimum buffer zones would be provided between treatment areas and water bodies and through adhering to the SOPs and mitigation.

Herbicides registered for use in terrestrial habitats may affect surface water and groundwater as a result of spills or misapplication on upland sites moving into aquatic systems. Misapplications and spills are the leading cause of impacts on non-target resources. These errors are caused by failure to follow label instructions and restrictions, and by applicator carelessness. The impacts of spills depend on the persistence and mobility of the herbicide, as well as how quickly and thoroughly the spill cleanup is conducted. BLM policy, including rigorous training requirements, and SOPs and mitigation minimize the risk of spills or misapplication impacts.

If applied directly to wetland and riparian areas, herbicides dissipate by transport through water, through chemical or biological degradation, or through adsorption and immobilization in soils. When herbicides are applied to well-drained areas, adjacent wetlands and riparian areas can play a critical role in filtering herbicides from runoff, through physical trapping and through chemical and biological processes.

Herbicides have the potential to enter water bodies and affect aquatic organisms through direct application into aquatic environments (of herbicides approved for use in these habitats), through accidental spraying, or through the movement of herbicides from upland areas to nearby water bodies as discussed above. At low concentrations, herbicides typically may have little or no effect on aquatic organisms. At moderate concentrations, herbicides may not kill aquatic organisms, but could be detrimental to the survival, growth, reproduction, or behavior of certain organisms (chronic effects). At high concentrations, some herbicides can be lethal to aquatic organisms (acute effects).

Cumulative Effects

Past, present, and future cumulative effects on water resources in the DHCMA arise from construction and utilization of roads and pipelines, mining activities, and recreational use. The unpaved sections of the Dalton Highway provide a sediment source that can contribute to increased turbidity in streams that cross or parallel the roadbed. 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 spread for considerable distances downstream. Effects from gravel and placer mining activity impact streams including altered channel morphology, increased turbidity and suspended sediment loads, and heavy metals contamination. Localized impacts due to recreational activities 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). Future oil and gas development could involve new infrastructure of roads, pipelines, power plants, processing facilities, loading docks, camps, airstrips, gravel pits, utility lines and landfills, with a substantial amount of water is needed for oil drilling. Such activities could have impacts on water resources including alteration of natural drainage patterns, contamination of water from fuel and oil spills, and erosion and sedimentation of surface waters.

The impacts to water resources from past, present, and reasonable foreseeable future actions are substantial and considered moderate overall in the DHCMA. The additive effects of Alternative A on water resources would result in no increased impacts to the cumulative case.

Conclusion
Alternative A would result in effective control of invasive plant infestations and benefit water resources and ecosystem integrity. The minor, short-term adverse impacts from herbicide use would be outweighed by the moderate, long-term benefits to water resources from control of invasive plants.

4.5.2 Impact of Alternative B

Impact Analysis
Some invasive plants can create conditions that modify water quantity and quality. Water quality can be affected by changes to streambank stability, sediment, turbidity, shade and stream temperature, dissolved oxygen, and pH.

Proposed manual, mechanical, and biological treatment measures such as pulling, or mowing are likely to have minimal impacts to water quality. The most likely impact under this alternative would arise from soil disturbance which could increase the potential for measurable surface erosion/sedimentation. Hand-pulling involves manually removing the invasive plant/roots out of the ground. When invasive plants are pulled, some surface soil may be exposed during the process. In addition, equipment used in invasive plant treatment has the potential to disturb or displace soil, making the soil more vulnerable to erosion. Short term erosion could be mitigated by creation of a restoration plan that would identify specific measures to ensure protection against erosion and resulting sedimentation. Overall, the amount of off-site sediment movement is expected to be insignificant due to the small amount of soil exposure expected.

Early detection of, and rapid response to remove, new infestations remove could prove sufficient over the long term to keep some invasive plant species from becoming established and potentially affecting water resources. However, it is possible that some species may not be effectively controlled by physical treatment under Alternative B. If so, Alternative B would not be effective in protecting water resources and the impacts would be similar to those described in Alternative C.

Cumulative Effects
Past, present, and foreseeable future actions that cumulatively effect water resources in the DHCMA are the same as described for Alternative A. Impacts of successful implementation of Alternative B on water resources would be minor and beneficial. The impacts of unsuccessful implementation of Alternative B would be minor to moderate and adverse.

Conclusion
Where manual and mechanical control methods are successful in managing invasive plant infestations, the impacts on water resources would be long-term, beneficial, and minor to moderate. Where physical control methods are not successful in managing invasive plant infestations, the impacts on water resources could be long-term, adverse and moderate.

4.5.3 Impact of Alternative C

Impact Analysis
Under Alternative C, there would be no strategic management or control of invasive plants in the DHCMA. Control efforts in the region would continue to be conducted in a less targeted fashion, similar to those conducted to date. Invasive species can modify habitats, reduce native biodiversity, and alter food webs. They can cause substantial adverse impacts in riparian areas if left uncontrolled. They can dominate native vegetation in riparian zones, and impacts may include poor water quality, reduced structural and habitat diversity for wildlife, reduced or altered forage for wildlife, altered soil erosion, and reduced ability to perform natural ecological functions and lower resilience to natural disturbances such as floods and fire.

In wetlands, invasive plants can crowd out native plants and animals, interfere with natural processes such as water flow and evapotranspiration, and lead to loss of native plant biomass. In densely infested areas, predator/prey relationships change due to changes in food and cover, resulting in a effects on vertebrate and invertebrate populations.

Cumulative Effects

Boreal habitats are likely to become increasingly susceptible to invasive plant invasions with climate change. Climate change may favor invasive plants by altering the amount and seasonal distribution of precipitation and seasonal temperature patterns. Highly competitive invasive plants could alter the plant composition of ecosystems which could then lead to changes to hydrology over large landscape areas to a greater degree with climate change. Invasive plants may also be better adapted than native species to the new environmental conditions resulting from climate change, and the resulting adverse effects on water resources, as discussed above, would increase. The greater the change in climate, the more likely the facilitation of establishment and spread of invasive plants will be.

The impacts of past, present, and future cumulative actions are substantial and can be considered moderate. Impacts of Alternative C on water resources from not controlling invasive plants would be adverse and at least moderate. The additive effects of Alternative C to other past, ongoing, and future impacts to water resources would result in at minimum moderate overall cumulative adverse impacts to water resources.

Conclusion

The effects of Alternative C on water resources would be direct, long-term, moderate and adverse as invasive plant infestations would cause potential changes to riparian ecosystems and related changes to hydrology.

4.6 SOCIOECONOMICS

Socioeconomic resources can be adversely impacted through activities that may alter the structure and patterns of social life and the manner in which social resources (physical, natural, and human) are defined and utilized. This assessment considers potential effects on local residents and communities, as well as the structure and patterns of economic activity within the local area, surrounding and including the DHCMA.

4.6.1 Impact of Alternative A

Impact Analysis

Implementation of the Strategic Plan, including the use of herbicides, would have the long-term beneficial effect of substantially reducing the overall impact to the local economy from losses associated with forgone productive or other uses of affected areas. The potential for invasive plants to encroach on native plant communities that provide habitat for subsistence species has been noted in this document. Changes to subsistence species habitat can alter wildlife species population distribution and/or numbers which would have direct effects on the activities and economics of the hunters, guides, air transporters, and recreationists who rely on these species. Use of integrated pest management techniques, including herbicides, is potentially more effective for certain species than the range of options available under Alternative B. As a result, the potential economic benefit associated with reduced costs for future treatment and elimination of losses due to lost utility and productivity of affected areas would be substantially increased.

Tourism is a source of revenue for businesses which utilize the DHCMA. The proposed vegetation treatment under Alternative A in the DHCMA would, in the short term, affect visual resources by changing the scenic quality of the landscape since herbicide treatments kill vegetation, which will resulted in “browned” areas until new native plants re-establish. Travelers, sightseers, and residents in the DHCMA would notice the effects of vegetation treatments on the visual quality of the landscape for the first year to several years following treatment, particularly in impacted areas near major roads or residential areas.

These visual impacts are likely to vary depending on the type of herbicide used. For instance, if a herbicide is selected for application that only targets dicots, grass-like plants should continue to persist in treated areas providing some healthy vegetation cover of treated areas. The duration of the treatment regime will also likely have an effect on the visual impact of the treatment. If the herbicide application is conducted repeatedly over the course of years, the visual impact of “browning” in the treated areas will persist for a longer term. The BLM may mitigate some of the potential visual impacts perceived by the public by: 1) re-seeding treated areas so that a healthy vegetation community persists within treated areas during an ongoing herbicide application regime, 2) re-seeding treated areas after herbicide treatments have ended so that a healthy vegetation community replaces the vegetation in a treated area and/or 3) physically removing the herbicide treated dead invasive plants.

The use of herbicides as a treatment option under this alternative may have a potentially adverse effect on some native plants that are economically useful, such as plants used for medicinal and other subsistence purposes. However, a wide range of best management practices, SOPs and mitigation would be employed in the use of herbicides (Section 2.1.1), therefore any associated adverse economic impact would be considered minimal. Mitigation has been developed in this analysis based on scoping meetings in local communities and with community leaders and tribal entities to identify areas of economic interest so that they may be avoided when herbicide use is indicated. One mitigation measure resulting from these meetings and consultations creates a no herbicide buffer around the community of Wiseman.

Cumulative Effects

Many past and current activities in the DHCMA and surrounding area have contributed to the introduction and spread of invasive plant species and resulted in adverse impacts to the socioeconomic condition. Reasonable foreseeable actions are also likely to contribute to adverse impacts on socioeconomic resources. The overall effect of the Proposed Action on socioeconomic resources when considered with the cumulative case would be generally beneficial with no increase in impacts on the existing economic condition. The potential cumulative impacts associated with this alternative are expected to be beneficial in reducing the adverse economic effects through use of the most effective treatment of invasive species.

Conclusion

The impact to socioeconomic resources from Alternative A would be generally long-term and beneficial and would reduce longer term cost to control invasive plants and reduce losses associated with economically productive uses of affected lands. Any potentially adverse impact that may be associated with herbicide use would be minor and could be further reduced through effective mitigation, SOPs and BMPs.

4.6.2 Impact of Alternative B

Impact Analysis

Implementation of the Strategic Plan without the use of herbicides under this alternative would be expected to have a minor to moderate beneficial impact on socioeconomic resources in the DHCMA and surrounding region. The mechanical and manual treatment options available under this option would be both labor intensive and time consuming, and would require multiple treatments over a number of years to be effective. As a result, the cost to control or eradicate certain species is likely to be higher than for other methods of treatment.

The success of treatments available under this alternative would vary from species to species and over multiple sites. Where these techniques are not successful, some level of adverse impact to the economic productivity and value of a given site may result. Information and education efforts to increase public participation in prevention efforts, early detection rapid response, and reporting of infestations on public and non-public lands will help mitigate an increase in adverse effects from Alternative B. However, in general, potentially adverse effects associated with the loss of economic values or productivity for affected areas would be expected to be reduced, as would the future costs of eradication, if the Strategic Plan were not implemented.

The cost of highway maintenance is increased by the presence of roadside invasive plants, such as white sweetclover. White sweetclover forms dense semi-continuous hedges on both sides of the Dalton Highway from the Yukon River north to Ft Hamlin Hills Creek and patches continue in one to two mile continuous stretches north of this point to the community of Coldfoot. The plant can reach 60 inches tall or more along the Dalton Highway and root crown diameter can be up to 10 inches with spreading tap roots up to 10 inches deep and the size of a large parsnip. ADOTPF report that this invasive plant increases grading time and effort, therefore increasing the cost of maintaining sight distance along the highway.

Cumulative Effects

Previous projects and other activities in the DHCMA and surrounding areas, have contributed to the overall spread of invasive plants in the DHCMA. Correspondingly, some loss of economic value may also be associated with these activities. Transportation and recreational uses of the highway and surrounding area would be expected to increase with future road improvements and increased access to previously inaccessible areas. As a result, opportunities for additional infestation and additional adverse economic effects may increase.

Impacts associated with this alternative when considered in conjunction with other activities in the DHCMA and surrounding area would be expected to be generally beneficial in eliminating existing invasive species and controlling any future spread. As a result, any cumulative effect resulting from the implementation of this alternative would be expected to be minor to moderate and generally beneficial for the protection of economically valuable resources and the reduction of losses associated with plant infestations.

Conclusion

The actions proposed under this alternative would be expected to have a minor to moderate and long-term beneficial effect on socioeconomic resources through control of the number and size of potential infestations, thereby reducing the overall long term costs associated with invasive plant management in the DHCMA, as well as reducing losses associated with forgone economic opportunities as a result of invasive plant infestation. Any adverse effect associated with the limitations of the control practices available under this alternative may be successfully mitigated.

4.6.3 Impact of Alternative C

Impact Analysis

Under Alternative C, there would be no strategic management or control of invasive plants in the DHCMA. Control efforts in the region would continue to be conducted in a less targeted fashion, similar to those conducted to date. Adverse effects on the local economy as the result of altered land use (e.g. subsistence fishing, hunting and gathering, industry, gardening and recreation) are possible if invasive plants are allowed to continue to expand. Invasive plants may alter land use by affecting soil properties, water quality and quantity, diversity, and availability of forage and cover for native and subsistence (Eiswerth et al. 2008).

Although in the short-term the costs associated with invasive plant control would be low under this alternative, lack of strategic control efforts are likely to result in substantial economic impacts over the longer term if left unchecked.

Notably, costs associated with invasive plants are accruing currently. For instance, the cost of highway maintenance is increased by the presence of roadside invasive plants, such as white sweetclover which forms continuous hedges on both sides of the Dalton Highway from the Yukon River north to MP 90 and dense patches and one to two mile continuous stretches north of this point to the community of Coldfoot. The plant can reach 60 inches tall or more along the Dalton Highway and root crown diameter can be up to 10 inches with spreading tap roots up to 10 inches deep. ADOTPF staff reports that this invasive plant increases grading time and effort, therefore increasing the cost of maintaining sight distance along the highway.

Although specific economic projections for the DHCMA are not available, some estimate of the potential impact of delaying control measures can be made by comparison with data from experiences in other areas. Eiswerth et al. (2008) calculated the potential increased costs associated with delaying plant control in the State of Nevada. Based on an estimated plant infestation expansion rate of between 10 and 30 percent per year, this study concluded that under a modest estimate of 10 percent expansion, delaying control efforts by six years would cause the costs to rise to almost double what would have been expected had control efforts been implemented in the first year. At the higher end boundary of 30 percent, which is close to average annual rate found by Smith, costs would increase by almost five times the original first year estimate.

The DHCMA and surrounding area are also economically important for recreation uses. Invasive species can have a direct effect on private and vendor-led recreational land uses.

In general, invasive plants may have a substantial adverse impact to the economy of the DHCMA and the surrounding region as well as the State of Alaska. This impact is predicted to increase over time if invasive plants are not controlled or eliminated from certain areas. The economic impacts would be a function of the rate of expansion of certain species.

Cumulative Effects

Several past and present projects and other actions could be expected to exacerbate the growth and spread of invasive plants in the DHCMA, thereby increasing the potential cost of any future eradication and increasing the potentially adverse economic consequences associated with particular infestations. Among these are the use of the Dalton Highway as a haul road, the presence of a utility corridor and the increased use of off-road recreational areas in the adjacent lands along the southern end of the DHCMA. Future plans to update and improve the highway for increased general use and future resource development would also be expected to increase the level of traffic along the highway.

Increased use of the highway for basic public transportation, industrial uses and recreational purposes can be expected to also increase opportunity for additional spread of invasive plants into the DHCMA through human activities. In conjunction with the existing expansion of areas of infestation left uncontrolled, the cumulative effect of current and planned future uses could substantially increase the potential economic effects associated with the cost of future management efforts, along with the lost value of any economically productive resources. Cumulative impacts would be expected to be moderately adverse when added to other past, present and reasonably foreseeable future actions.

Conclusion

Alternative C would be expected to have a substantial adverse effect on both the resident populations, especially subsistence or partial subsistence communities, as well as the local economy in general. Impacts under this alternative would be expected to be adverse, moderate and long-term. Otherwise healthy and economically productive areas such as forest land and recreation areas may potentially be lost to the local economy. Without efforts to eradicate existing invasive plant species and control any future infestation, costs associated with any future management efforts would be expected to increase, as would the overall economic damage associated with forgone opportunities on affected lands.

4.7 SUBSISTENCE

This assessment of impacts to subsistence resources and uses evaluates those elements in the alternatives that may impact the uses of natural resources by rural residents in the DHCMA and the surrounding vicinity. A significant restriction to subsistence uses may occur in at least two instances: 1) when an action substantially reduces populations or their availability to subsistence users, and 2) when an action substantially limits access by subsistence users to resources (BLM, 2010b).

4.7.1 Impact of Alternative A

Impact Analysis

Under Alternative A, the Strategic Plan specifying the use of herbicides in addition to manual and mechanical treatment techniques would be implemented. By including the use of herbicides, this alternative would have the beneficial effect of substantially increasing the effectiveness of invasive plant management efforts and reducing the adverse effect posed by invasive plants on subsistence resources and indirectly on subsistence users and practices. Invasive plants currently present in the DHCMA have the potential to alter recruitment of native forage plants upon which subsistence species, particularly moose, rely. Left unchecked, infestations of invasive plants may directly alter the availability and distribution of forage plants and therefore alter the availability and distribution of subsistence game species for subsistence users.

The effects of the manual and mechanical treatments under this alternative would be similar to that for Alternative B. The inclusion of herbicides as a part of the integrated program of invasive plant management is potentially more effective for certain species than the range of options available under Alternative B.

If native plants used for subsistence purposes are inadvertently exposed to herbicides in areas where subsistence practices are conducted, this could adversely affect the safety of plants used for human consumption as well as their desirability for other uses as part of various subsistence practices (NPS, 2008). As a result, in some instances, herbicide treatment may have the potential to adversely affect some subsistence users. This alternative provides for rapid treatment of infestations using minimum-volume herbicide spot-treatments rather than allowing for infestations to expand as a result of ineffectual physical control methods (NPS 2008). The majority of proposed treatment areas are along and adjacent to the highway and would therefore likely have a negligible impact on natural vegetation.

Because none of the chemicals to be used under this alternative pose a serious human health risk, any potentially adverse impacts to subsistence resource use would be minimal. Additionally, a wide range of best management practices are required to ensure legal, safe, and responsible use. Other mitigation measures employed where herbicides are used serve to further minimize effects. Treated areas would be posted and public information efforts would be undertaken to inform the public of the location of treated areas and the period during which these areas should be avoided. A program of safety education for local residents would also serve to inform potential subsistence users of any dangers or potential hazards associated with certain treatments. Extensive consultation with local tribal governments, community residents and other subsistence users of the area during scoping have assisted in identifying and avoiding herbicide use in areas where native species important to subsistence practices are present. As a result of comments from these groups, an herbicide free buffer area of 150 meters will be maintained around the community of Wiseman. This buffer exceeds all label requirements, BLM buffer zone requirements for sensitive areas (BLM Manual H-9011-1), and the drift, run off and leaching potential of all application methods and herbicides proposed in Alternative A.

Cumulative Effects

The overall effect on subsistence resources under Alternative A would be generally beneficial as a result of the increased ability to rapidly control the growth and spread of certain species through herbicide application. Some minor, short-term adverse effects may be associated with herbicide use and other physical treatments, but ultimately these would not be expected to have a substantial incremental effect on the existing condition when considered with other past, present and reasonably foreseeable activities in the area. The potential cumulative impacts associated with this alternative would therefore be expected to be moderately beneficial for subsistence uses and practices in the area. Invasive plants currently present in the DHCMA have the potential to alter recruitment of native forage plants upon which subsistence species, particularly moose, rely. Left unchecked, infestations of invasive plants may directly alter the availability and distribution of forage plants and therefore alter the availability and distribution of subsistence game species for subsistence users. Any associated adverse impacts would be negligible to minor and are expected to be successfully mitigated by SOPs and stipulations in this assessment and the PEIS.

Conclusion

In general, Alternative A would be expected to have a long-term, moderate and beneficial impact on subsistence resources and practices, as well as on subsistence populations in and around the DHCMA. Some potentially minor, short-term, adverse impacts may be associated with herbicide uses, but these can be successfully mitigated through implementation of best management practices, public education, and outreach with the affected communities.

4.7.2 Impact of Alternative B

Impact Analysis

Implementation of the Strategic Plan, without the use of herbicides, under Alternative B would be expected to have a minor to moderate, indirect beneficial impact on subsistence uses and practices by eliminating the potential threats to native vegetation and wildlife habitat through spread of invasive plant species away from the highway and adjacent disturbed areas. The mechanical and manual options that would be the main treatments used under this alternative would result in some surface disturbance to treated areas, potentially affecting both desirable as well as undesirable species. However, because most treatment areas are adjacent to the highway and many are relatively small (<1 acre), any disturbance would be temporary and would have only a minimal adverse impact on the overall availability and access to resources by subsistence users in the area. Where infestations larger than one acre are involved, as appropriate, site restorations using native grasses would serve to stabilize areas and discourage reestablishment of invasive plant species.

To the extent that some treatments may be ineffective in reducing the threat from certain species or in certain environments, potentially minor to moderate adverse impact may be anticipated in areas where subsistence resources may be present. In combination with extensive consultation with local community and tribal leaders, a public information and education effort to increase awareness of the potential threat to subsistence resources and identify sites where such resources are threatened would be effective as mitigation for any potentially adverse effects.

Cumulative Effects

The impact of this alternative, when considered along with other past, present, and reasonably foreseeable projects or other activity in the surrounding areas would be generally beneficial in reducing the level of invasive plant infestations. By reducing both the number and extent of new and existing infestations, actions taken under this alternative would be expected to have a minor to moderate beneficial impact on the availability of subsistence resources in the affected area, and correspondingly an indirect beneficial effect on the subsistence consumption and other practices of rural communities in the surrounding area. Potential effects associated with various physical control techniques would be expected to only minimally alter existing conditions in the affected areas.

Conclusion

This alternative would result in an overall minor to moderate beneficial impact to subsistence users and resources through management of invasive species that could otherwise spread to areas where they would threaten subsistence resources. The control methods available under this alternative would be expected to have only negligible to minor adverse impacts to surface areas where control techniques are applied. Any subsequent effect could be easily mitigated through revegetation.

4.7.3 Impact of Alternative C

Impact Analysis

Under Alternative C, no strategic invasive plant management would be conducted. Existing infestations would be expected to continue to expand. New species and new infestations of existing species would be expected to become established.

Eiswerth et al. (2008) reports that invasive plants can lead to a reduction in the diversity and numbers of animals such as deer, elk, waterfowl and other birds and limit forage for wildlife that are important for subsistence populations. In Alaska, there is some evidence that sweetclover inhibits native riparian vegetation and is associated with higher willow mortality (Spellman and Wurtz 2010). Willow species provide important forage for moose in the DHCMA.

Furthermore, invasive plant infestations may lure pollinators away from native plants reducing plant yields and adversely affecting habitat for subsistence resources (USDI 2010). There is some evidence that native-plant pollinator networks are altered by the presence of white sweetclover in Alaska (Schneller et al. *in prep*). Invasive plant species may also be a threat to sacred, medicinal, or other natural resources important for traditional uses.

Local residents would be expected to incur some level of cost, either in terms of additional labor or as a monetary expense associated with any attempts to control spread and new invasions on an individual basis. A potentially adverse effect would be anticipated. Over the long-term, impacts to subsistence uses and practices could be minor to moderate and adverse depending on the location and conditions at sites of invasive plant infestations.

Cumulative Effects

The growth and spread of invasive plant species in the DHCMA may be influenced by a number of past and present projects and other actions in the area. Among these are the use of the Dalton Highway as a haul road, the presence of a utility corridor and the use of off-road recreational areas in the adjacent lands along the southern end of the DHCMA. Many of these actions are located in areas where invasive plant infestations are also found. Additionally, a portion of the relatively large population of the Fairbanks area utilizes the Dalton Highway corridor and likely represents a significant vector for the introduction and spread of invasive plants. Plans to update and improve the highway are likely to be associated with increased levels of highway traffic and more opportunities for invasive plant spread.

The impacts to subsistence resources and uses would be likely to increase in the absence of any systematic plan to address management and control. Increased use of the highway for basic public transportation, industrial uses and recreational purposes can be expected to also increase the opportunity for additional spread of invasive plants. Substantial and noticeable changes in access and the availability of subsistence resources would be expected. Overall, the impact of Alternative C, when added to other past, present and reasonably foreseeable future actions, would be a change in the availability of and access to subsistence resources. This change would be expected to result in a moderate adverse impact on subsistence resources and would indirectly affect both existing subsistence practices and the resident subsistence populations in the area.

Conclusion

The absence of management strategies to address elimination and control of invasive plants under Alternative C would be expected to have minor to moderate adverse effects on subsistence resources, as the number and size of specific invasion sites increase, especially if infestations move into naturally disturbed areas and natural vegetation communities adjacent to the highway. Existing invasive species could also be transported to remote sites through multiple mechanisms. Over the long-term, impacts would be expected to become increasingly adverse, altering individual practices and uses due to changes in the availability and access to resources.

4.8 HUMAN HEALTH AND SAFETY

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 could be is determined by defining the terms.

(1) “Probability” is defined as: The chance that a given event will occur. Probability ratings are:

Low - If factors considered indicate it would be unlikely that an accident could occur;
Medium - If factors considered indicate it would be likely that an accident could occur; or
High - If 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 ratings are: Low, First Aid Case; Medium, Serious injury or illness; High, Fatality.

4.8.1 Impact of Alternative A

Impact Analysis

The use of herbicides, which would be implemented under Alternative A, involves potential risk to workers and members of the public living or engaging in activities in or near herbicide treatment areas. Risk to two types of human “receptors” is evaluated: occupational receptors and public receptors. Receptors are representative population groups that could have specific exposures to the herbicides. Occupational receptors included those workers that mix, load, and apply herbicides and operate transport vehicles, recognizing that in some cases an occupational receptor may perform multiple tasks, increasing his or her exposure. Public receptors included those members of the public most likely to come into contact with applied herbicides. Public receptors include adult and child hikers, hunters, anglers, berry pickers, swimmers, and residents.

The potential effects to the public would be less than to workers because they are not performing treatment tasks, and signs would be posted warning people of treatment activities. The risks associated with manual and mechanical control, which would also be used under this alternative, are described under Alternative B. The additive risk of using herbicides is analyzed here and is based on three conditions:

> **Half-life** is the time required for half of the compound to degrade.
>
> **1 half-life = 50% degraded**
> **2 half-lives = 75% degraded**
> **3 half-lives = 88% degraded**
> **4 half-lives = 94% degraded**
> **5 half-lives = 97% degraded**
>
> Remember: the amount of a chemical remaining after a half-life will always depend on the amount of the chemical originally applied.

1. Job Hazard Analysis (JHA) - developed and followed for each of the jobs to be completed. Workers are expected to follow the JHA recommendations (personal protective equipment use, well-maintained equipment and herbicide supplies, good work practices, etc.) when completing that job.
2. Training - Workers 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 three conditions are not met, then the severity and probability of worker or public injuries would increase.

Hazard Rating of Selected Herbicides

The herbicides recommended for use, hazard ratings, health risks, and half-life are shown in Table 4-3. 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. The complete fact sheets can be found at: http://www.wsdot.wa.gov/Maintenance/Roadside/herbicide_use.htm.

Table 4-3. Herbicide hazard ratings, health risks, and half-life.

Active Ingredient of Herbicide	EPA Toxicity Category	Health Risks	Half-life
2, 4-D (e.g.Weedone)	Toxicity class III (Low) Signal word: CAUTION	Low toxicity if individuals accidentally eat, touch, or inhale residues. Causes eye irritation, moderate skin irritation, and no skin sensitization. Cancer risk under average exposure: negligible	Less than 7 days
Chlorsulfuron (Telar)	Toxicity class III (low) Signal word CAUTION	Low toxicity if individuals accidentally eat, touch, or inhale residues. Mild eye and skin irritant but not a skin sensitizer. Cancer risk under average exposure: negligible	1 to 3 months, with a typical time of 40 days
Clopyralid (Transline)	Toxicity class III (low) Signal word	Low toxicity if individuals accidentally eat, touch, or inhale residues. Vapors may irritate the eyes, and direct contact	14 to 56 days, with a typical time of 40 days

Active Ingredient of Herbicide	EPA Toxicity Category	Health Risks	Half-life
	CAUTION	may cause very slight but temporary eye injury. It is not a skin sensitizer or irritant. Cancer risk under average exposure: negligible	
Dicamba (Vanquish)	Toxicity class III (low) Signal word CAUTION	Low toxicity if individuals accidentally eat, touch, or inhale residues. Mild skin irritant, mildly to extremely irritating and corrosive to the eyes, and has no to moderate potential to cause skin sensitization. Cancer risk under average exposure: negligible	1 to 4 weeks, with a typical time of 2 weeks
Glyphosate (Roundup Pro) (Rodeo)	Toxicity class II (moderate) Signal word WARNING Toxicity class III (low) Signal word CAUTION	Low toxicity if individuals accidentally eat or inhale residues and very low toxicity if touched. It is not a skin irritant or sensitizer but it is an eye irritant. Severe eye damage from exposure to Roundup is rare. Roundup has caused irritation of the mouth, nausea, intestinal discomfort, vomiting and diarrhea when eaten by people. Eating large amounts has caused hypotension (low blood pressure) and pulmonary edema (fluid in the lungs). Cancer risk under average exposure: negligible	1 to 174 days, with a typical time of 47 days
Imazapyr (Arsenal, Habitat)	Toxicity class III (low) Signal word CAUTION	Low toxicity if individuals get residues on their skin, and very low toxicity if it is eaten or inhaled. Not irritating to rabbit eyes, but was mildly irritating when applied to the skin. Did not produce sensitization in guinea pigs. Cancer risk under average exposure: negligible	10 days
Metsulfuron methyl (Escort)	Toxicity class III (low) Signal word CAUTION	Low to very low toxicity if people eat, touch, or inhale residues. The technical material is very irritating but not corrosive to the eyes of laboratory rabbits, moderately irritating to the skin and not a skin sensitizer. Cancer risk under average exposure:	14 to 180 days, with a typical time of 30 days

Active Ingredient of Herbicide	EPA Toxicity Category	Health Risks	Half-life
		negligible	
Sulfometuron methyl (Oust)	Toxicity class III (low) Signal word CAUTION	Low to very low toxicity if individuals accidentally eat, touch, or inhale residues. The material is slightly irritating to the eyes of laboratory rabbits, nonirritating to the skin, and not a sensitizer. Cancer risk under average exposure: negligible	20 to 28 days, with a typical time of 20 days
Triclopyr (Garlon 4)	Toxicity class III (low) Signal word CAUTION	Low toxicity if individuals accidentally eat, touch, or inhale residues. Slightly irritating to the eyes, nonirritating to the skin, and causes skin sensitization. The herbicide formulation Garlon 3A may cause irreversible damage to the eyes. Cancer risk under average exposure: negligible	30 to 90 days, with a typical time of 46 days

Source: WSDOT, 2010

Public receptors could be exposed to herbicides via offsite drift during or following routine application. Accidental exposure could occur through direct spray and spills. Exposure scenarios for the public include 1) dermal exposure through spray drift, 2) dermal contact with vegetation, 3) dermal contact with water while swimming, and 4) consumption of berries, water, fish, and game.

Workers would be mixing chemicals and water, cleaning equipment, and storing and applying the designated herbicides. The herbicides would be applied using minimum volume techniques, backpack or hand held spray mechanism for direct contact with target plants. Spray mechanisms would be equipped with flow regulators that control application rates, maximize effectiveness, and minimize drift. Workers could be exposed through inhalation and dermal contact.

Potential health risks to workers and the public from herbicide applications are listed in Table 4-3 for proposed active ingredients. The probability of injuries occurring is low. The severity of injuries is low to medium.

Ground applications typically pose a lower risk to offsite receptors than aerial applications (which is not an application method considered in this alternative) because the receptors are less likely to be exposed to spray drift. Similarly, spot rather than boom/broadcast applications are less likely to result in adverse effects to downwind receptors. However, spot applications could present an increased risk to the occupational receptors charged with applying the herbicide because they are more likely to come into contact with the herbicide.

Most of the herbicides do not present a risk to human receptors when applied at the appropriate application rate. In general, there are lower risks to public receptors than occupational receptors. However, within this category, there is higher risk to children than adults.

In general, because the proposed herbicide applications for this EA would be relatively small, 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.

Accidents could occur during the process of non-herbicide invasive plant treatment.

Cumulative Effects

Effects on human safety and health that could occur in relation to this Alternative may result from exposure to traffic operations while conducting roadside work, motor vehicle operations, ATV operations, or slips, trips, or falls. Such injuries would be negligible to moderate depending on circumstances. No increase in worker 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. The additive effects of Alternative A to other past, ongoing, and future impacts to human health and safety would result in no more than moderate overall cumulative impacts.

Conclusion

Alternative B would have low to moderate effects on human health and safety due to accidents that could be associated with manual or mechanical weed removal activities. Treating invasive plants by the use of herbicides with approved application methods and proposed public notification and area closures would result in low overall risk of injuries to workers or the public, and the impacts to human health and safety would be short-term, adverse and minor. Alternative B would have low to moderate effects on human health and safety due to accidents that could be associated with manual or mechanical weed removal activities.

The lack of invasive plant control may also leave unchecked some safety issues since roadside vegetation reduces site distance on curves and hills and blocks detectability of animals along the highway. White sweetclover can occur as tall, dense stretches of vegetation at the road-surface edge along the highway. Roadside vegetation, including invasive plants, can undermine the road surface and ultimately lead to hazardous road conditions.

4.8.2 Impact of Alternative B

Impact Analysis

Under Alternative B, only manual and mechanical treatments would be used to control invasive plants. Accidents could occur during the process of non-herbicide invasive plant treatment.

Cumulative Effects

Effects on human safety and health that could occur in relation to this Alternative may result from exposure to traffic operations while conducting roadside work, motor vehicle operations, ATV operations, or slips, trips, or falls. These effects would be negligible to moderate depending on circumstances. The additive effects of Alternative B to other past, ongoing, and future impacts to human health and safety would result in minor to moderate overall cumulative impacts.

Conclusion
Alternative B would have low to moderate effects on human health and safety due to accidents that could be associated with manual or mechanical weed removal activities.

4.8.3 Impact of Alternative C

Impact Analysis
Under Alternative C, only manual and mechanical treatments would be used to control invasive plants. Accidents could occur during the process of non-herbicide invasive plant treatment.

Cumulative Effects
Effects on human safety and health that could occur in relation to this Alternative may result from exposure to traffic operations while conducting roadside work, motor vehicle operations, ATV operations, or slips, trips, or falls. These effects would be negligible to moderate depending on circumstances. No increases in human injuries would be expected to occur under this alternative. The additive effects of Alternative C to other past, ongoing, and future impacts to human health and safety would result in minor to moderate overall cumulative impacts.

Conclusion
Alternative C would have low to moderate effects on human health and safety due to accidents that could be associated with manual or mechanical weed removal activities.

5.0 CONSULTATION AND COORDINATION

5.1 PUBLIC INVOLVEMENT

Scoping is the effort to involve agencies and the general public in determining the scope of issues to be addressed in the environmental document. Among other tasks, scoping determines important issues and eliminates issues not important; allocates assignments among interdisciplinary team members and/or other participating agencies; identifies related projects and associated documents; identifies other permits, surveys, consultations, etc. required by other agencies; and creates a schedule which allows adequate time to prepare and distribute the environmental document for public review and comment before a final decision is made. Scoping includes any interested agency, or any agency with jurisdiction by law or expertise (including the Advisory Council on Historic Preservation, the State Historic Preservation Officer, and Indian Tribes) to obtain early input.

A scoping letter (Appendix D) and scoping flyer (Appendix E) describing the project and requesting public input on the selected alternatives was issued to private parties and state, federal, and local agencies. The public scoping period for the project began on February 26, 2010 and ended on March 31, 2010.

5.2 TRIBES, INDIVIDUALS, ORGANIZATIONS, AND AGENCIES CONSULTED

See Appendix C for full list of stakeholders consulted.

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DRAFT
Dalton Management Area Integrated Invasive Plant Strategic Plan

Alaska

Bureau of Land Management

2009

EXECUTIVE SUMMARY

The Bureau of Land Management (BLM) manages over two million acres of land along the Dalton Highway north of the Yukon River and south of Slope Mountain. These lands, hereafter referred to as the Dalton Management Area (DMA), are used for camping, hiking, hunting, fishing, canoeing and rafting, wildlife viewing, sightseeing, gold panning, mining, subsistence use and commerce. The Dalton Highway is a secondary road whose original purpose was the resupply of oil fields on the North Slope and maintenance of the Trans Alaskan Pipeline (TAPS). Built in 1974, the "Haul Road" was open to industrial traffic only at first, but, in 1995, it was opened for use by the general public, too. The highway has since become a gateway for arctic adventure, tourism, and recreation for many people and its use has steadily increased (Central Yukon Field Office files). The highway has also become an avenue for the northward expansion of invasive plants.

The ecosystems along the Dalton Highway changes as the latitude increases northward, beginning with boreal forest communities near the Yukon River valley, followed by dry, tundra-covered hills and mountains in the Brooks Range, and finally to wet tussock-tundra on the southern reaches of the Arctic coastal plain. The BLM-managed lands along the highway include nine Areas of Critical Environmental Concern (ACECs), as well as the Toolik Lake Research Natural Area. Several conservation units lie adjacent to BLM-managed lands along the highway, including the Arctic National Wildlife Refuge, Gates of the Arctic National Park and Preserve, Kanuti National Wildlife Refuge, and the Yukon Flats National Wildlife Refuge.

The Bureau of Land Management proposes to implement a five year Integrated Invasive Plant Strategic Plan to manage non-native invasive plant (NIP) species within the DMA. Integrated invasive plant management is a comprehensive approach to weed management. It employs multiple methods of control and eradication (e.g. manual, mechanical, cultural, and chemical), and utilizes a cooperative, interagency approach to monitoring, early detection and rapid response, and public outreach and education. The purpose of this strategic plan is to provide a strategy for the prevention, control, monitoring, and management of NIP in the DMA in cooperation with state and federal agencies, non-governmental organizations, private industry, and the public.

This strategy outlines the current status of invasive plants on BLM lands within the DMA, describes past control efforts, and recommends a combination of treatment strategies to suppress or eradicate existing and future invasive plant populations. It will serve as an initial step towards addressing outreach and partnership opportunities regarding control and management of invasive plants along the Dalton Highway and other areas of the DMA. Since this is a strategic plan, this document does not make decisions regarding weed management and is not considered to constitute a decision related to the National Environmental Policy Act (NEPA). After developing partnerships and exploring strategies for invasive plant control and management, the Bureau of Land Management will analyze potential decisions and alternatives in compliance with NEPA. The goals of this plan include:

1. Present Integrated Invasive Plant Management strategies to control invasive plants according to their invasiveness risk, size of infestation, and their susceptibility to control.
2. Present a monitoring program based on Early Detection and Rapid Response (EDRR).
3. Work with partners to establish a Cooperative Weed Management Area in the DMA.
4. Increase public awareness of non-native invasive species, the environmental problems they cause, as well as building advocates for and encourage investment to manage NIP.

This strategic plan is based on the goals and strategies outlined in "*Partners Against Weeds*", an action plan developed by the BLM in 1996 to prevent and control the spread of NIP on public lands.

It is in compliance with the *Utility Corridor Resource Management Plan*, and the Bureau's 2007 *Programmatic Environmental Impact Statement (EIS) on Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States* (FES-07-21). The programmatic EIS on Vegetation Treatments Using Herbicides provides a broad, comprehensive source of information to which subsequent environmental analyses can be tiered and allows the use of 14 herbicides in Alaska after careful, case-by-case evaluation (listed in Table 1 on page 2-3 of the Record of Decision). All of the herbicides proposed for potential use in this strategic plan are currently approved in this EIS and by Alaska Department of Environmental Conservation (ADEC).
OVERVIEW

Existing Conditions

Twenty-eight non-native invasive plant species have been documented within the DMA. Of these plants:

- Eleven species are considered highly invasive, exist only in a few isolated places and are potentially eradicable;
- Eight species are highly to moderately invasive, are relatively well established and must be controlled to prevent movement into native ecosystems;
- Nine species, though relatively well established on the roadside, are not considered a threat to native ecosystems.

The nineteen species that are identified for eradication or control represent a wide variety of plant types (grasses or forbs), life cycles (annuals, biennials, and perennials), reproductive strategies (seeds and/or stolons), and life forms (prostrate or erect).

Serious negative economic and ecological impacts are predicted if these species are left to expand. For example, six of these species are nitrogen fixing: sweetclover (*Melilotus officinalis*), alfalfa (*Medicago sativa*), alsike clover (*Trifolium hybridum*), birdsfoot trefoil (*Lotus corniculatus*), and bird vetch (*Vicia cracca*). Boreal forest and tundra communities are naturally nitrogen poor ecosystems; additions of nitrogen could change ecosystem processes (e.g. by accelerating microbial decomposition, altering plant communities, and changing plant succession) in fundamental and unpredictable ways. Generally, nitrogen-fixing plants do not grow well on acidic soils. Soils along the Dalton Highway are basic and as a result, nitrogen-fixing NIP species are spreading rapidly along the Dalton Highway. In fact, recent greenhouse research has indicated that white sweetclover plants grown on native soils from the Dalton Highway are more vigorous when compared to those grown on soils collected along the Steese and Parks Highways.

NIP have spread rapidly throughout disturbed areas in the Dalton Highway Management Area in past years and some have recently moved off the highway right-of-way into native, undisturbed habitats (Tim Craig, BLM Wildlife Biologist, pers. com.). In the past decade, roughly 2 million acres have burned in the Dalton Highway Corridor and NIP have also been found in areas that were burned in these recent wildfires (Skip Theisen, BLM Fire Management Specialist, pers. com.). Research indicates that many of these burned areas are susceptible to invasion by NIP for up to 20 years after the fire (CNIPM, 2007).

Current Management

The introduction, spread, and reproduction of non-native invasive species must be prevented and/or controlled to protect native ecosystems. BLM and its partners' efforts to halt the spread of NIP within the Dalton Management Area have included manual and mechanical control of target species. Current partners include Friends of the Wildlife Refuges, Fish and Wildlife Service, CNIPM (Committee for

Noxious and Invasive Plant Management) as well as contacts in Alaska Department of Transportation and Public Facilities (ADOTPF) and Alyeska Pipeline Service Company (Alyeska). Management efforts within the DMA have been focused at river crossings to prevent the spread of NIP, particularly sweetclover, downstream to private and public lands, owned by native corporations, and managed by the BLM, National Park Service (NPS) and U.S Fish and Wildlife Service (FWS). BLM efforts have also been centered on halting the northward spread of target species, including sweetclover, oxeye daisy (*Leucanthemum vulgare*), yellow toadflax (*Linaria vulgaris*), bird vetch, and common tansy (*Tanacetum vulgare*). In addition, the BLM inventoried NIP in the DMA in the summer of 2004. Inventory, control and monitoring protocols adhere to recommendations of the North American Weed Management Association (NAWMA), but were adapted by the BLM to the DMA. Data that were collected are stored electronically, and in hard copy, at the Fairbanks District Office, and will be incorporated into the BLM National Weed Database, when the database becomes available. The data are also stored on the Alaska Exotic Plant Information Clearinghouse (AKEPIC) database, which is coordinated by the Alaska Natural Heritage Program (ANHP), University of Alaska-Anchorage.

Unfortunately, the current control methods used in the past have not arrested infestations of NIP in the DMA. These infestations provide seed that move with vehicles, equipment, and through normal road maintenance. It now appears that it is not possible to effectively halt the spread of NIP within the DMA or to adjacent lands by manual and mechanical means with the limited human resources. The proposed strategic plan would include several key practices including:

- Methods of integrated invasive plant management (including manual, mechanical, and chemical measures);
- A inventory, mapping, monitoring, and reporting procedure;
- An invasive plant infestation prevention program;
- The creation of a Dalton Highway Cooperative Weed Management Area (CWMA);
- Public awareness; and,
- The Best Management Practices (BMP) for land use actions (mitigation) conducted by or permitted by BLM.

INTEGRATED INVASIVE PLANT MANAGEMENT

Integrated invasive plant management involve the use of several different control techniques prescribed for a target weed species in a planned, coordinated program to limit the impact and spread of the plant. These techniques usually include the following and are often used in combination to achieve desired results– manual, mechanical, chemical, prescribed fire, and biological practices. Due to the limited knowledge of the effects of prescribed fire and biological control methods in Alaska, these methods are not projected to be used, but are still an option for the future.

Manual methods incorporate the use of hand-operated tools to cut, clear, thin, or prune herbaceous and woody species as well as the use of mulch, weed barrier, cloth, and other materials to inhibit the growth of vegetation. This can include tools such as your hand, shovel, pruners, etc. **Mechanical** methods incorporate power tools such as chain saws and motorized brush cutters. The current program of weed management along the Dalton Highway combines these two methods, specifically hand pulling and weed-cutting at river crossings and access points off the highway.

Manual methods are highly selective and have less impact on other resources. However, these techniques are so labor-intensive and expensive that at the landscape scale, such as in the DMA, the costs per acre are much higher than for alternative methods. Alternatively, mechanical methods are less labor intensive than manual pulling and more cost efficient, but are often less effective.

Chemicals kill plants by disrupting their physiology in a number of different ways. Some herbicides are highly selective while others kill all of the vegetation on a site. Some herbicides only kill above ground vegetation while others kill underground root systems and reduce resprouting. Some are pre-emergent and inhibit germination. Many herbicides decompose shortly after use while others remain temporarily active in the soil to reduce reinvasion of the target plants. All herbicides that are considered for use must be registered under Environmental Protection Agency (EPA) regulations. The herbicides proposed for use in this strategic plan are registered with EPA and approved for the use in Alaska (FES-07-21, page 2-3). They will be stored in compliance with Occupational Safety and Health Administration (OSHA) regulations (29 CFR). All actions and protective equipment requirements will be followed in compliance with manufacturer and product specific Material Safety Data Sheets (MSDS). Crew leader will hold a valid Alaska Pesticide Use License with the proper permission granted for pesticide use.

There are generally four different methods for applying herbicides, two mechanical (aerial or land-based via boom sprayer) and two human-powered (backpack equipment and hand application). This strategy focuses efforts on using manual control methods in conjunction with hand applications and backpack sprayers in order to target individual, unwanted plants or patches and reduce effects on non-target organisms and other elements of the environment. Boom mounted sprayers on four wheelers or trucks will also be considered for contiguous roadside patches and other linear or large patches, for example along highway, trails or airstrips. These techniques will be more cost effective than manual techniques currently used since labor costs will be greatly reduced.

Prescribed fire and management of wild fires can be used to reduce hazardous fuels, prepare sites for seeding/planting, rejuvenate forage for wildlife, maintain fire-dependent landscapes, control insects and diseases, and maintain habitat for threatened and endangered species. However, fire, both controlled and wild fires, disturb the soil. These disturbances sometimes lead to increased opportunities for NIP introduction (National Invasive Species Information Center, 2008). Fire may also encourage *in situ*, non-native invasive plants to increase depending on the heat tolerance, vigor, sprouting ability, and seed sensitivity of individual plant species and the duration and intensity of the fire (Forest Pest Management, 1990). Adjacent fire prone habitats also diminish the viability of fire as a weed control tool. There is very little information on the usage of prescribed fire to control NIP species in Alaska. Therefore, the BLM does not anticipate using this method, but it may be a tool in the future.

Biological methods of controlling vegetation include the use of insects and pathogens. Often it takes three to five different insects to control one plant species (Forest Pest Management, 1990). These introduced species usually have no natural enemies; therefore, they have the potential to become invasive themselves and attack non-targeted species. Again, due to the lack of research, this method also is not anticipated to be used, but still can be a tool in the future.

Proposed Management Strategies

The NIP that have been found in the DMA were evaluated using a decision tree and ordered to determine the best control methods for each species (Appendix II). This decision tree selects the level of response based on the plant's potential for eradication, its risk of invasiveness (high, medium or low), and the type of ground infested (altered or unaltered). A synopsis of these results with suggested goals and practices based on efficacy, critical habitat, available funding, special management areas and input from other agencies are contained in Appendix III. Recommended management strategies for each species are outlined in Appendix IV. Finally, Appendix V reviews the Standard Operating

Procedures (SOPs) for applying herbicides removed directly from FES-07-21 and Appendix VI contains maps locating the various species of concern within the DMA.

Inventory, Monitoring, Mapping, and Evaluation

Weed surveys identify the species present, their locations, and the severity of the infestation. Inventories in the DMA will be conducted annually. Observations will be processed using GPS (Global Positioning System) technology and we will establish photo points to visually depict changes in infestations. We will use standardized data sheets developed by the Bureau of Land Management (Appendix I) to record data. A "Special Status Species" survey will also be conducted before any treatment is considered.

The sheet provided by AKEPIC can also be used for monitoring infestations throughout the entire growing season and from year to year. At the end of the season, the data sheets will be analyzed to evaluate the effectiveness of the selected control efforts and help determine if modifications are needed for particular species or locations.

The following would be concluded after each growing season:

- Evaluate each infestation to determine if the control method accomplished the goals established in Appendix III for each particular species using photo point referencing.
    - Evaluate effectiveness, costs/benefits versus cost/benefit of other alternatives, and projected costs of no action.
- Evaluate and correct actions in regard to the following:
    - Were the target populations adequately suppressed?
        - Should treatment be repeated, modified?
        - Should an alternative treatment be considered?
    - Was the cost of suppression equal to, or less than the cost of no action?
    - What was the effect on non-target organisms?
    - Was there an improvement of wildlife habitat?
    - Were the side effects included in the cost-benefit analysis?
    - Was funding and manpower available at the appropriate time?
    - Was training adequate?
    - Were there changes in the weed regime due to external factors?
    - Lessons learned?

Reporting

All treatments will follow BLM Standard Operating Procedures and a report made of every treatment following BLM protocols outlined in BLM's programmatic EIS. The first year's work will be used as baseline comparison of the success of subsequent treatments. The results of consequent evaluations will be used to guide future decisions on priorities and control methods and adjust rankings of NIP and control methods yearly.

Weed Management Area Status Report will be completed by the CWMA Board (or as established in CWMA Memorandum of Understanding) annually to track progress. It may include:

- Charting the progress made in the Weed Management Area in achieving established objectives as well as accomplishments made by partners.

- Record of funding expended in the current year and a projected budget for out years.
- Account of the total number of acres per NIP species placed under management within the CWMA. The treatment techniques would differ by site and species.
- Measure of the acres treated or retreated by the technique outlined in the CWMA Management Plan.

MONITORING - PREVENTION, EARLY DETECTION AND RAPID RESPONSE

Annual damage from invasive species worldwide was estimated at $1.4 trillion according to CNIPM in 2007. One weed – spotted knapweed – now costs Montana over $14 million per year and covers over 5 million acres. In Alaska, this species has been found on over 10 sites from Ketchikan to Anchorage.

A strong prevention program is necessary to hinder the further spread and cost of invasive species along the Dalton Highway Corridor. EDRR allows resource managers to find and control invasive weeds before they become wide-spread and negatively affect natural ecosystems because it is easier and more economical to control younger and smaller populations. Prevention is best accomplished by ensuring that weed seed and/or vegetative plant parts are not introduced into an area. Common methods of weed introductions include: contaminated seed, feed grain, straw, or mulch for reclamation projects; movement of unclean personal vehicles or mining equipment/machinery from weed contaminated areas; animals (domestic and wildlife) that may have viable weed seed present in their digestive tract or attached to their hair or wool; wind or waterways dispersing seed; hunters, hikers, fishers, pilots moving NIP parts with viable seed; gardeners planting NIP as ornamentals; land owners scattering contaminated wild bird seed or allowing NIP to produce seed along water-ways and roadways; and Alaska Department of Transportation and Public Facilities / Alyeska Pipeline Service Company equipment and maintenance practices using gravel, road fill, or top soil contaminated with noxious weed seed or vegetative reproductive plant parts.

Without the influx of funds, this strategy will rely on educational outreach and relationship building. Through initial consult with BLM cooperators, this strategy proposes the following as preventative measures which may be addressed with available funding and effectiveness:

- Develop EDRR programs and brochures for the public on new NIP which include easy-to-use EDRR reporting forms at various locations frequently visited. Forms and guides will be made available to local rural communities along the Yukon and Koyukuk Rivers, tourists, truck drivers and included with permits for land authorizations to prevent infestations from going unnoticed.
- Continue monitoring to determine if there are new invading NIP or if existing infestations are expanding. Initiate an immediate, strong eradication program if new invaders are confirmed.
- Ensure that seed, feed grains, straw or mulch used in the CWMA is free of weed reproductive plant parts.
- Declare the area north of Coldfoot a weed-free zone to prevent northward spread, and monitor the area regularly to detect early and eradicate any outbreaks of NIP.
- Create weed free zones within 500 feet of bridges and river crossings and monitor these areas regularly for early detection of NIP species and eradicate, as necessary, any outbreaks of NIP.
- Target non-permitted activities through public outreach by utilizing education on Best Management Practices (BMPs).

- Provide information on weed-free materials to permitted and non-permitted land use activities.
- Require permitted land use activities to incorporate weed prevention project proposals including:
  - Develop Best Management Practices (BMPs) for road construction material sites, sand and gravel pits, mulch, and other material source sites.
    - use certified weed-free materials
  - Require as a stipulation in all permits that operators clean all equipment before entering and leaving project sites when operating in areas infested with weeds, and that equipment brought from outside the area should be cleaned before it leaves the point of origin. Designate an area where equipment would be cleaned and frequently monitor the site for new NIP. Discarded seeds and plant parts be collected and incinerated. Require project proponents to communicate with the BLM and local weed specialist to develop BMPs and cooperative strategies as necessary.
  - To avoid weed invasion, build and maintain self-sustaining, healthy plant communities wherever possible, including along utility rights-of-way, roadsides, highway landscaping projects, rest areas, and scenic overlooks. Any seeding or planting will be with weed-free certified seed and nursery stock.
  - Train/educate maintenance staff and truck operators to recognize weeds and report locations of infestations to the local weed specialist.
  - Coordinate blading and/or pulling of noxious weed-infested roadsides or ditches in consultation with the local weed specialist. As a minimum, blade from least infested to most infested areas. Along the Dalton Highway, preventing NIP movement northward is vital; therefore, grading from north to south may be preferable. Also, time disturbing activities to precede seed set and ensure weed propagules are not moved to uncontaminated sites.
    - I.e. Grade roads in the spring instead of later in the growing season; thus preventing spread of weed seed and the creation of a seed bed for weeds.
  - Avoid acquiring water for road dust abatement where transit is through weed-infested sites.
  - Conserve original weed-free top soil where applicable.
  - Treat weeds in road decommissioning and reclamation projects before roads are made impassable. Sites with moderate to high weed density should be treated for several seasons prior to decommissioning. Regardless of weed density, revegetate with certified weed-free seed to speed recovery and mitigates soil erosion. Reinspect and document response.
  - BLM actions on the landscape will adhere to the same standards.
- Weed Management for burned areas
  - Restore fire lines using the same material that was removed during construction.
  - Require Fire Suppressing personnel to develop proper cleaning techniques of their equipment before and after fire.
  - Ensure rehabilitation as part of the suppression effort.
  - Start rehabilitation immediately after the fire or as soon as possible.

WEED MANAGEMENT AREAS

The goal of a Cooperative Weed Management Area (CWMA) is a partnership with other agencies, organizations and interests to prevent the reproduction and spread of NIP into and within the CWMA. These areas create a new (often natural) management boundary that replaces jurisdictional boundaries that weeds do not recognize. Cooperators jointly prioritize weed management efforts based on species or geographic area and work together to manage infestations. Cooperators may include those who hold easements, rights-of-way, special use permits, private property, as well as state and federal land managers adjacent to the BLM-managed lands along the Dalton Highway. Construction of such a partnership is vital to preventing the spread as well as the management of NIP species.

Potential Partners / Interested Parties: Alaska Association of Conservation Districts (AACD), Alaska Department of Transportation and Public Facilities (ADOTPF) , Alyeska Pipeline Service Company, Alaska Department of Natural Resources (DNR), Divisions of Land, Forestry and Agriculture, Alaska Department of Fish and Game (ADF&G), University of Alaska Fairbanks Cooperative Extension Services (CES), Master Gardener's Program, tour companies, United States Fish and Wildlife Service (FWS), National Park Service (NPS), Gates of the Arctic National Park and Preserve, Kanuti National Wildlife Refuge, Arctic National Wildlife Refuge, Commercial Visitor Services (including Yukon River Camp, Hot Spot, Coldfoot Camp), and several rural communities (Wiseman, Bettles, Evansville, Alatna, Allakaket, Hughes, Steven's Village, Rampart, and Tanana).

PUBLIC AWARENESS AND OUTREACH

Increased awareness of non-native invasive species and the economic and ecological problems associated with their establishment will help the general public understand the importance of a long-term weed management program. The BLM already recognizes this and has undertaken several opportunities since 2004 to increase education.

In 2004, the BLM and CES conducted the first NIP inventory in the Dalton Highway Management Area from the Yukon River Bridge to approximately Mile Post 295 (northern extent of BLM land along the Dalton Highway) with funding from the National Fish and Wildlife Foundation (NFWF) Pulling Together Initiative. During the same time frame (with funding from the grant and BLM), a weed specialist from the Montana BLM State Office conducted workshops in Fairbanks and Anchorage on developing Cooperative Weed Management Areas. Several CWMAs have been created throughout Alaska since the workshops and many are still being developed.

Through this and other NFWF grants, the BLM and CES partnered to create a temporary position to coordinate CNIPM meetings and annual workshops which resulted in the development of weed awareness week, production of *Pulling Together in Alaska: A Volunteer's Guide to Community Weed Pulling Events,* the trademark lime green weed pull bags, and community weed pulls and other inventory efforts. CNIPM (of which the BLM is a founding member) was created in 2000 through a Memorandum of Understanding signed by 36 agencies and organizations statewide. The BLM continues to be an active member of CNIPM and participates as a non-voting member of the CNIPM Board.

The BLM has partnered with other agencies to fund the annual CNIPM workshops and has presented papers on BLM national and state weed programs, 2004 Dalton Management Area NIP inventory, inventory of NIP in and adjacent to the interior fires of 2004, and DMA volunteer control efforts as well as giving a keynote address regarding the history of CNIPM. Other outreach presentations include those to annual meetings of the Federal Subsistence Regional Advisory Councils and Dalton Highway Interagency meetings.

Since 2005, the BLM has given annual presentations to the Alaska Director's Resource Advisory Council (RAC) including an overview of the BLM weed program in Alaska, preliminary efforts to develop this strategic plan, and a presentation of the draft. During August of 2008, the RAC participated in a demonstration effort to manually control sweetclover and bird vetch at Rosie Creek, which crosses the Dalton Highway. The RAC observed the severity and impact of these infestations and intensity of labor required to manually control them.

In 2006, biannual control work lead by the BLM began in partnerships with Friends of Alaska National Wildlife Refuges (Friends), NPS, FWS and Tribal Civilian Community Corp (TCCC).

- 2006 – Six volunteers from Friends, eight volunteers from TCCC, one NPS staff, and four BLM staff, manually controlled sweetclover at ten river crossings and roads/trails leading to or draining into the Kanuti National Wildlife Refuge, state, BLM and private lands. This trip also included the removal of oxeye daisy from the Arctic Interagency Visitor Center, two isolated sites of yellow toadflax, one of common tansy, and two of birdsfoot trefoil. A total of 2,575 pounds of NIP were removed between Mile Post 104 to 175.
- 2007 – Friends visited the above sites for two one-week efforts. A total of twelve volunteers and four BLM staff removed the same target species, except the oxeye daisy at the Visitor's Center. A total of approximately 7,000 pounds were removed! This year they also incorporated mechanical methods (such as weed whackers) which proved to be more efficient and effective on first year plants.
- 2008 – The Friends returned to the sites with a total of nine volunteers and two BLM staff to conduct two one-week efforts. The group removed approximately 1,700 pounds over the same area, effectively removing the annual seed crop and documenting the decrease in biomass resulting from the 2006 and 2007 efforts.

Publications include *Invasive Plants of Alaska,* a collaborative effort through several federal agencies and CNIPM. Other coverage has been through articles in the DOI newspaper *People, Land and Water*, *BLM Alaska Frontiers* quarterly publication, *Fairbanks Daily News Miner* newspaper, *Anchorage Daily News* newspaper and interviews aired on KUAC-FM. All news publications highlighted threats of NIP as well as the volunteer efforts conducted by BLM through partnerships. Posters and other invasive species outreach and education materials developed by the BLM Washington Office are displayed in the lobby or public room of the BLM Fairbanks District Office.

All these activities have provided outreach on BLM efforts, programs, mandates and policy, but the following public awareness and outreach activities may be undertaken as funding becomes available to further the cause:

- Develop displays and outreach programs for the general public outlining problems caused by NIP. Stress information on :
  - Damage to wildlife habitat, crop, and forage production;
  - Health problems associated with weeds, including skin irritations and allergies; and,
  - Impacts on scenic and recreational values.
- Educate BLM staff on weed identification and reporting.
- Educate land use permit holders on weed identification and reporting.

- Designate BLM Fairbanks District Office personnel to coordinate all NIP control activities, compile data, and represent the agency.
- Continue to open lines of communication entities to reduce the spread of NIP:
    - ADOTPF and Alyeska
        - Encourage development of BMPs for maintenance (road and vehicle) activities
    - Commercial Visitor Services -
        - Encourage control of NIP on their property.
    - Rural Communities -
        - Educate and encourage land owners to control NIP on their property.
        - Set up an Early Detection and Rapid Response (EDRR) Program.
    - Arctic Interagency Visitor Center -
        - Develop informative displays and brochures.
    - UAF Cooperative Extension Service -
        - Provide information on the status of NIP along the Dalton Highway.
    - Tour Companies -
        - Provide educational materials in order to limit their spread of NIP along the highway due to their activities.
        - Communicate current efforts taking place in order to incorporate information into tour.
    - Alaska Department of Fish and Game -
        - Provide information to educate hunters and anglers on the threat of NIP and the benefits of EDRR to the environment.
    - Local Correctional Facility, Environmental Organizations -
        - Develop community service hours to include weed control projects.

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APPENDIX I

NON-NATIVE PLANT SURVEY AND INVENTORY REPORT

Alaska Bureau of Land Management

Survey Date: _____/____/_____ **Observer 1:** ______________________________ **Affiliation: BLM**

YYYY /MM / DD **Observer 2:** ______________________________ **Affiliation: BLM**

A. SITE INFORMATION

Site Code (YYYY-INT-####): ______________ **Visit Type** (circle one): Inventory Monitor Control Research

Area Surveyed (Acres): ______________________ (0.1 Ac =37 ft radius, 0.5 Ac=83 ft, 1 Ac=118ft radius or 208 ft x 208 ft)

Project Name: ______________________ Veg Community Description: ______________________

Disturbance Type: ______________________ Estimated Age of Disturbance (years): ______________

B. LOCATION INFORMATION

Latitude: ______________________ **Longitude:** ______________________

Collection Method: GPS or Map **Precision** (circle one): 0-5 0-30 0-100 0-1000 1000+ feet

Map Source: ______________________ Map scale: 1: ____________ Map Date: ______________

Road Name: ______________________ Milepost: ______________________

Location Notes: ____

____

C. INVENTORY INFORMATION

Plant Name: ______________________ **Species Code:** ______________ **Est Infested Ac:** ______________

Cover and Stems Per: total area sq meter acre other: ________ Infestation Canopy Cover: ______ %

Infestation Cover Class (circle one): Trace (< 1%) Low (1-5%) Moderate (6-25%) High (>25%)

Est. Stem Count (circle one): 1-5 6-25 26-50 51-150 151-500 500-1000 1000-10000 10000+ Actual Stems __________ Aggressiveness (circle one): None Low Medium High

Phenology: seedling rosette bolting bud flowering seed set seeding senescent woody

Notes about non-native species: ____

D. COLLECTION INFORMATION

Voucher Collection: Yes No **Location:** BLM ALA TNES WTU Other: ______________________

Photo Taken: Yes No Photo location: BLM ALA TNES WTU Other: ______________________

Monitoring Photo Point Established? Yes No *Record azimuth and distance from point to marker*

Marker # 1	Azimuth	Distance (ft)	Notes:
Marker # 2			
Marker # 3			
Marker # 4			

Collection Notes: ____

E. TREATMENT INFORMATION (NON-CHEMICAL) Complete only if weed control treatment is conducted

Control Action: None **Manual:** pull/dig/cut **Mechanical:** pull/mow/dig/cut **Biological:** graze

Date: (if different from above): ____/____/________ **Acres controlled:** ______________________

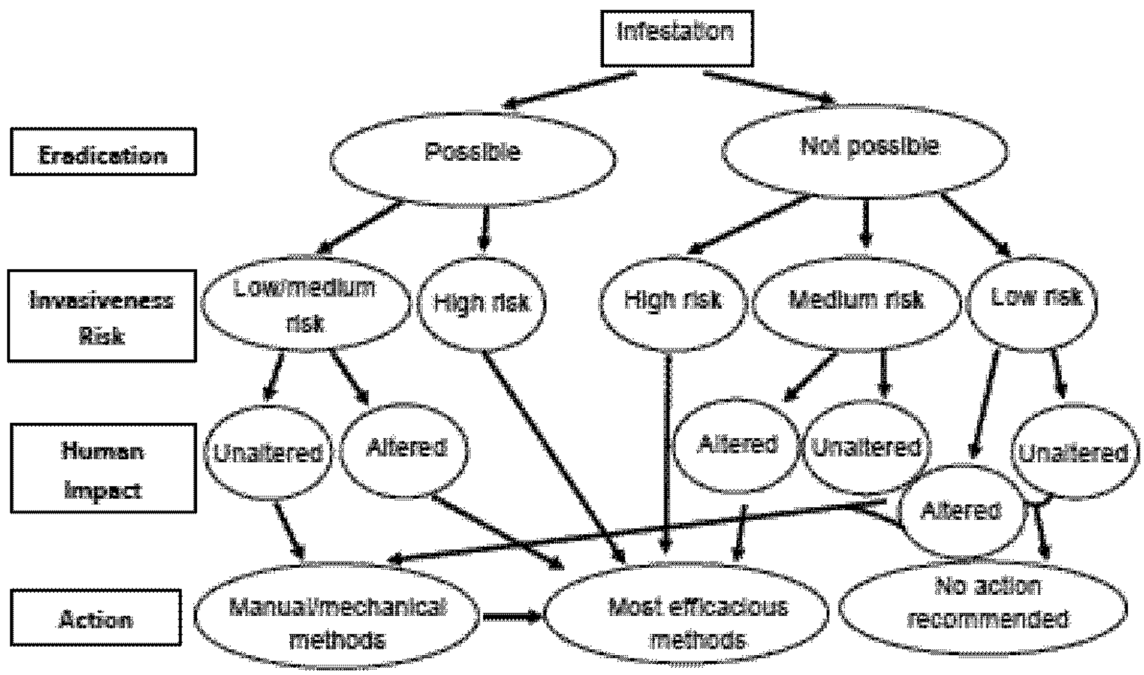
Hours spent: ______________________ **Recommended Retreatment:**(Month/Year): ______________

Treatment Notes: ____

Draft Strategic Plan Appendix II: Management Decision Tree

APPENDIX II

Integrated Vegetation Management Decision tree for non-indigenous plant species found in the Yukon and Interior AK BLM regions



Invasiveness risk is associated with the potential of the plant species to expand in the ecosystem and comes from research conducted by the Alaska Natural Heritage Program.

Altered ground is land that has been changed from the natural state due to human activities. Examples of altered ground include campgrounds, roadsides, pipelines, hiking trails, quarries, and lawns, but do not include fire.

Methods for control are grouped into categories based on the aggressiveness of the action. Most efficacious methods include all methods (manual, mechanical, chemical). If manual/mechanical methods fail to achieve the desired goal, the next step would be to employ the most efficacious method including chemical.

Based on the results of the decision tree, a management goal has been determined for each species (eradication, control or monitor) and for each NIP, optimum control methods have been selected appropriated to the management goal.

Examples of the Decision Tree Ranking for Selected Invasive Plants

Ecological Impact Score 0 to 40 with 0 = no impact
Feasibility of Control Score 0 to 10 with 0 = easy to control
Invasiveness rank <50 low, 50 to 59 medium, and >60 high invasiveness

					CONTROL METHODS	
SPECIES	**IMPACT**	**CONTROL**	**ERADICATION**	**INAVSIVENESS RANK**	**ALTERED GROUND**	**UNALTERED GROUND**
Linaria vulgaris	22	9	possible	69	manual chemical	manual
Tanacetum vulgare	20	8	possible	56	manual chemical	manual
Leucanthemum vulgare	20	8	possible	61	manual chemical	manual chemical
Vicia cracca	27	9	possible	73	manual chemical	manual chemical
**Melilotus officinalis*	29	9	not possible	80	manual chemical	manual chemical
**Crepis tectorum*	9	3	not possible	47	chemical	no action
Hordeum jubatum	18	9	not possible	63	manual chemical	no action
Taraxacum officinale	18	8	not possible	58	no action	no action

The above table illustrates how the decision tree was used for a few selected NIP species. Those species with an asterisk are species that some local experts hypothesize that are less invasive in the DMA environment. Ecological Impact infers the level of negative impact caused by the NIP.

Draft Strategic Plan Appendix III: Species of Concern in DHMCA

Plant species of concern documented within the Dalton Management Area

Common name	Scientific name	Sites	Area (acres)	Goal	Recommended Control
Yellow toadflax	*Linaria vulgaris*	2	<1	Eradicate	Hand weed
Common tansy	*Tanacetum vulgare*	2	<1	Eradicate	Hand weed/spray
Ox-eye daisy	*Leucanthemum vulgare*	5	2	Eradicate	Hand weed/spray
Perennial sowthistle	*Sonchus arvensis*	1	<1	Eradicate	Hand weed
Birdsfoot trefoil	*Lotus corniculatus*	4	<1	Eradicate	Hand weed
Iceland poppy	*Papaver nudicanle*	1	<1	Eradicate	Hand weed
Purple sand spurry	*Spergularia rubra*	1	<1	Eradicate	Hand weed
Spreading bluegrass	*Poa pratensis var. irrigata*	2	0.1	Eradicate	Hand weed
Common pepperweed	*Lepidium densiflorum*	11	<1	Eradicate	Hand weed
Bird vetch	*Vicia cracca*	28	7	Eradicate	Mechanical/herbicide
Herb sophia	*Descurainia sophia*	2	2	Eradicate	Hand weed
Meadow foxtail	*Alopecurus pratensis*	5	<1	Eradicate	Hand weed
Smooth brome	*Bromus inermus*	7	1	Control	Cut/hand weed
Narrowleaf hawkweed	*Hieracium umbellatum*	13	12	Control	Spray
White/yellow sweetclover	*Melilotus officinalis*	142	41	Control	Spray/hand weed
Alfalfa	*Medicago sativa* ssp. *sativa*	8	1	Control	Hand weed
Alsike clover	*Trifolium hybridum*	10	10	Control	Hand weed
Narrowleaf hawksbeard	*Crepis tectorum*	27	6	Control	Possible spray
Foxtail barley	*Hordeum jubatum*	80	72	Control	Hand weed/spray
Shepherd's purse	*Capsella bursa-pastoris*	5	2	Monitor	No action
Lamb's quarters	*Chenopodium album*	7	2	Monitor	No action
Bluegrass	*Poa pratensis var. pratensis*	3	4	Monitor	No action
Prostrate knotweed	*Polygonum aviculare*	32	6	Monitor	No action
Dandelion	*Taraxacum officinale*	40	11	Monitor	No action
Pineapple weed	*Matricaria discoidea*	34	9	Monitor	No action
Common plantain	*Plantago major*	35	11	Monitor	No action
European stickweed	*Lappula squarrosa*	0	0	Monitor	Look for
Slender wheatgrass	*Agropyron …*	0	0	Monitor	Look for
Spotted knapweed	*Centaurea stoebe*	0	0	Monitor	Look for
Canada thistle	*Cirsium arvense*	0	0	Monitor	Look for

Draft Strategic Plan Appendix IV: Recommended Strategies per Species

The following strategies were recommended by a Dr. Steven Seefeldt, Research Agronomist with the United States Department of Agriculture (USDA), Agricultural Research Service (ARS), Subarctic Agricultural Research Unit in Fairbanks, Alaska, who was on a sixty day assignment to the BLM. References included 2008 Pacific Northwest Weed Management Handbook published by the Weed Science Society of America; Invasive Plant Treatment Guide, National Wildlife Refuges in Alaska done by the USFW Service; Biology and Management of Noxious Rangeland Weeds (Oregon State University press).

Alopecurus pratensis – meadow foxtail

Status – These plant species have been found in only a few locations (Map 3) and only in small patches on altered land. Many were hand weeded when discovered.

Goal – Due to the size of the infestations, ease with which they can be controlled, and potential to displace native plants, these species should be eradicated.

Preferred management actions – These species should be visited early in the growing season. After counting the plants, they should be hand weeded with care taken to remove as much of the roots as possible. The sites should be revisited once a month. The area within at least a 150 foot radius of the infestation and any disturbed areas within a half mile should be scouted for new plants. Infested areas should be seeded with native grasses and fertilized.

Bromis inermus ssp inermis – smooth brome

Status – These plants species have been found on several sites in patches that are up to an acre in size (Map 5).

Goal – Due to the size of the infestation and the impact of many treatments on native vegetation, these plants cannot be eradicated. Due to the competitive ability of these plants and their ability to spread and displace native species, they should be contained, the population densities reduced, and the infestations monitored.

Preferred management actions – These perennial grass species should not be allowed to produce seed. When the plants reach the flag leaf to boot stage (floral part can be felt in the top of the elongating stem), the plants should be mown, cut, or hand weeded to remove as much vegetation as possible. The site should be revisited monthly.

Crepis tectorum – narrowleaf hawksbeard

Status – This plant species has been found along the Dalton Highway and Alyeska pipeline at numerous locations (Map 9).

Goal – Due to the potential of this species to spread (wind-blown seeds), its rapid indeterminate growth, its lack of competitiveness, and its small size, this plant species should be monitored and only controlled on altered ground near natural disturbances such as wildfire.

Preferred management actions – Infestations along the roadside or pipeline within one half mile of a fire should be treated to prevent seed production that could potentially spread to the burned area. The infestations should be treated as soon as possible after the fire. Hand weeding is usually not an option as seedlings are hard to find and do not pull up easily. In some substrates, however, pulling can be effective. After estimating densities and patch size the area plus a 50 foot buffer around the area on altered ground should be treated with *metsulfuron-methyl* (Ally) at 1 oz per acre. This herbicide would kill most of the broadleaf vegetation on which it is sprayed, but grasses would not be harmed. The sites should be revisited annually. The area within at least a 600 foot radius and any disturbed areas within a half mile should be scouted for new plants.

Hieracium umbellatum – narrowleaf hawkweed

Status – This plant species has been found on multiple sites along the Dalton Highway, infesting up to 12 acres (Map 6).

Goal – Due to the rapid and long distance seed dispersal characteristics, competitive ability against many native species, and ease of chemical control, this plant species should be contained, the population densities reduced, and the infestations monitored.

Preferred management action – Like dandelion, this is a rosette forming plant that is difficult to hand weed. These plants have already been found 100 feet off the highway. After counting plants or estimating area and density, control of patches can be achieved with the use of *chlorsulfuron* (Telar) at 2 oz per acre with a 0.25% of a non-ionic surfactant. A backpack sprayer should be used to spray the entire infested area and the area within 50 feet of the patch. Spraying should take place early in the summer (late June) when rosettes are rapidly growing, but before plants begin to flower. The sites should be revisited each year. The herbicide should control seedlings for several years. The area within at least a 150 foot radius and any disturbed areas within a half mile should be scouted for new plants.

Hordeum jubatum – foxtail barley

Status – This plant species is widespread along the Dalton Highway and has been recorded within the pipeline corridor and in previously burned areas (Map 10).

Goal – Because the plant is native to North America, has a potential to spread (wind-blown and animal carried seeds), lacks competitiveness, and is of small size this plant species should be monitored and controlled only on altered ground such as camping areas where pets can be harmed by the awns of the mature seed.

Preferred management actions – Infestations in altered areas where pets frequent should be controlled before setting seed. All plants should be counted or density and size of infestation estimated before treatments. With small infestations, hand weeding is quite effective, with care taken to remove the entire root crown. For larger infestations, spot spraying plants with *glyphosate* (Roundup) at 0.3 lb per acre with a 0.5% non-ionic surfactant when they are actively growing in the spring or summer would control up to 100% of the plants. The treated sites should be revisited annually. The area within at least a 150 foot radius and any disturbed areas within a half mile should be scouted for new plants.

Leucanthemum vulgare – oxeye daisy

Status – This plant species has been found in and around Coldfoot on both altered and unaltered land (Map 2).

Goal – Due to the small size of the infestation and its ability to spread through wind dispersed seeds, displace native perennial species, and out compete many native plants, this species should be eradicated.

Preferred management actions on altered sites – Sites should be visited once a month starting one month after snow melts. All plants should be counted and carefully dug up to collect as much of the roots as possible. The area within at least a 600 foot radius of the infestation and any disturbed areas within one mile should be scouted for new plants. After counting stems, spot spray plants with any of the following herbicides while following label directions: clopyralid (Transline); imazapyr (Arsenal); *metsulfuron methyl* (Escort); or triclopyr (Redeem). All of these herbicides are toxic to many native forbs and shrubs. In our ecosystem, metsulfuron methyl and imazapyr should kill these adult plants and any seedlings the following year. With all four herbicides, care should be taken to prevent drift. Do not apply this herbicide to riparian areas or to natural or manmade bodies of water. Visit the site each year when plants are bolting and repeat herbicide application or hand weed after counting the plant stems.

Preferred management actions on unaltered sites – Sites should be visited once a month starting one month after snow melts. All plants should be counted and carefully dug up to collect as much of the roots as possible. The area within at least a 600 foot radius and any disturbed areas within a mile of the infestation should be scouted for new plants. Other plant species at the site should be encouraged to grow (through fertilization) and perennial native grasses seeded into the treated area in order to suppress growth of *Leucanthemum vulgare*.

Linaria vulgaris – yellow toadflax

Status – This plant species has been found in two locations (Map 1).

Goal – Due to the small size of the infestation and its potential to spread (through seeds and rhizomes), alter pollination ecology, displace native perennial species, and form dense clumps, this species should be eradicated.

Preferred management actions – Sites should be visited once a month starting one month after snow melts. All plant stems should be counted and carefully dug up to collect as much of the rhizomes as possible. Documenting the number of stems can help evaluate the success of the control prior to the next season. The area within at least a 150 foot radius of the infestation and any disturbed areas within a half mile should be scouted for new plants. Other plant species at the site should be encouraged to grow through fertilization and perennial native grasses should be seeded into the treated area in order to suppress growth of *Linaria vulgaris*.

Alternative management action – After counting stems, plants should be sprayed before flower initiation with *glyphosate*. This herbicide would kill most of the vegetation that it is sprayed on. As the herbicide has no residual activity, surviving *Linaria vulgaris* rhizomes would re-sprout and rains would encourage growth of seedlings from the seed bank in the soil. Therefore, the areas would have to be revisited and possibly sprayed multiple times each year until eradication is achieved.

Melilotus officinalis – yellow and white sweetclover

Status – This plant species has been found in numerous locations within the DMA and mostly on altered land (Map 7).

Goal – Due to the size of the infestations and the longevity of the seed bank (80 years in the contiguous 48 states), this plant cannot be eradicated. Because of the potential for these plant species to spread (seeds), fix nitrogen (altering natural nutrient status), form dense stands, and invade and dominate alluvium along glacial streams and rivers, they should be contained, the population densities reduced, and the infestations monitored.

Preferred management action on altered sites – Sites should be visited for control treatments well before flower initiation, which can occur in mid-June. Plant densities and patch sizes must be estimated before treatment. Infested areas are numerous and sometimes widespread, they generally follow the Dalton Highway.

Although eradication is not an option, certain locations are critical for control and should be given priority with localized eradication as a long-term goal. Critical areas include roadsides within 500 feet of bridges and small isolated patches well away from larger infestations. Jeff Conn, Alaska Research Agronomist with the USDA Research Service in Fairbanks, estimates downstream movement of 20 miles per year, so it is important to eradicate this invasive weed in proximity to rivers and streams in order to prevent downstream movement. These critical areas should be visited regularly and any observed plants pulled after recording the extent of the infestation.
Non-critical areas should be treated with herbicide to reduce or eliminate seed production on a regular basis with a goal towards reducing the overall seed bank.

Cut plants rapidly flower and set seed, so physical control is limited to hand pulling. Hand pulling would disturb the soil and typically results in another flush of these plants; once pulling is initiated, the site should be revisited every other week. Several herbicides are quite effective, providing almost complete control of growing plants. In wet land areas, spot spraying of imazapyr (Habitat) and *glyphosate* (Roundup) are quite effective. On rights-of-way, chlorsulfuron (Telar), imazapyr (Arsenal), 2,4-D, dicamba (Banvel), metsulfuron-methyl (Escort), and sulfometuron-methyl (Oust) are all effective. In Alaska, these plants are very sensitive to Telar (2 oz per acre with 0.25%

non-ionic surfactant) and would provide control of seedlings for several years as it is actively taken up by the roots, as do several of the above mentioned herbicides (Habitat, Arsenal, and Oust). If herbicides are used, the area within 50 feet of the patch along the right-of-way should be treated as well to prevent any seedling success of dispersed seeds.

Grading of the roadway after the plants set seed would spread seeds up and down the highway and should be prevented. Working with DOT to grade in the spring or early summer before seed set is an excellent method for killing seedlings and second year plants.

Preferred management action on unaltered sites – This plant species is almost entirely found on altered sites. However, after recent fires, there is evidence that it is beginning to spread to land disturbed by natural processes (Villano and Mulder, 2008). It took several decades for these two species to adapt to Alaskan roadside conditions after their first introductions. It may very well be that these plants are now adapting to undisturbed Alaskan soils, particularly those soils along the Dalton Highway, which have a higher soil pH. Legumes such as *Melilotus*, do not grow well on acidic soils as it reduces nitrogen fixation. Therefore, these unaltered sites are critical for weed control. On unaltered sites, these plants should be counted and pulled and the infested area sprayed with a soil active herbicide, such as chlorsulfuron (Telar) to kill any seedlings. These sites should be revisited every year before plants go to seed and retreated if seedlings are found. An area 20 feet around the infestation should also be sprayed to control isolated individuals or any newly germinating seeds.

Tanacetum vulgare – common tansy

Status – This plant species has been found in small quantities at several locations associated with parked fire-fighting equipment (Map 1).

Goal – Due to the small size of the infestation, it’s potential to spread (seeds and rhizomes), has an unpalatable to poisonous forage quality with the ability to alter riparian ecology and displace native perennial species, this species should be eradicated.

Preferred management actions – Sites should be visited in midsummer after plants have bolted. All plant stems should be counted and carefully dug up to collect as much of the rhizomes as possible. Care should be taken to wear gloves at all times to reduce the possibility of irritation due to plant toxins. The area within at least a 300 foot radius and any disturbed areas within a half mile should be scouted for new plants. After counting stems, spot spray plants at the bud to bloom stage with a 1 oz/acre rate of *metsulfuron methyl* (i.e. Escort). In our ecosystem, this herbicide should kill these adult plants and any seedlings the following year. This herbicide would kill many native species at very low doses as well, so care should be taken to prevent drift. Do not apply these herbicides to riparian areas or to natural or manmade bodies of water. Visit the site each year when plants would be in the bud to bloom stage and repeat herbicide application or hand weed after counting the plant stems.

Trifolium hybridum – alsike clover

Status – These plant species have been found in several areas along of the Dalton Highway, infesting up to 10 acres (Map 8).

Goal – Due to their nitrogen fixing capabilities, these clovers can alter ecosystem processes due to their long lived seed (over 20 years) and their ability to grow in shade. These plants should be contained, their population densities reduced, and the infestations monitored.

Preferred management actions – Small patches and outlying infestations from larger patches should be hand weeded to keep the plant from spreading to newly disturbed areas. It is doubtful that these plants would grow well on unaltered lands. There are herbicides that would kill these plants, but the size of these infestations combined with the off-target impacts of using herbicides, make this plant species problematic for real control. Seeding of native grasses would provide adequate competition to reduce the density of these species. Infested sites should be visited annually. The area within at least a 75 foot radius of the infestation and any disturbed areas within 600 feet of the infestation should be scouted for new plants.

Vicia cracca – bird vetch

Status – This plant species has been found in multiple locations (Map 4) on both altered and unaltered land.

Goal – Due to the size of the infestations and this species' potential to spread (through seeds and rhizomes), cover short native vegetation (< 3 feet tall), fix nitrogen (altering natural nutrient status), and form dense mats, this species should be eradicated.

Preferred management actions on altered and unaltered land – The seed bank life of *Vicia cracca* is 5 years, which has positive implications for eradication. Sites should be visited before flower initiation, which can occur from early to late July. After estimating density and size of infestation, all plants should be mown or pulled and sprayed. The site should be revisited every six weeks and the treatment repeated, after infestation measures are recorded, until winter. The area within at least a 150 foot radius and any disturbed areas within a half mile should be scouted for new plants. After five years of treatment, when the seed bank should be free of *Vicia cracca* seeds, the plants should be sprayed while they are actively growing and before flowering with 1 pint/acre of *clopyralid* (Transline) with an approved adjuvant (0.25% v/v) to kill the adult plants.

Other species:

Capsella bursa-pastoris **– shepherd's purse**
Chenopodium album **– lamb's quarters**
Poa pratensis **– (non-native) blue grass (e.g. *irrigata* variety)**
Polygonum aviculare **– prostrate knotweed**
Taraxacum officinale **– dandelion**
Matricaria matricariodes **– pineapple weed**
Plantago major **– common plantain**
Lotus corniculatus **– birdsfoot trefoil**
Papaver nudicanle **– Iceland poppy**
Spergularia rubra **– purple sand spurry**
Lepidium densiflorum **– common pepperweed**
Medicago sativa spp. sativa **– alfalfa**
Phalaris arundinacea **– reed canary grass**

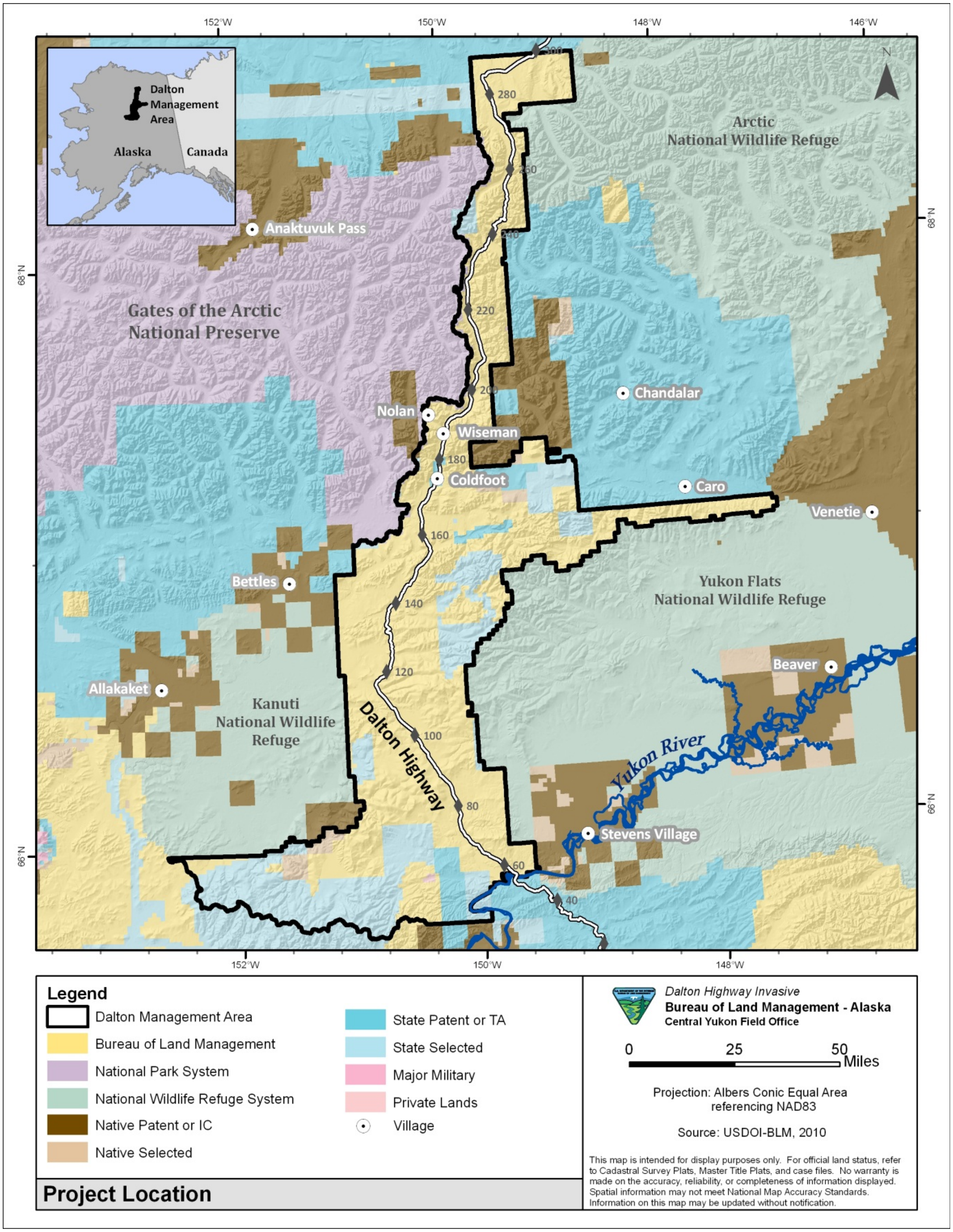
Draft Strategic Plan Appendix V: SOPs for Applying Herbicides

Standard Operating Procedure for Applying Herbicides

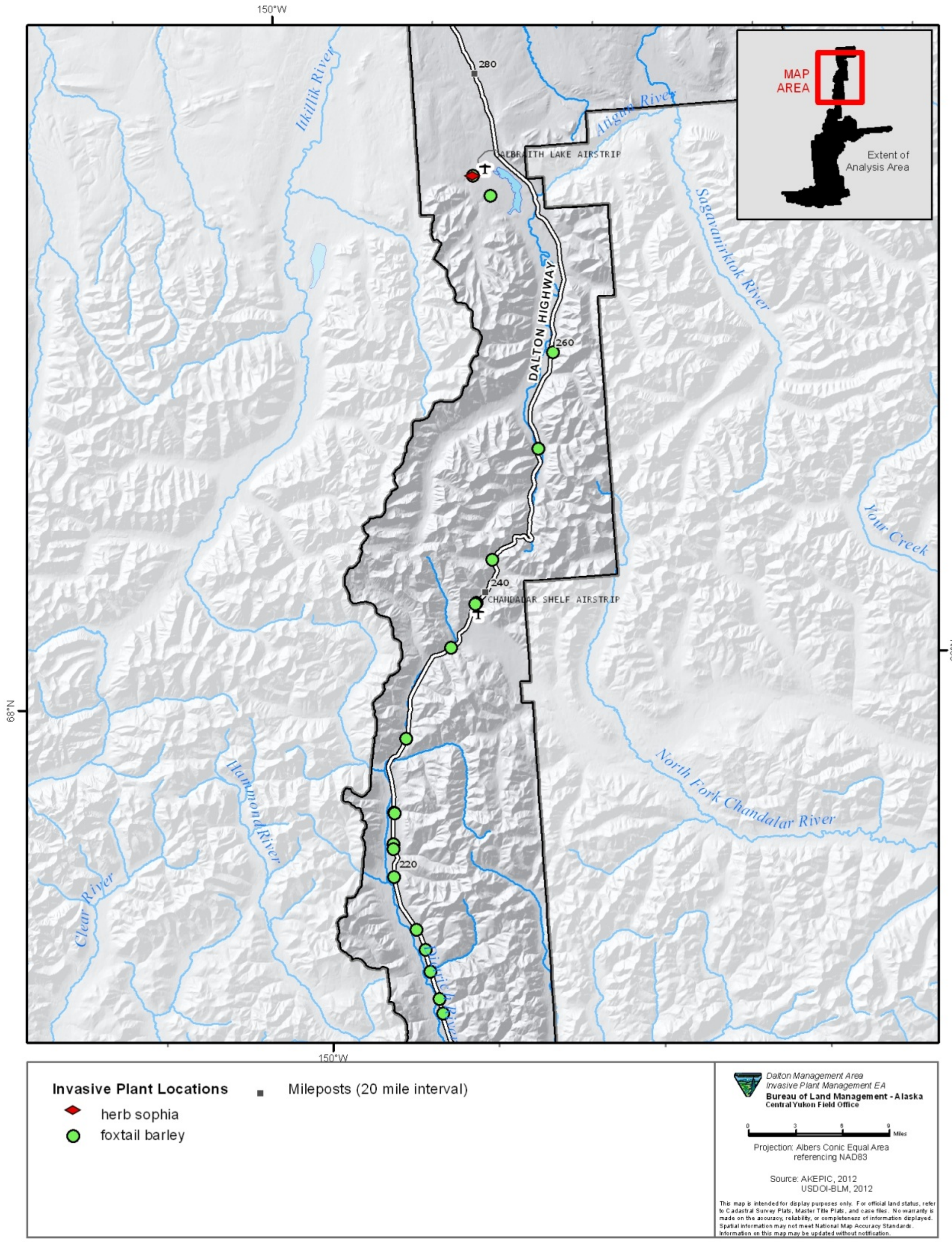
BLM Handbook H-9011-1 (*Chemical Pest Control*); and manuals 1112 (*Safety*), 9011 (*Chemical Pest Control*), 9012 (*Expenditure of Rangeland Insect Pest Control Funds*), 9015 (*Integrated Weed Management)*, and 9220 (*Integrated Pest Management*)

- Prepare spill contingency plan in advance of treatment.
- Conduct a pretreatment survey before applying herbicides.
- Select herbicide that is least damaging to environment while providing the desired results.
- Select herbicide products carefully to minimize additional impacts from degradate adjuvants, inert ingredients, and tank mixtures.
- Apply the least amount of herbicide needed to achieve the desired result.
- Follow product label for use and storage.
- Have licensed applicators apply herbicides.
- Use only USEPA-approved herbicides and follow product label directions and “advisory” statements.
- Review, understand, and conform to the “Environmental Hazards” section on the herbicide label. This section warns of known pesticide risks to the environment and provides practical ways to avoid harm to organisms or to the environment.
- Minimize the size of application areas, when feasible.
- Comply with herbicide-free buffer zones to ensure that drift will not affect crops or nearby residents/landowners.
- Post treated areas and specify reentry or rest times, if appropriate.
- Notify adjacent landowners prior to treatment.
- Keep copy of Material Safety Data Sheets (MSDSs) at work sites. MSDSs available for review at http://www.cdms.net/.
- Keep records of each application, including the active ingredient, formulation, application rate, date, time, and location.
- Avoid accidental direct spray and spill conditions to minimize risks to resources.
- Take precautions to minimize drift by not applying herbicides when winds exceed >10 mph (>6 mph for aerial applications) or a serious rainfall event is imminent.
- Use drift control agents and low volatile formulations.
- Conduct pre-treatment surveys for sensitive habitat and special status species within or adjacent to proposed treatment areas.
- Consider site characteristics, environmental conditions, and application equipment in order to minimize damage to non-target vegetation.
- Use drift reduction agents, as appropriate, to reduce the drift hazard to non-target species.
- Turn off applied treatments at the completion of spray runs and during turns to start another spray run.
- Refer to the herbicide label when planning revegetation to ensure that subsequent vegetation would not be injured following application of the herbicide.
- Clean OHVs to remove seeds.

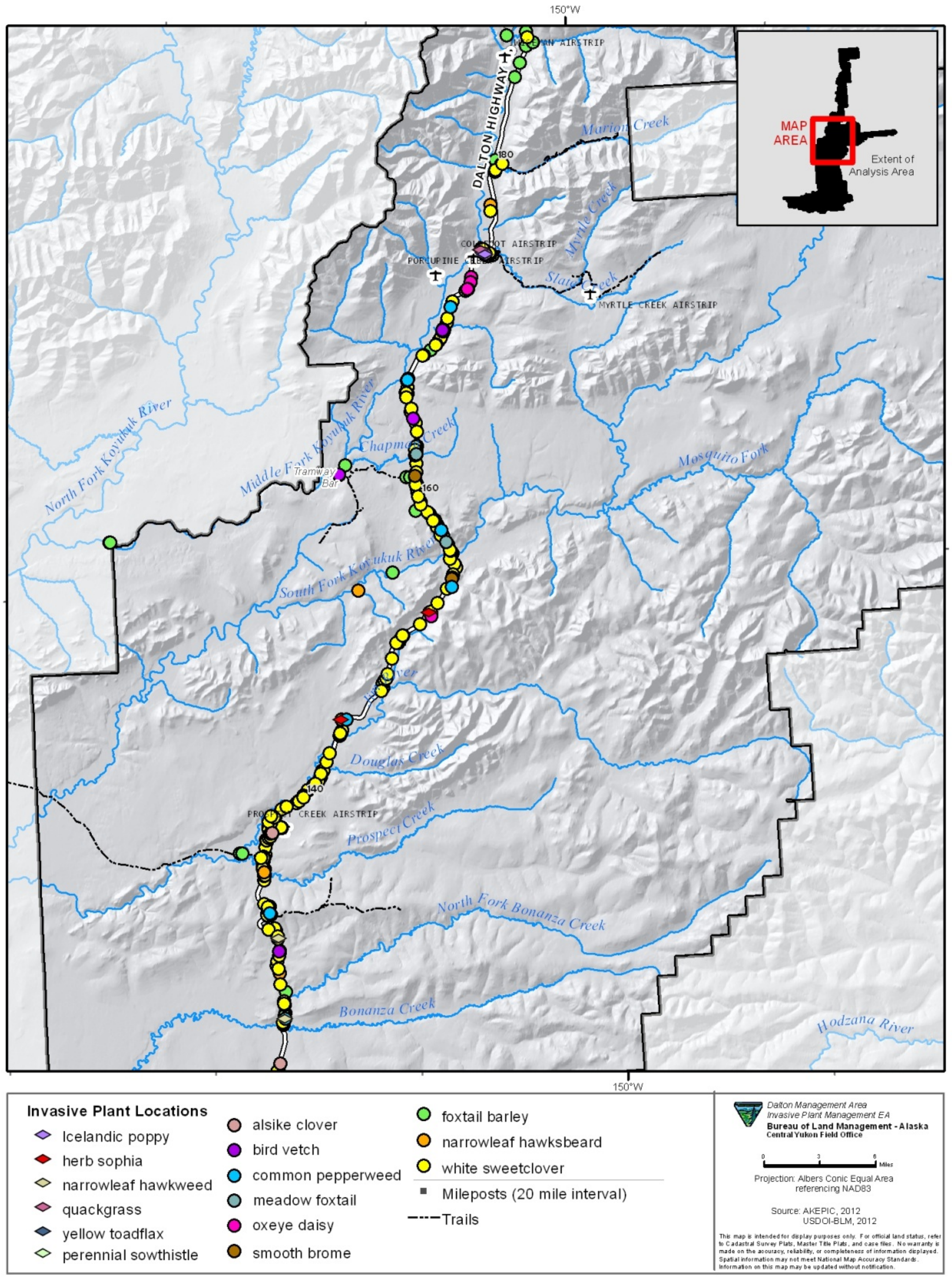
APPENDIX B. STUDY AREA MAPS



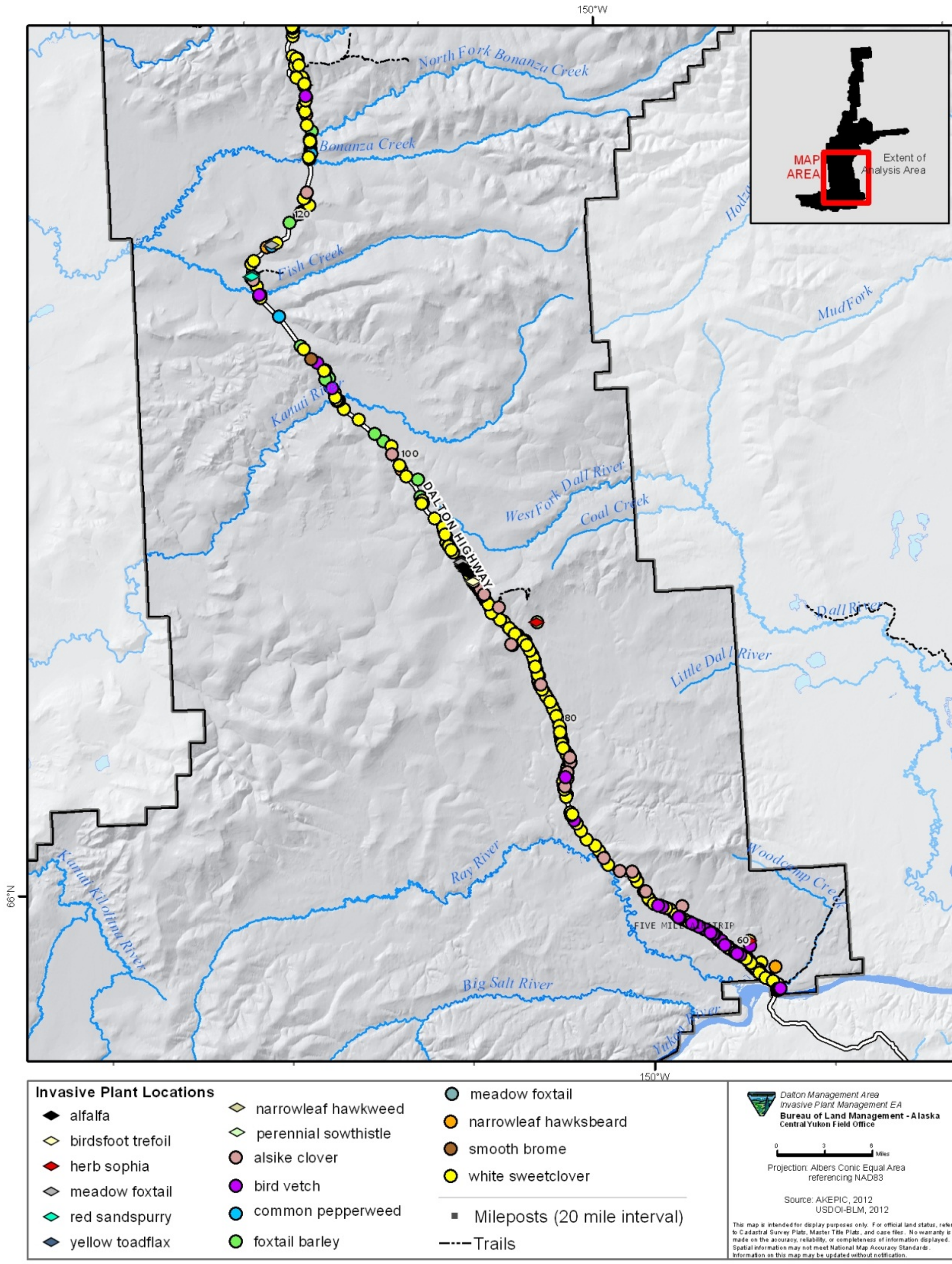
Map 1. Vicinity map of the Dalton Highway and the DHCMA.



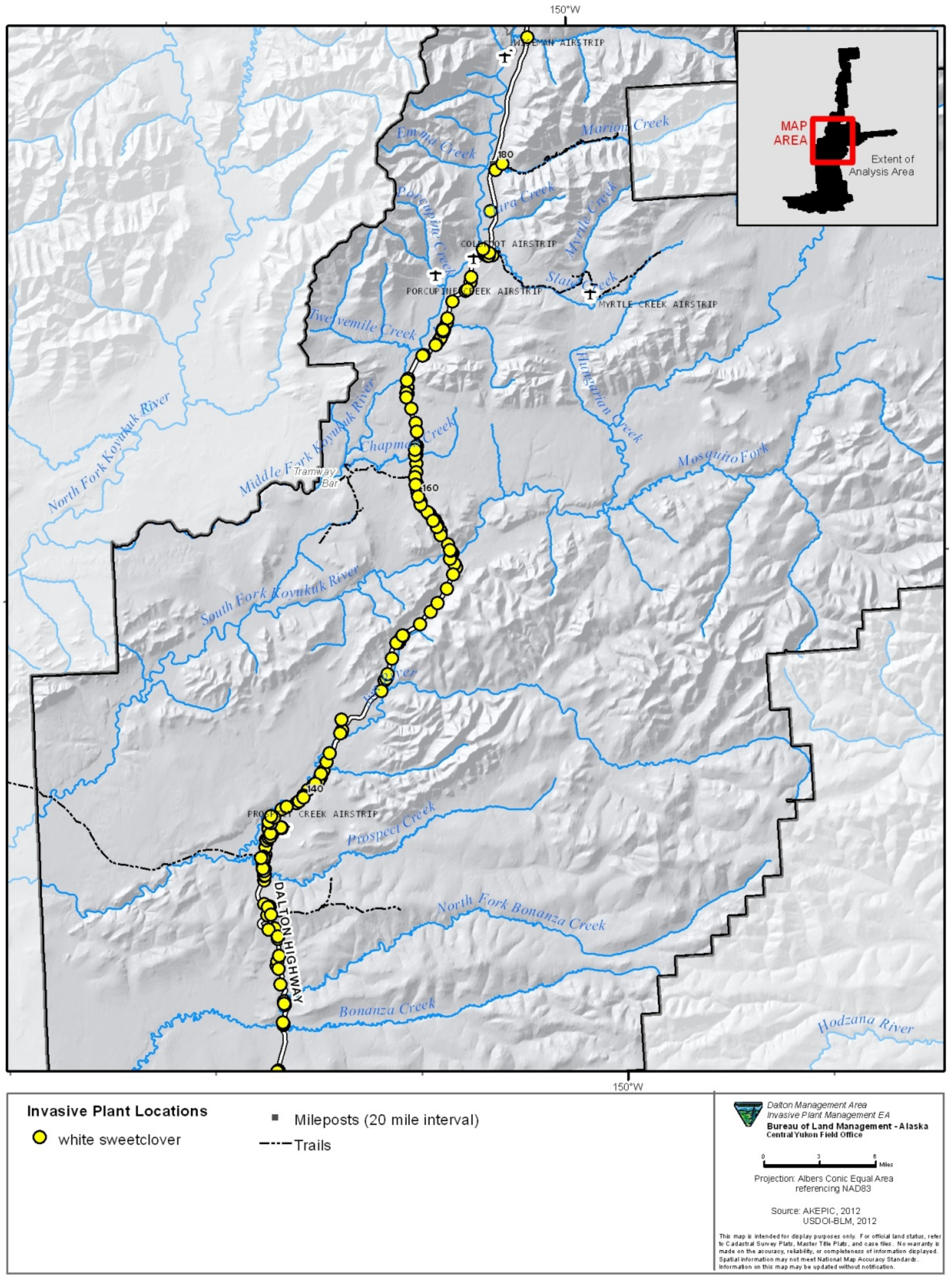
Map 2. Locations of known invasive plant populations in the Northern DHCMA (Dalton MP ~210-280).



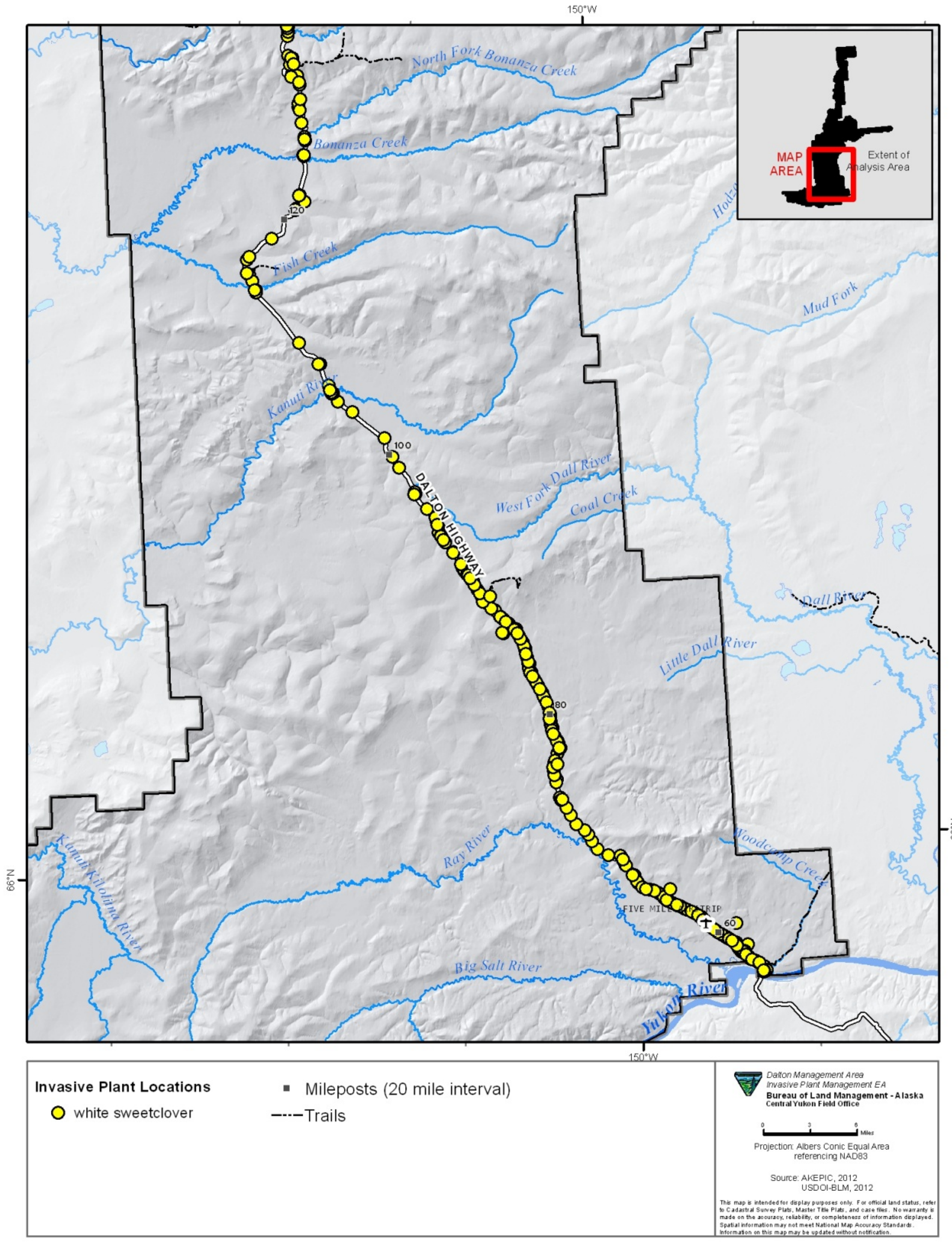
Map 3. Locations of known invasive plant populations in the Central DHCMA (Dalton MP ~130-200).



Map 4. Locations of known invasive plant populations in the Southern DHCMA (Dalton MP ~60-130).



Map 5. Locations of known white sweet clover populations in the Central DHCMA (Dalton MP ~130-190).



Map 6. Locations of known white sweet clover populations in the Southern DHCMA (Dalton MP ~60-130).

APPENDIX C: COMMUNITY STAKEHOLDERS

Annette Boroughs, Chairperson, Wiseman Community Association
Benedict Jones, Traditional Chief, Middle Yukon River Advisory Committee
Florence Nictune, Chief, Evansville Tribal Council
Geraldine Simon, President
Gilbert Vent, Tribal Administrator, Allakaket Traditional Council
Harold Simon, First Chief, Stevens Village IRA Council
Henry Wiehl, Yukon River Drainage Fisheries Association
Jamie Klaes, City of Bettles
Leo Lolnitz, Chief, Koyukuk Traditional Council
Linda Evans, President, Baan O Yeel Kon Corporation
Marilyn Roberts, City Administrator, City of Koyukuk
Monique Beetus, Mayor, Allakaket
Orville Huntington, Huslia
Peter David, Chief, Alatna Traditional Council
Pollock Simon, Koyukuk River Advisory Committee
Randy Mayo, President, Dinyea Corporation
Ronald Sam, Allakaket, AK
Shirley Lee, President, Evansville, Incorporated
Speedy Sam, Mayor, City of Huslia
Stanley Ned, Chief, Allakaket Traditional Council
Tom Wiehl, Chief, Rampart Traditional Council
William Derendoff, Chief, Huslia Traditional Council
William Derendoff, Vice-Chairman, Koyukuk River Advisory Committee
Wilmer Beetus, Chief, Hughes
Wilmer Beetus, Mayor, Hughes City Council

APPENDIX D. SCOPING LETTER

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Central Yukon Field Office
1150 University Avenue
Fairbanks, Alaska 99709-3844
http://www.blm.gov/ak

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:
6711 (AKF030)

Dear Interested Participant:

The BLM will soon start preparation of an Environmental Assessment (EA) for the management of invasive weeds along the Dalton Highway and surrounding BLM-managed public lands. This EA will analyze potential environmental impacts of invasive plant management as developed in our Draft Strategic Plan for the Management of Invasive Plants (Weeds), completed last year. We are pleased to announce opportunities for public comment and are planning on holding public scoping meetings during April and May 2010.

The Draft Strategic Plan includes several new proposals involving public education, monitoring, and an Early Detection Rapid Response program. It also addresses current and past efforts to halt the spread of weeds within the Dalton Highway/Utility Corridor Management Area. These efforts included manual and mechanical control of target species including white sweetclover, oxeye daisy, yellow toadflax, bird vetch, and common tansy.

Unfortunately, the current control methods have proven inadequate. It now appears that manual or mechanical means alone will not effectively halt the spread of weeds within the Dalton Highway/Utility Corridor or to adjacent lands. Therefore, the Draft Strategic Plan considers the use of herbicides, as well as other methods of control, within an integrated pest management approach.

I have asked our contractor, Shelly Wade from the consulting firm of Agnew::Beck, to contact leaders and groups in several communities, including Stevens Village, Rampart, Wiseman, Allakaket, Alatna, Bettles, Evansville, Hughes, Huslia, Koyukuk, and Fairbanks to determine interest in scheduling a public meeting during which issues and concerns with invasive weed management can be discussed.

Once the draft EA is completed, the BLM will hold an additional 30-day comment period before we make a decision regarding implementation of the proposed action or alternative.

I know spring is a busy time of year. Any help and time you can spend reviewing the Draft Strategic Plan and providing your comments to us will be sincerely appreciated. The Draft Strategic Plan as well as information regarding our public meeting schedule can be found online at the following URL:

http://www.blm.gov/ak/st/en/fo/fdo/central_yukon_field/dalton_invasives.html

or by contacting Ruth Gronquist at the above address or by phone at (907) 474-2377.

Respectfully,

/s/ Nichelle W. Jacobson

Nichelle W. (Shelly) Jacobson, Manager
Central Yukon Field Office

APPENDIX E. SCOPING FLYER

APPENDIX F. SUMMARY OF POTENTIAL ENVIRONMENTAL FATE AND EFFECTS OF PROPOSED HERBICIDES

Active Ingredient	Persistence in Soil	Residual Soil Activity	Volatility and Burning By-products	Solubility	Leaching Potential	Surface Waters	Toxicity
2, 4-D (Banvel, Curtail, Tributon)	At the highest application rate 2,4-D persists 30 days	May remain active for 1 to 6 weeks in soils	Oil soluble amine forms are least volatile. Burning vegetation treated with 2,4-D has not generated detectable amounts of by-products in the field.	Low solubility in water	Binds to organic matter in soil over time. 2,4-D ranges from being mobile to highly mobile in sand, silt, clay loam and sandy loam, but potential groundwater contamination is low due to rapid degradation in soils and rapid uptake by plants.	2,4-D residues dissipate rapidly, especially in moving water. Do not apply to water or wetlands, except as specified for certain uses.	No effect at recommended field application rates to soil microorganisms. At higher levels, 2,4-D suppresses soil fungi and nitrogen fixing algae. 2,4-D is highly toxic to non-target plants. Effects of 2,4-D amine salts are nearly non-toxic to fish, but ester formulations are highly toxic to fish and aquatic invertebrates. Effects to terrestrial organisms range from practically non-toxic to birds from butyl ester, ester formulations are least toxic to insects, and mammals are moderately sensitive to 2,4-D exposures.
Chlorsulfuron (Glean, Telar, Finesse)	Half-life is one month for slightly acidic soil to 3 months for alkaline soil	Active in soil and usually absorbed from soil by plants	Does not evaporate easily. No information on potential by-products from burning.	Telar may be suspended in water with constant agitation and dispensed.	Telar has high potential for leaching in permeable soils, but less in soils with pH below 6.0. Potential groundwater contamination is low due to low use rates and dispersion of residues with leaching.	No information is available.	No effect on soil microorganisms. Contact with non-target plants may kill or injure plants. Nearly non-toxic to most fish and aquatic invertebrates. Practically non-toxic to birds and mammals, and relatively non-toxic to bees.

Active Ingredient	Persistence in Soil	Residual Soil Activity	Volatility and Burning By-products	Solubility	Leaching Potential	Surface Waters	Toxicity
Clopyralid (Curtail, Redeem R&P, Transline)	Half life is 15-287 days. May be present in anaerobic soil or soils with low micro-organisms.	Active in soils and usually absorbed from soil by plants. Soil micro-organisms break down clopyralid.	Does not evaporate easily. No information on potential by-products from burning.	Highly soluble in water.	May leach into groundwater because clopyralid is highly soluble in water, does not absorb to soil particles and is not readily decomposed in soil. Clopyralid may contaminate ground water where applied to areas with very permeable soils and shallow water tables.	Because clopyralid is soluble, surface waters may be contaminated if directly applied to water bodies or wetlands.	No information on effects to microorganisms. Non-target plants may be injured or killed. Low toxicity to fish and aquatic invertebrates. Clopyralid does not bio-accumulate in fat tissues. Low toxicity to birds and mammals and not toxic to bees.
Dicamba (Banvel, Yukon)	Half-life in soils ranges from 1 to 4 weeks. Microbes and sunlight break it down.	May leach in humid regions, may persist longer with low soil moisture and rainfall.	Dicamba is relatively volatile and can evaporate easily. Main products from burning are amines, hydrochloric acid, organo-chlorine molecules, carbon monoxide and oxides of nitrogen.	Dicamba salts are highly soluble in water.	Dicamba is highly mobile in the environment and has the potential to leach through soils and contaminate groundwater. The potential for leaching depends on the rate of its movement in soil water versus the rate of degradation by microorganisms to its metabolite, which is less mobile.	Dicamba has been found in runoff, but contamination of surface waters due to runoff is unlikely except when heavy rainfall occurs soon after application.	No information on effects to microorganisms. Dicamba is toxic to many broadleaf plants and to conifers, but does not injure most grasses. Practically non-toxic to aquatic invertebrates. Slightly toxic to coldwater fish and practically non-toxic to warmwater fish. Practically non-toxic to birds, slightly toxic to mammals, and low toxicity to bees.

Active Ingredient	Persistence in Soil	Residual Soil Activity	Volatility and Burning By-products	Solubility	Leaching Potential	Surface Waters	Toxicity
Glyphosate Products (Roundup, Rodeo)	Half-life ranges from 3-130 days, and soil micro-organisms break it down. Surfactant in Roundup has half-life of less than 1 week.	Generally not active in soil, and plants do not usually absorb glypho-sate from soil.	Does not evaporate easily. Major products from burning treated vegetation include phosphorus pentoxide, acetonitrile, carbon dioxide, and water. None of these compounds is known to be a health threat at levels from a vegetation fire.	Dissolves easily in water.	Potential for leaching is low, and glyphosate and surfactant in Roundup are strongly absorbed by soil particles. Half life for glyphosate in water ranges from 35-65 days. Surfactant half life ranges from 3-4 weeks.	Very low concentrations of glyphosate have been observed in surface water following heavy rains up to 3 weeks after application.	No known effect on micro-organisms from glyphosate or associated surfactants. Non-target plants may be injured or killed. Does not bio-accumulate in fish. Accord and Rodeo formulations are practically non-toxic to fresh water fish and aquatic invertebrates, but Roundup is slightly to moderately toxic to fish and invertebrates. Practically non-toxic to birds, mammals, and bees.
Imazapyr (Arsenal, Assault)	Exposure to sunlight may break down. Soil micro-organisms contribute to breakdown.	Can remain active in soil for 6 months to 2 years.	Does not evaporate easily.	Soluble in water.	Low potential for leaching into ground water.	May move from treated areas to streams, but mostly found in runoff from storms. Streamside management zones can significantly reduce water contamination. Half life in water is about 4 days.	Little effect on soil micro-organisms. Non-toxic to conifers, but toxic to many other non-target plants. Low toxicity to invertebrates and practically non-toxic to fish. Does not build up in aquatic animals. Practically non-toxic to birds and mammals, has low toxicity to bees, and is rapidly excreted by animals.

Active Ingredient	Persistence in Soil	Residual Soil Activity	Volatility and Burning By-products	Solubility	Leaching Potential	Surface Waters	Toxicity
Metsulfuron methyl (Ally, Cimarron, Escort, Oust)	Half-life ranges from 120 to 180 days. Soil micro-organisms contribute to breakdown.	Generally active in soil, and usually absorbed from the soil by plants.	Does not evaporate easily. Insufficient information is available on potential by-products from burning.	Dissolves easily in water.	Has the potential to contaminate ground water at very low concentrations and leaches through silt loam and sandy soils.	Surface waters may be contaminated if applied directly to water or wetlands. When exposed to artificial sun light, half life was 1 to 8 days.	Insufficient information on effects to soil microorganisms. Non-target plants may be injured or killed with contact. Practically non-toxic to fish and aquatic invertebrates, and does not bio-accumulate in fish. Practically non-toxic to birds, mammals and bees.
Sulfometuron methyl (LanDHCMArk, Oust, Westar)	Increases with cooler temps, low soil moisture, and higher pH. It is broken down by microbes and chemical reactions in water and by sunlight.		Does not evaporate easily. No information is available on potential by-products from burning.	Soluble in water.	Moderately mobile in the environment but rapidly degraded and not expected to contaminate groundwater.	Moderately persistent and mobile and has potential to enter surface waters from runoff.	Contact will injure or kill non-target plants. Slightly toxic to fish. Practically nontoxic to birds, mammals, and aquatic insects.

Active Ingredient	Persistence in Soil	Residual Soil Activity	Volatility and Burning By-products	Solubility	Leaching Potential	Surface Waters	Toxicity
Triclopyr (Access, Garlon 3A/4, Redeem)	Average half-life in soil is 46 days. Micro-organisms degrade triclopyr rapidly.	Active in soil and absorbed by plant roots.	Potential for volatilization is very low, but no information is available on potential by-products from burning treated vegetation.	Moderate to low solubility.	Potential for leaching depends on soil type, acidity, and rainfall conditions. Because triclopyr binds to clay and organic matter, leaching should not be a concern, except in heavy rainfall and light soils.	Sunlight rapidly breaks down triclopyr in water. Half life in water is less than 24 hours. Irrigation ditches or waters used for domestic uses should not be polluted with triclopyr.	Slightly to practically non-toxic to soil microorganisms. It is toxic to many plants, and small amounts may injure some plants. Low toxicity to fish except the ester form in Garlon 4, which rapidly breaks down. Does not bio-accumulate in fish. Practically non-toxic to birds, mammals and bees.

Sources: BLM, 2007a; WSDOT, 2010

APPENDIX G: HERBICIDE CHARACTERISTICS RELEVANT TO WILDLIFE AND HABITAT EFFECTS

Chlorsulfuron

Non-target Vegetation Chlorsulfuron is an effective and potent herbicide and adverse effects on some nontarget plant species, both terrestrial and aquatic, are plausible unless measures are taken to limit exposure. For terrestrial plants, the dominant factor in the risk characterization is the potency of chlorsulfuron relative to the application rate. The typical application rate considered in this risk assessment, 0.056 lb/acre, is over 6000 times higher than the NOEC determined in vegetative vigor (direct spray) assay of the most sensitive nontarget species – i.e, 0.0000088 lb/acre in onions and sugar beets – and only a factor of 2.5 below the NOEC for the most tolerant species in the same assay – i.e., 0.14 lb/acre in wheat, wild rye, and some other grasses. The highest application rate that may be considered in Forest Service programs – i.e., 0.25 lb/acre – is over 25,000 times the NOEC in sensitive species and about a factor of 2 above the NOEC in tolerant species. Given these relationships, damage to nontarget plant species after ground broadcast applications could extend to distances of greater than 900 feet from the application site. This risk characterization applies only to ground broadcast applications. When used in directed foliar applications (i.e., backpack), offsite drift could be reduced substantially but the extent of this reduction cannot be quantified.

Mammals Chlorsulfuron has been tested in only a limited number of species and under conditions that may not well-represent populations of free-ranging nontarget species. Notwithstanding this limitation, the available data are sufficient to assert that no adverse effects are anticipated in terrestrial animals. The mammalian toxicity of chlorsulfuron is relatively well characterized in experimental mammals; however, there is relatively little information regarding nontarget wildlife species. It seems reasonable to assume the most sensitive effects in wildlife mammalian species will be the same as those in experimental mammals (i.e., weight loss and decreased body weight gain).

Birds Results of acute toxicity and reproduction studies in birds indicate that birds appear to be no more sensitive than experimental mammals to the toxic effects of chlorsulfuron. For terrestrial mammals, the dose-response assessment is based on the same data as the human health risk assessment (i.e., an acute NOAEL of 75 mg/kg/day and a chronic NOAEL of 5 mg/kg/day). None of the exposure scenarios, acute or longer term, result in exposure estimates that exceed this NOAEL. Birds appear to be substantially less sensitive to chlorsulfuron than mammals with an acute NOAEL 1686 mg/kg/day of from a 5-day feeding study and a longer-term NOAEL from a reproduction study of 140 mg/kg/day. Therefore, adverse effects in mammals, birds, terrestrial insects, and microorganisms are not likely using typical or worst-case exposure assumptions at the typical application rate of 0.056 lb a.e./acre or the maximum application rate of 0.25 lb a.e./acre.

Insects and Other Terrestrial Invertebrates Toxicity data on terrestrial invertebrates are not extensive. Based on direct spray studies, no mortality would be expected at application rates of up to 107 lb/acre. Indirect effects to herbivorous insects associated with sub lethal effects on treated vegetation have been noted at very low application rates – i.e., about 0.001 lb/acre to 0.002 lb/acre. Soil microorganisms do not appear to be sensitive to chlorsulfuron with an NOEC of 10 ppm (or 10 :g/g soil).

Bioconcentration The potential for accumulation of chlorsulfuron in fish was studied in bluegill fish exposed to 0.01 and 1.0 mg/L (Han 1981c) and channel catfish exposed to 0.5 mg/L 14C-chlorsulfuron for 28 days (Priester et al. 1991b). Both studies examined the bioconcentration of 14C-chlorsulfuron in muscle (edible tissue), liver and viscera during a 28-day exposure period. Following

1 day of exposure, no bioconcentration of chlorsulfuron in edible tissue occurred in bluegill sunfish (BCF = 1) or channel catfish (BCF = 0.12). Over the 28-day exposure period, the highest BCF observed in edible tissue was 1.5 in channel catfish on days 7 and 14 of exposure.

Clopyralid

Non-target Vegetation Sensitive plant species could be adversely affected by the off-site drift of clopyralid under a variety of different scenarios depending on local site-specific conditions that cannot be generically modeled. If clopyralid is applied in the proximity of sensitive crops or other desirable sensitive plant species, site-specific conditions and anticipated weather patterns will need to be considered if unintended damage is to be avoided. More tolerant plant species are not likely to be affected unless they are directly sprayed or subject to substantial drift. Because of the tendency for clopyralid to move into soil rather than to be transported by runoff and because of the greater toxicity of clopyralid by foliar deposition compared to soil contamination, off-site movement of clopyralid by soil runoff does not appear to be substantial risk to nontarget plant species.

Birds. The acute toxicity of clopyralid has been assayed using Mallard ducks and Bobwhite quail, both standard test species required by the U.S. EPA in the registration of pesticides. Most of the acute studies in birds involve dietary administration over short periods of time (i.e., 5 days). The LD50 data on experimental mammals, however, involve gavage administration of a single dose (placing the compound directly into the stomach by intubation). One gavage study in birds (Fink et al. 1980) is available on the acute toxicity of clopyralid to Mallard ducks. As indicated in Appendix 2, the LD50 by gavage in Mallard ducks was 1465 mg/kg bw (1220–1760 mg/kg bw). Since this study was conducted in the early 1980's, clopyralid from the older penta process was probably used. Thus, this LD50 in birds is most directly comparable to the reported LD50 in rats of >5000 mg/kg (Jeffrey et al. 1987b). As summarized in Appendix 1, the study in rats by Jeffrey et al. (1987b) noted no mortality and no signs of toxicity after single gavage doses of 5000 mg/kg bw to 9-week old male and female Fischer rats. The lower LD50 of 1465 mg/kg in ducks (Fink et al. 1980) with dose-related CNS effects at sub-lethal doses suggests that ducks could be somewhat more susceptible than mammals to the acute toxic effects of clopyralid.

Mammals A substantial number of toxicity studies is available in experimental mammals, specifically rats, mice, rabbits, and dogs exposed to clopyralid. The acute toxicity of clopyralid is relatively low: LD50 values of about 3000 mg/kg for clopyralid produced by electrochemical process and >5000 mg/kg for clopyralid produced by the penta process. The mode of action of clopyralid in plants is well understood; however, its mode of action for causing toxicity in mammals has not been determined. There is no consistent toxic effect or set of toxic effects to an organ or an organ system which can be attributed to clopyralid. The U.S. EPA (1997b) RfD uses decreased body weight in rats as a critical effect—the adverse effect occurring at the lowest dose level. Effects on liver and kidney weight as well as changes in gastric epithelial tissue have also been noted at dose levels similar to those associated with changes in body weight.

Insects and Other Terrestrial Invertebrates Several studies (Cole 1974a,b; Dow Chemical 1980e; Hinken et al. 1986c) have been conducted on the toxicity of clopyralid to bees—a test required by the U.S. EPA in the registration of pesticides—using both oral and direct contact exposures (Appendix 3). No significant increase in mortality was noted in bees at doses of up to 0.1 mg/bee. Based on the results of a static bioassay on earthworms summarized in Dow AgroSciences (1998), the soil LC50 of clopyralid to earthworms is greater than 1000 ppm soil. In addition to these standard bioassays, Hassan et al. (1994) have provided a summary of an apparently large series of bioassays and field trials on clopyralid as well as a number of other pesticides using a variety of terrestrial invertebrates. The form of clopyralid used in this study was Lontrel 100, a formulation of clopyralid that is no longer marketed commercially (480 g/ha of 0.012% a.i. was used in the experiments). While this publication does not provide detailed dose, exposure, or response data, it does indicate that clopyralid was classified by the study authors as *harmless*—a category that is defined by these investigators as exposures which result in less than 30% mortality—to 14/17 insect parasites and predatory mites in contact bioassays. Higher mortality rates (25–50%) were observed with clopyralid in *Semiadalia 11-notata* (Coccinellidae), *Anthocoris nemoralis* (Anthocoridae), and *Chryosperla carnea* (Chrysopidae). The authors classified this level of mortality as *"slightly harmful"*. A recent laboratory study on spiders (*Theridion impressum*) reported an acute (96-hour) lethality of less than 10% following a direct application clopyralid (Lontrel) at the recommended application rate (Pekar et al. 2002).

Bioconcentration One study regarding the bioconcentration of clopyralid has been encountered. Bidlack (1982) exposed bluegill sunfish to 14C-labeled clopyralid for 28 days and found no indication of bioconcentration.

Glyphosate

Non-target Vegetation For relatively tolerant nontarget species of plants, there is no indication that glyphosate is likely to result in damage at distances as close as 25 feet from the application site. For sensitive species at the upper range of application rates, there is a modest excursion about the NOEC at offsite distances of 100 feet or less. It should be noted, however, that all of these drift estimates are based on low-boom ground sprays. Many applications of glyphosate are conducted by directed foliar applications using backpacks. In such cases, little if any damage due to drift would be anticipated. Nontarget terrestrial plants are not likely to be affected by runoff of glyphosate under any conditions.

Birds Glyphosate has been classified by the U.S. EPA/OPP 1993c as no more than slightly toxic to birds. As an index of potential toxicity from acute exposure, the U.S. EPA/OPP 1993c uses the gavage study by Fink et al. (1978) in which the LD50 was >2000 mg/kg in bobwhite quail. The more recent studies by Palmer and Beavers (1997a,b) indicate five day dietary LC50 values of greater than 5620 ppm in both bobwhite quail and mallard ducks. These dietary values are actually an NOEC in that no mortality or signs of toxicity were observed in any test animals. For longer-term effects, U.S. EPA/OPP 1993c uses the dietary NOAELs of 1000 ppm in bobwhite quail (Fink 1975) and mallard ducks (Fink and Beavers 1978). Both of these studies were assays for reproductive toxicity, a relevant and sensitive endpoint for the ecological risk assessment. In this risk assessment, the acute dietary studies by Palmer and Beavers (1997a,b) will be used to assess the effects from acute exposures. For longer term exposures, the reproductive NOAEL of 1000. For birds, a dose of100 mg/kg is used as a NOAEL for characterizing chronic risks. It should be noted that this dose is very close to the NOAEL of 175 mg/kg used for mammals and is consistent with the apparent lack of variability in the toxicity of glyphosate among species. As in the assessment for mammals, this NOAEL is based on a repeated dose study for reproductive effects. The acute NOAEL is taken as 562 mg/kg from a five-day dietary study in bobwhite quail and mallard ducks.

Mammals For mammals, the toxicity data used to characterize risk are identical to those used in the human health risk assessment – i.e., a NOAEL of 175 mg/kg with an associated LOAEL of 350 mg/kg. The 175 mg/kg NOAEL and 350 mg/kg LOAEL values are used for both the acute and chronic risk assessments. This approach is taken because of the lack of a substantial dose-duration or dose-severity relationship for glyphosate.

Insects and Other Terrestrial Invertebrates In standard oral and contact bioassay summarized by U.S. EPA/OPP (1993c), the LD50 values for bees was over 100 microgram/bee. Three more recent studies have been submitted to the U.S. EPA that are consistent with these earlier reports. Glyphosate has been tested as an insecticide for spider mites, *Tetranychus urticae*, a pest species on apple trees (Ahn et al. 1997) as well as for toxicity to *Typhlodromus pyri*, and an important predator of spider mites (Weppleman 1998b). Direct foliar spray of glyphosate IPA at 0.593 to 4.74 mg ai per leaf (kidney bean plants) had no effect on the spider mite based on mortality in eggs, larva, nymphs or adults (Ahn et al. 1997) an was essentially ineffective as an insecticide. In the field, application rates of 360, 720, and 1440 g ae/ha resulted in decreased spider populations that were attributed to secondary effects from changes in the vegetation (Haughton et al. 2001b). No substantial effects were observed in spider populations at application rates of 90 or 180 g a.e./ha (Haughton et al. 1999).

Three studies are available relating to the potential effects of glyphosate on earthworms. In a laboratory study, effects on earthworm cultures treated at levels equivalent to application rates of 0.7 to 2.8 g glyphosate/ha included decreased growth rates and early mortality (Springett and Gray 1992). The direct relevance of this study is limited, however, because the exposure conditions (spraying twice weekly on culture dishes) do not closely approximate field conditions. Dalby et al. (1995) report no effects on earthworms in applications designed to mimic agricultural use. This study, however, does not report exposures either as g/ha or ppm soil and thus cannot be used directly in this risk assessment. The soil LC50 for glyphosate to *Aporrectodea caliginosa*, a worm common in Libya, has been reported to be 246 to 177 mg glyphosate/kg soil dry weight over exposure periods of 8 to 37 days (Mohamed et al. 1995). One study is available on the toxicity of glyphosate to a terrestrial snail, *Helix aspersa*, Brown garden snail, in which diets containing 4994 ppm glyphosate resulted in no mortality over a 14 day exposure period. Assuming a 30% food consumption factor for this species (APHIS 1993), this corresponds to a dose of about 1,500 mg/kg (4994 ppm × 0.3 mg/kg bw ppm = 1498.2 mg/kg bw).

Bioconcentration Based on the study by Forbis (1989), the U.S. EPA/OPP (1993c, p. 36) used maximum bioconcentration factors of 0.38 for edible tissues and 0.52 for whole fish. Calabrese and Baldwin (1993) have reviewed a number of different methods for estimating BCF values in fish based on chemical and physical properties. Using a log Ko/w of -4.85 at pH 6.86 (from Chamberlain et al. 1996 as summarized in Table 2-2), the estimated BCF values in fish would be well below unity, consistent with the study by Forbis (1989) and the BCF values used by U.S. EPA/OPP (1993c).

Imazapyr

Non-target Vegetation Imazapyr is an effective herbicide and even tolerant plants that are directly sprayed with imazapyr at normal application rates are likely to be damaged. Some sensitive plant species could be affected by the off-site drift or by off-site movement in runoff of imazapyr depending on site-specific conditions. When applied to areas in which runoff is favored, damage from runoff appears to pose a greater hazard than drift. Residual soil contamination with imazapyr could be prolonged in some areas. In relatively arid areas in which microbial degradation may be predominant factor in the decline of imazapyr residues in soil, residual toxicity to sensitive plant species could last for several months to several years. In areas of relatively high rainfall rates, residual toxicity to sensitive plant species would be much shorter. This characterization of risk for residual soil contamination is general rather than site-specific. The persistence and movement of imazapyr in soil is highly complex and substantially different estimates of persistence and transport could be made if different site-specific factors were considered. Thus, these estimates of risk should be considered only as crude approximations of environmentally plausible consequences.

Birds While toxicity studies on birds (Appendix 2) are less extensive than those on mammals, both ducks and quail have been assayed in 5 day acute toxicity studies and 18 week reproduction studies. As with the mammalian studies, no adverse effects have been noted in birds. In the acute studies (Fletcher 1983a,b), no mortality was observed at imazapyr concentrations of up to 5000 ppm in the diet. These acute exposures were equivalent to average daily doses of 674 mg/kg in quail (Fletcher 1983b) and 1149 mg/kg in ducks (Fletcher 1983a). Similarly, in the 18-week dietary studies, no effects on reproductive endpoints (i.e., egg production, hatchability, survival of hatchlings) were observed at dietary concentrations of up to 2000 ppm. These 18-week exposures were equivalent to average daily doses of 200 mg/kg in both quail and ducks (Fletcher et al. 1995a,b). The LD50 for Bobwhite quail and Mallard ducks is >2150 mg/kg (Fletcher et al. 1984a,b). Acute toxicity studies (5-day) in Bobwhite quail and Mallard ducks found no adverse effects at dietary concentrations up to 5000 ppm (Fletcher et al. 1984c,d).

Mammals Virtually all of the studies on imazapyr are negative (i.e. no effects clearly attributable to the compound have been identified). Thus, while the toxicity of imazapyr to plants is understood relatively well (Section 4.1.2.4), it is not clear what, if any, specific toxicity imazapyr may cause in mammalian wildlife. While this may be considered an uncertainty or a lack of knowledge, it has a relatively minor impact on this risk assessment because the available toxicity studies are relatively complete—chronic studies in three mammalian species (dogs, rats, and mice) and several reproduction studies in two mammalian species (rats and rabbits)—and indicate that imazapyr is not likely to be associated with adverse effects at relatively high-dose levels.

Insects and Other Terrestrial Invertebrates The only information on the toxicity of imazapyr to a terrestrial invertebrate is provided by the honey bee studies by Atkins (1984) and Atkins and Kellum (1983). Atkins and Kellum (1983) identifies an oral LD50 in the honey bee of >100 g/bee, equivalent to >0.1 mg/bee. Taking an average weight of 0.093 g/bee or 0.000093 kg/bee (USDA/APHIS 1993) and making the very conservative assumption of 100% absorption, this would correspond to an LD50 greater than 1000 mg/kg bw [0.1 mg imazapyr/bee ÷ 0.000093 kg bw/bee = 1075 mg/kg]. This order of toxicity is comparable to the LD50 values reported in experimental mammals (Appendix 1) and birds (Appendix 2). This suggests that the toxicity of imazapyr to terrestrial invertebrates may be similar to the toxicity of this compound to terrestrial vertebrates. On the other hand, there are a very large number of terrestrial invertebrates in any diverse environment. Typically, as with imazapyr, information is available on only a single terrestrial invertebrate species, the honey bee. Thus, the ability to characterize potential effects in other species is limited.

Bioconcentration As part of the registration process, experimental bioconcentration factors are required and one such study has been submitted to U.S. EPA (McAllister et al. 1985). The author exposed bluegill sunfish to 14C-labeled imazapyr for 28 days and found no indication of bioconcentration. The measured bioconcentration factor was less than 0.5. In other words, the concentration of imazapyr in the fish was less than the concentration of imazapyr in the water. In mollusks, the available data on imazapyr show no bioconcentration (Christensen et al. 1999, Drotter et al. 1996).

Metsulfuron methyl

Non-target Vegetation. The toxicity of metsulfuron methyl to terrestrial plants was studied extensively and is well characterized. Metsulfuron methyl inhibits acetolactate synthase (ALS), an enzyme that catalyzes the biosynthesis of three branched-chain amino acids, all of which are essential for plant growth. Terrestrial microorganisms also have an enzyme that is involved in the synthesis of branched chain amino acids, which is functionally equivalent to the target enzyme in terrestrial macrophytes. There are laboratory and field studies on the effects of metsulfuron methyl to soil microorganisms. These studies suggest that transient effects on soil bacteria are plausible.

Birds Several acute toxicity studies and two reproduction studies are available on the toxicity of metsulfuron methyl to birds. These studies indicate that birds appear to be no more sensitive than experimental mammals to the toxic effects of metsulfuron methyl, with the major effect again being decrease body weight gain.

Mammals The mammalian toxicity of metsulfuron methyl is relatively well characterized in experimental mammals; however, there is relatively little information regarding nontarget wildlife species. It seems reasonable to assume the most sensitive effects in wildlife mammalian species will be the same as those in experimental mammals (i.e., decreased body weight gain). In experimental mammals, the acute oral LD50 for metsulfuron methyl is greater than 5000 mg/kg, which indicates a low order of toxicity. In addition, non-lethal signs of toxicity were apparent after single oral doses as low as 50 mg/kg. The most common sign of acute, subchronic, and chronic toxicity is decreased body weight gain. The only other commonly noted effect involves changes in various hematological parameters as well as changes in absolute and relative organ weights. None of these changes, however, suggest a clear or specific target organ toxicity. There is speculation that the effects of metsulfuron methyl on the blood might be related to saccharin, which is a metabolite of metsulfuron methyl. At very high doses, saccharin caused hematological effects in mice. Appropriate tests have provided no evidence that metsulfuron methyl presents any reproductive risks or causes malformations or cancer. Metsulfuron methyl also is irritating to the skin and eyes, but does not produce sensitizing effects following repeated dermal exposure.

Insects and Other Terrestrial Invertebrates At exposure rates that exceed the highest recommended application rate by about a factor of 3, metsulfuron methyl appears to be somewhat toxic to the Rove beetle, *Aleochara bilineata*, causing a 15% decrease in egg hatching. There are also several acute assays on the honey bee that indicate that bees are no more sensitive than either mammals or birds to metsulfuron methyl.

Bioconcentration The bioconcentration of 14C-metsulfuron methyl in muscle (edible tissue), liver and viscera was examined during a 28-day exposure period. Details of these studies are provided in Appendix 8. Following 1 day of exposure, no bioconcentration of metsulfuron methyl in edible tissue occurred bluegill sunfish (BCF = 0.21). Over the 28-day exposure period, no bioconcentration metsulfuron methyl in edible tissue was observed, with the highest BCF of 0.61 on day 7 of exposure.

Sulfometuron methyl
Non-target Vegetation. Results of both pre-emergent and post-emergent bioassays show that terrestrial plants are highly susceptible to the effects of sulfometuron methyl. Concern for the sensitivity of non-target plant species is further increased by field reports of substantial and prolonged damage to crops or ornamentals after the application of sulfometuron methyl in both an arid region, presumably due to the transport of soil contaminated with sulfometuron methyl by wind, and in a region with heavy rainfall, presumably due to the wash-off of sulfometuron methyl contaminated soil. Sulfometuron methyl exposure inhibited growth of several soil microorganisms and caused significant growth inhibition in *Salmonella typhimurium* after exposure periods of less than 3 hours.

Birds Results of acute exposure studies in birds indicate that avian species appear no more sensitive than experimental mammals to the toxic effects of sulfometuron methyl. Chronic exposure studies in birds were not identified in the available literature. Birds appear to exhibit the same low order of toxicity to sulfometuron methyl as mammals, with an acute NOAEL of 312 mg/kg based on changes in body weight observed following a single gavage administration to mallard ducks. No chronic exposure studies of birds to sulfometuron methyl were identified in the available literature. Since results of acute exposure studies suggest that the sensitivity of birds to sulfometuron methyl is similar to that of mammals, in the absence of chronic exposure data in birds the chronic NOAEL of 2 mg/kg/day in rats is used for birds.

Mammals The mammalian toxicity of sulfometuron methyl is relatively well characterized in experimental mammals; however, there is relatively little information regarding non-target wildlife species. In standard experimental toxicity studies, sulfometuron methyl has low acute and chronic oral toxicity. In experimental mammals, the acute oral LD50 for sulfometuron methyl is greater than 17,000 mg/kg, which indicates a low order of toxicity. The lowest dose reported to cause any apparent effects after single gavage administration to rats is 5000 mg/kg. Acute exposure studies of sulfometuron methyl and the sulfometuron methyl formulation Oust give similar results, indicating that formulations of sulfometuron methyl are not more toxic than sulfometuron methyl alone.t seems reasonable to assume the most sensitive effects in wildlife mammalian species will be the same as those in experimental mammals (i.e., changes to blood and decreased body weight gain).

Insects and Other Terrestrial Invertebrates Results of two acute exposure studies in honey bees indicate that bees are no more sensitive than either mammals or birds to sulfometuron methyl. However, the available data are not sufficient to determine whether this apparent low level of toxicity can be generalized to other species of terrestrial invertebrates. Nevertheless, there is no clear basis for suggesting that effects on terrestrial animals are likely or would be substantial. Adverse effects in mammals, birds, terrestrial insects, and microorganisms are not likely using typical or worst-case exposure assumptions at the typical application rate of 0.045 lb a.e./acre. For terrestrial invertebrates, based on direct spray studies in honey bees, no mortality would be expected following acute exposure to doses up to 1075 mg/kg

Bioconcentration In catfish, bioaccumulation occurred in both muscle and viscera. Following 1 day of exposure, the bioconcentration factor (BCF) in muscle was 3 and the BCF observed in viscera was 3.5. Over the 28-day exposure period, the highest BCF in edible tissue was 7, which was observed following 21 days of exposure, and the highest BCF in viscera 6, observed after 28 days of exposure.