MUNICIPALITY OF ANCHORAGE
INVASIVE PLANT MANAGEMENT PLAN - DRAFT

Prepared for the Municipality of Anchorage
Parks and Recreation Department
July 2010

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ACKNOWLEDGMENTS

Invasive plants are an important environmental concern in Anchorage and in Alaska. The Municipality of Anchorage Invasive Plant Management Plan was prepared by Gretchen Gary as the result of a collaborative process among the Anchorage Cooperative Weed Management Area to develop shared strategies for reducing the threat of invasive plants in Alaska.

The following individuals, organizations, and agencies contributed to this plan:

Anchorage Cooperative Weed Management Area
Anchorage Parks Foundation
Scott Stringer and Isobel Roy – Municipality of Anchorage
Jeffrey Heys and David Wigglesworth – United States Fish and Wildlife Service
Gino Graziano – State of Alaska Department of Natural Resources, Division of Agriculture
Michael Rasy and Ashley Grant – University of Alaska Fairbanks, Cooperative Extension Service
Bonnie Million – National Park Service
Dr. Robert DeVelice – United States Forest Service
Allegra Hamer – Citizens Against Noxious Weeds Invading the North
Helen Cortes-Burns and Lindsey Flagstad – Alaska Natural Heritage Program

This report could not be possible without the assistance of a grant from the United States Fish and Wildlife Service through the Anchorage Parks Foundation.

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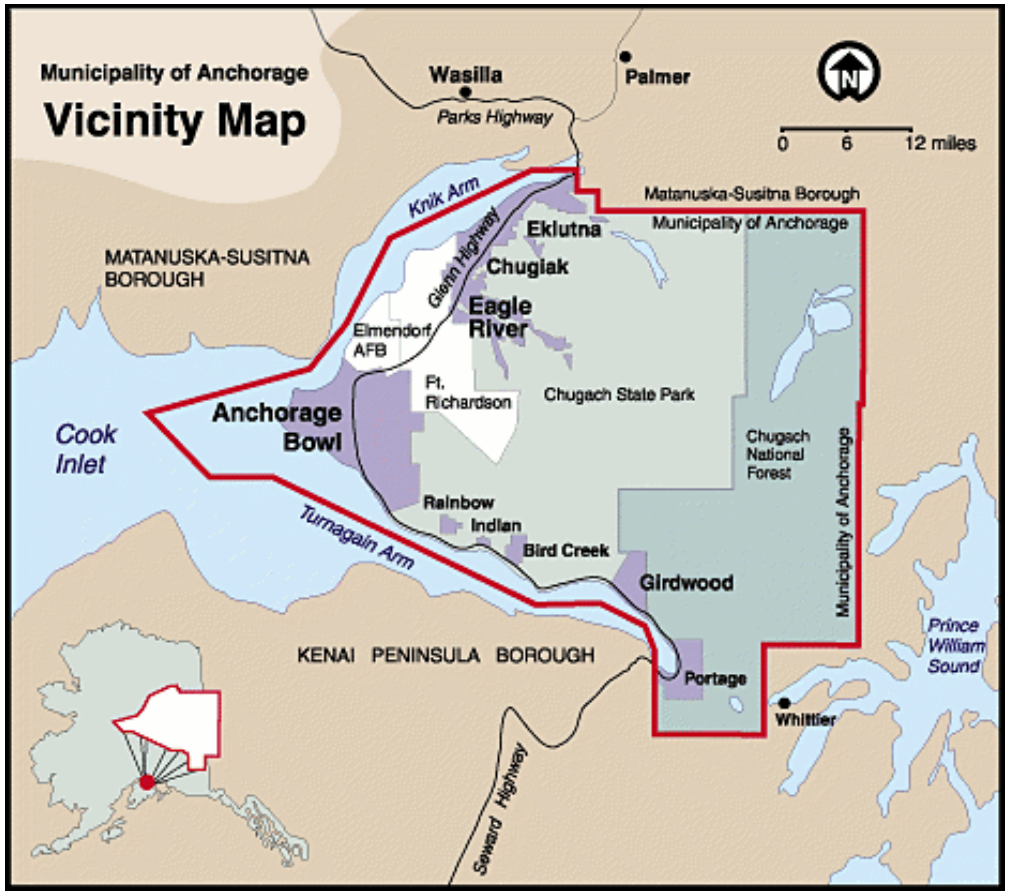
*Cover photo: *Impatiens glandulifera*, Ornamental Jewelweed

LIST OF ACRONYMS

AKEPIC	Alaska Exotic Plant Information Clearinghouse
AKNHP	Alaska Natural Heritage Program
ANC-CWMA	Anchorage Cooperative Weed Management Area
APF	Anchorage Park Foundation
BMP	Best Management Practices
CES	University of Alaska Cooperative Extension Service
CNIPM	Committee for Noxious and Invasive Plants Management
DOT	Department of Transportation
EDRR	Early Detection and Rapid Response
IPM	Integrated Pest Management
IWM	Integrated Weed Management
MASS	Municipality of Anchorage Standards and Specifications
MOA	Municipality of Anchorage
NRCS	Natural Resources Conservation Service
USFWS	United States Fish and Wildlife Service
YEP	Youth Employment in Parks

MUNICIPALITY OF ANCHORAGE MAP[1]



[1]Map courtesy of the Municipality of Anchorage (http://www.muni.org/Departments/Planning/PublishingImages/vicinity.gif)

MUNICIPALITY OF ANCHORAGE
LAND USE

There are thousands of landowners within the borders of the Municipality of Anchorage (MOA). This Plan is intended to be used as a management tool for land managers working on MOA owned and managed land. The practices and activities described herein are also recommended for other land owners within the MOA, other parts of Alaska, and throughout the country when and where it is appropriate.

The source of the data in the tables below is an MOA data layer, compiled by Davey Resource Group. The data and report are still in DRAFT stage as of July 2009. The data listed below should be updated when the report by Davey Resource Group is completed. The MOA totals listed below include the entire municipal boundary and do not yet include "other" state and federal land outside of Chugach State Park and Chugach National Forest. As the data is preliminary, the following notes apply:

1. As of July 2010 the boundary of Eagle River is still being determined within the GIS database.
2. Residential and commercial land use data for Girdwood is not available.
3. The MOA Total considers all land use data available within the municipal boundary. The amount not included in the Anchorage Bowl, Eagle River, and Girdwood urban areas falls outside those urban areas, but within the MOA boundary. This accounts for the discrepancy in totals. Similarly, within the three urban areas, the totals consider all land use data available within those urban areas.

Table 1: Land Use within the Municipality of Anchorage

MOA Totals	Area (Acres)
All Residential	29,935
All Commercial/Industrial	7,075
All Trails (25ft Buffer)	4,484
Chugach National Forest	245,685
Chugach State Park	464,332
Total	751,511

Anchorage Bowl	Area (Acres)
Land Use-Commercial/Industrial	5,706
Land Use-Residential	19,550
State Owned	3,319
Federal Owned	963
ROW ('psuedo' parcel, 30/40/50ft - Local, Sec, Major buffer)	10,417
All Hydro (35ft stream and 25ft lake buffer)	1,952
Trails (25ft Buffer)	2,605
Total	71,419

Eagle River	Area (Acres)
Land Use-Commercial/Industrial	183
Land Use-Residential	943
State Owned	457
Federal Owned	2
ROW ('psuedo' parcel, 30/40/50ft - Local, Sec, Major buffer)	638
All Hydro (35ft stream and 25ft lake buffer)	95
Trails (25ft Buffer)	70
Total	3,413

Girdwood	Area (Acres)
Land Use-Commercial/Industrial	N/A
Land Use-Residential	N/A
State Owned	2,632
Federal Owned	3,462
ROW ('psuedo' parcel, 30/40/50ft - Local, Sec, Major buffer)	409
All Hydro (35ft stream and 25ft lake buffer)	753
Trails (25ft Buffer)	216
Total	24,902

INTRODUCTION

Land managers face a serious long-term challenge to develop and conduct effective programs to prevent new invasions and manage invaded ecosystems. With this plan land managers in the Municipality can coordinate invasive plant management and control efforts and take advantage of opportunities to pool talents and resources. The Anchorage Invasive Plant Management Plan provides land managers with clear guidelines and management priorities to increase awareness and understanding of invasive plants, address the spread of infestations to other ecosystems, and develop cost-effective and environmentally sound management programs.

Invasive Weeds: Definition and Impacts

Alaska's natural lands are a critical component of the State's economy and quality of life. The introduction, establishment, and spread of invasive weeds are serious and growing concerns for these natural lands. Invasive plants have the potential to negatively impact natural areas of Alaska and have contributed to the loss of native ecosystems in areas across the state. Invasive plants can also impact agricultural production in Alaska, and urban areas typically have higher concentrations of weeds serving as a potential vector for the introduction of weeds to agricultural and natural lands. According to the best available data[2] there are 208 species of invasive plants recorded in Alaska, of which over half are found within the Municipality of Anchorage (hereafter called MOA).

Many non-native species are routinely introduced to ecosystems, although comparatively few become invasive. For example, cultivated broccoli is not native to Alaska, yet it poses little threat to native ecosystems or the economy. For the purposes of this document the terms "weed," "invasive weed," and "invasive plant" are used synonymously and defined as: "a plant, including its propagules, roots, and vegetative structures, that is not native to the ecosystem under consideration and whose introduction does or is likely to cause economic or environmental harm or harm to human health" (Executive Order 13112; USDA Forest Service 2004a; USDA Forest Service 2005). In other words, a weed is a species of plant that has relocated beyond its native range, where it establishes and becomes an ecological and, often, economic problem. Weeds thrive in novel ecosystems due to a suite of adaptive characteristics such as vegetative reproduction, high numbers of seeds and fruit, early maturation, late season senescence, rapid growth, lack of natural predators, and allelopathic (poisonous to other plants) defenses.

Weeds are introduced to new ecosystems through a variety of pathways. Cities are often the focal point of species introductions due to the variety and volume of possible vectors; people, vehicles, pets and livestock, trade and commercial goods which are imported from

[2] For more information on invasive species issues in Alaska refer to the websites for the Alaska Exotic Plant Information Clearinghouse (http://akweeds.uaa.alaska.edu/) and the Alaska Committee for Noxious and Invasive Plants (CNIPM) (http://www.uaf.edu/ces/cnipm/).

around the world. Travelers carry plants from their native ecosystems, intentionally and as hitchhikers. Plant parts and propagules are transported on shoes, in luggage, and on domesticated animals. Vehicles, including cars, boats, and planes are important weed vectors, and transportation corridors allow weeds to spread quickly. The use and transport of heavy equipment, fill, and gravel perpetuate the spread of weeds. Some plants are introduced intentionally for erosion control, landscaping, gardening, or crops that escape cultivation to become weeds.

Weeds come at a high cost to ecosystems. They often lack natural predators in their new habitats, allowing weeds to re-allocate resources from defense strategies to growth and reproduction, enabling weeds to out-compete native plants. Many species, such as purple loosestrife (*Lythrum salicaria*) and reed canarygrass (*Phalaris arundinacea*), form dense monocultures that effectively eliminate native vegetation, dramatically reduce wildlife habitat, and alter water quality and flow. Weeds are often exposed to closely-related native plants with which they may hybridize, thereby compromising the genetic integrity of the native species and ecosystem. Weeds can also alter processes such as nutrient cycling, fire frequency, hydrologic cycles, sediment deposition, and erosion, negatively impacting ecosystem function.

The economic impact of invasive weeds is equally complex. As of 2004, approximately $120 billion annually of profits have been lost or spent in the United States due to the impacts and control of invasive species (Pimentel et al. 2004). Reduction in timber, game animals, fisheries, pharmaceutical products, agricultural production and land value are readily identifiable economic impacts. Ecosystem services such as maintaining water quality and supply, flood protection, power generation, fire protection, recreation, climate regulation, regeneration of soil fertility, decomposition, and maintenance of biological diversity are impacts that are more difficult to assign monetary values.

The MOA, home to about 42% of Alaska's human population[3], is the epicenter of weed introductions in the state. Much of the developed land within the MOA now harbors weeds, but labor and funds are insufficient to permit the control of all of the species or infestations. Therefore, land owners and managers must choose which ones to control with the available resources. Current and complete information on weed species and control practices is vital for making these choices. Successful long-term solutions to the problem of invasive weeds in Alaska must include a broad-scale approach to management in the MOA as outlined in this plan.

History of Anchorage Weed Management

In June of 2000, groups were invited by the University of Alaska Cooperative Extension Service to meet and look for solutions for controlling noxious and invasive plants in the Interior of Alaska. The statewide Alaska Committee for Noxious and Invasive Plants

[3] http://labor.state.ak.us/news/2010/news10-07.pdf

Management (CNIPM) was thus established. The purpose of CNIPM is to work for the statewide management of noxious and invasive plants in Alaska. It is an informal group of individuals representing agencies and organizations statewide. There are no formal membership requirements; anyone statewide may participate. The first goal of CNIPM was to launch and coordinate a process for the development of a strategic plan to manage noxious and invasive plants. A Memorandum of Understanding (MOU) was developed to establish CNIPM and to secure agency and organizational support. Agencies and organizations from the MOA signed the CNIPM MOU in 2000, realistically beginning weed management in Anchorage.

The Municipality of Anchorage - Cooperative Weed Management Area (ANC-CWMA) was first convened through the efforts of citizen activists from Anchorage that became concerned after discovering an invasive plant, Canada thistle (*Cirsium arvense*), growing in the pot of a garden plant that was produced outside Alaska and purchased locally. Formally established in 2007, the ANC-CWMA is a group of multi-agency, multi-jurisdictional land managers, educators, and concerned citizens who have agreed to work together to protect the MOA from the threat of invasive weeds. The purpose of a CWMA is to find landscape solutions to problems caused by weeds, rather than strictly focusing on management within specific land ownership and management boundaries. Some accomplishments of the ANC-CWMA and partners are highlighted below.

- Each year since 2003 several training sessions have been held by various agencies regarding weed identification and treatments. These training sessions are for professional staff, and some are open to the public. Additionally, weed education has been introduced to youth in the MOA through a curriculum called “WEED WACKERS: A K-6 Educators Guide to Invasive Plants of Alaska.” In early 2009 several of these curriculums were distributed to teachers throughout the Anchorage school district. Funds were made available to these teachers in the fall of 2009 for purchasing weed education supplies.

- The first annual ANC-CWMA Invasive Weed Fair was held in 2008. The event promoted awareness through media attention and celebrated the ANC-CWMA by bringing the signatories together to pool resources and educate MOA residents about the impacts of weeds. Former Governor Sarah Palin attended to say a few words along with Representative Craig Johnson, who sponsored a bill to create an Invasive Weeds and Agricultural Pest Coordinator position for the State of Alaska. The former Governor ceremonially signed the bill and unveiled the new ANC-CWMA logo. This event saw more than 50 participants. On May 15, 2009, Palin declared June 21-27, 2009, as Alaska Invasive Weed Awareness Week. The second ANC-CWMA Invasive Weed Fair was celebrated to promote and help kick off the Week.

- Citizen Weed Warriors is a program of Anchorage Park Foundation (APF) and the MOA wherein the MOA organizes weed pull events in which community volunteers participate. Between 2006 and 2009 Citizen Weed Warriors conducted up to 28 weed pulls throughout the Anchorage bowl, focusing weed pull activities on infestations of plants such as purple loosestrife, Canada thistle, bird vetch (*Vicia cracca*), and white sweetclover (*Melilotus alba*). A DVD, printed brochure, and website[4] have been developed for the Citizen Weed Warriors program and are available to the public.

Between 2006 and 2009 Citizen Weed Warriors volunteers have treated weed infestations in 12 Municipality parks during more than 28 weed pulls

- Girdwood Parks and Recreation conducted seven community weed pulls in 2009 with a total of 70 volunteers. A grant through the U.S. Fish and Wildlife Service (USFWS) Coastal Program supported youth crews to pull white sweetclover, narrow leaf hawksbeard (*Crepis tectorum*), and reed canarygrass throughout Girdwood. A total of about 25 acres were treated in Girdwood in 2009.

- Spotted knapweed (*Centaurea stoebe*), a plant targeted for eradication in Alaska, is the focus of control efforts along Turnagain Arm. The efforts are ongoing by the ANC-CWMA and partners.

- APF and the Alaska Exotic Plants Information Clearinghouse (AKEPIC) have two different online, publically accessible, weed reporting systems. Report weeds online at: http://www.anchorageparkfoundation.org/projects/weedswarriors_report.htm and http://akweeds.uaa.alaska.edu/. The AKEPIC protocol for data collection is the minimum standard for the collection of scientific weed data in the MOA.

[4] (http://www.anchorageparkfoundation.org/projects/weedswarriors.htm)

Strategically placed education and outreach materials can increase public awareness about invasive plants in Anchorage, such as the interpretive sign shown here at a puprple loosestrife infestation.

- Several weed surveys have been executed in the MOA since 2001 and are recorded in the AKEPIC database. The database contains data about weeds in Alaska from as early as 1997, with contributions from as many as 13 organizations. The Alaska Natural Heritage Program (AKNHP) performed an exhaustive weed inventory along four MOA trail systems in 2008. The resultant report (Cortes-Burns and Flagstad 2009) provides management recommendations based on the findings.

- AKNHP, in cooperation with several partners, developed an invasiveness ranking system for non-native plants found in Alaska, 56 of which are found in the MOA. Appendix 1 is a list of 80 plants and their rankings. This ranking system has been successfully utilized for prioritizing weed management and control in the MOA and around the state, and was used as a tool to help develop a list of prioritized species for MOA management in this plan. Appendix 2 is the MOA invasive plant "Watch List," which is a list of species that have not yet been recorded in the MOA but whose biology indicates that MOA land is at risk for invasion from these plants.

- The APF/MOA Adopt-a-Patch program encourages volunteer commitment to remove a known weed infestation in a local park. Volunteers receive tools from the MOA and are responsible for the removal and monitoring of a selected patch of weeds.

- The first known escaped population of purple loosestrife in Alaska was discovered in Westchester Lagoon in 2005. A multi-agency cooperative weed pull was organized to begin eradication efforts. The 2005 and subsequent year pulls were hugely successful, reducing the population from 289 stems in 2006 to 13 stems in 2009. Each year these weed pull events at Westchester Lagoon provide public education and media outreach concerning this highly invasive species. Additional outreach efforts were successful in having purple loosestrife removed from the perennial garden bed at the Alaska State Fairgrounds and having it eliminated from the 2009 cut flower competition.

MANAGEMENT NEEDS and MANAGEMENT PLAN GOALS

The success of weed management in the MOA to date is a solid start to the development of a comprehensive and ongoing management program. There are many pressing needs for successful management tools and actions as more species are being established and spread every year. This Plan was developed to facilitate weed management within the MOA by identifying needs, setting goals, and outlining specific management objectives. The remainder of this Plan identifies future management actions for the MOA. It is a working document, designed to adapt to the changing needs of the ecosystems and the community. Written[5] with the input of the ANC-CWMA, the Plan uses an Integrated Weed Management (IWM) approach for managing invasive plants. The following goals address management needs that are outlined in detail in the subsequent sections of the Plan:

I. ***Organization***
Create and maintain a sustainable invasive plant management program in the Municipality of Anchorage

II. ***Education and Outreach***
Increase public and professional cognizance of invasive plants and their associated impacts. Educate about early detection, prevention, control, and how to minimize anthropogenic roles in the establishment and spread of weeds.

III. ***Prevention***
Prevent the introduction of new invasive plant species to the MOA and prevent the spread of infestations into weed free lands. Use Best Management Practices (BMPs) during MOA activities and encourage private landowners to use BMPs. Develop design criteria standards that reduce the impact of invasive plant vectors.

IV. ***Early Detection and Rapid Response***

[5] The content and format of this Plan borrows from similar plans developed for the state of Alaska by CNIPM (http://www.uaf.edu/ces/cnipm/docs/strategic.pdf), the Kenai Peninsula – Cooperative Weed Management Area (http://www.homerswcd.org/invasives/FINCWMAStrategy120107.pdf) and the document entitled: Creating an Integrated Weed Management Plan: A Handbook for Owners and Managers of Lands with Natural Values (http://parks.state.co.us/NR/rdonlyres/E4FAAC68-00B4-44A8-A4E3-4C88B185BC78/0/IWMhandbooktext.pdf).

Continually update weed and critical habitat survey and maps of known infestations. Promote early detection and rapid response (EDRR) practices for all MOA agencies. The primary long term goals of EDRR are detecting, identifying, reporting, and immediately eradicating or controlling suspected new plant species with populations in the MOA.

V. ***Control***

Prioritize weed species, infestations, and uninfested areas for control work within the MOA. Focus on Integrated Weed Management (IWM) strategies for control.

VI. ***Monitoring***

Develop a network of professionals and trained community members to monitor known infestations. Maintain data in publicly accessible databases and restore ecosystems to a more natural state following the removal of infestations.

VII. ***Research***

Facilitate appropriate research activities to ensure weed management programs are effective and based on sound science. Adapt management funding, priorities and strategies based on research findings.

I. ORGANIZATION and COORDINATION

Establishing an invasive plant management program in the MOA will require coordination and organization among many major land managers and stakeholders. All invasive plant programs, activities, and related communications within the MOA must be coordinated among state, local, and federal agencies and the private sector. Ultimately, the purpose of the invasive plant management plan is to prevent the introduction, establishment, and spread of invasive weeds in the MOA.

Objectives: Organization and Coordination

Hire a Municipality of Anchorage Invasive Plant Program Coordinator to organize, manage, and facilitate the MOA invasive plant management program.

Adopt the Anchorage Invasive Plant Management Plan as a recognized MOA document to be used as a guideline for land management on MOA-owned property.

Maintain an active CWMA partnership that includes regular meetings and collaborations. Incorporate consultation, input, and support from stakeholders and facilitate hands-on stewardship.

Develop a communication strategy that incorporates consultation, input, and support from stakeholders; education and engagement from stakeholders and the public; and stewardship that includes hands-on involvement. Develop an early alert program where cooperators and interested individuals from the community share the location of new infestations. Continue the efforts of the ANC-CWMA to educate stakeholders on how to respond to new infestations.

Maintain positive relations with the Anchorage Soil and Water Conservation District (ASWCD) that includes regular communication among ASWCD board members and CWMA partners.

II. EDUCATION AND OUTREACH

Creating awareness through education and outreach is a critical for long-term, successful defense against weeds. Prevention, detection, control, monitoring, restoration, and research should all incorporate outreach and education. Increasing awareness, addressing concerns, and changing individual behaviors are invaluable for investing stakeholders in weed management. Every educational message pertaining to weeds in the MOA must begin with how unique Alaska's natural resources are, and how important it is to protect these resources. Education can help people understand and modify their role in the dispersal and establishment of weeds by avoiding activities that spread weeds. Stakeholder understanding of what can be lost is critical for gaining support in the fight against invasive species.

Identifying and targeting key audiences for educational programs and information is essential for a successful educational campaign. Key audiences include but are not limited to: environmental groups, non-profit organizations, green industries, gardeners, elected officials, colleges and universities, military, sportsmen, landowners, and youth. Educational programs should provide these groups with presentations, hands-on opportunities at weed identification and control workshops, invitations to weed pulls and other community events, and should allow for feedback on curriculum and management plan development. Outreach programs should extend to the training of agency personnel and the general public in plant identification, reporting, management, and monitoring protocols. Weeds do not respect property boundaries, which makes every individual in the MOA a stakeholder.

The following education and outreach objectives are specific to the MOA and were compiled based on discussions among the members of the ANC-CWMA, as well as the following documents: Integrated Weed Management Strategy Focusing on Early Detection/Rapid Response for the Kenai Peninsula – Cooperative Weed Management Area (2007), and the Strategic Plan for Noxious and Invasive Plants Management in Alaska (2001).

Objectives: Education and Outreach

Educate lawmakers, community leaders, and budgetary decision makers by preparing briefing packages and hosting ANC-CWMA "weed tours" to keep elected officials up to date on funding and research needs.

Provide outreach to Community Councils with information on weeds in their area.

Regular media outreach. Record a weekly public radio spot (e.g. "weed of the week") during the growing season, generate a monthly newspaper article with photographs, develop and distribute informational brochures and flyers, and develop a general education Public Service Announcement for regular television and radio airplay.

Post and maintain weed identification signs and other outreach materials at trailheads, road turnouts, and other public places, including highly visible signs when and where weeds are in bloom. Develop interpretive signs to alert the public of the threat of invasive weeds and the efforts of the ANC-CWMA. Encourage educators and other groups to use parks and other public spaces as outdoor classrooms.

***Encourage the adoption of weed curricula by public and private schools*.** Facilitate workshops for teachers to learn the existing K-6 and 9-12 weed management curricula in Alaska. Work with curriculum developers to facilitate completion of the K-12 invasive weed curriculum for Alaska.

Continue the efforts of the Citizen Weed Warriors program by conducting periodic weed pull events that include (but are not limited to) groups such as garden clubs, Boy Scouts, church groups, recreation clubs, youth groups, and general volunteers. Conduct the weed pull events in highly visible areas with extensive media coverage.

Partner with garden suppliers, big box stores, and retail nurseries to educate consumers about weeds. Request that garden stores host volunteers in May and June to inform customers about weeds, address concerns, offer landscaping suggestions, and provide alternatives to practices that spread weeds.

Educating children about the effects in invasive plants on human and ecosystem health and the economy is an important part of any management plan.

Identify knowledgeable individuals as "weed trainers" and provide them with the tools to be weed-fighting ambassadors to their colleagues and neighbors. Work with CES to develop a training program to establish individuals as "weed trainers."

III. PREVENTION

The most cost effective strategy for managing weeds is to prevent them from ever being introduced. Prevention relies on a diverse set of tools and methods including communication, partnerships, monitoring, and education. Prevention includes identifying and protecting critical habitats and land where weeds have not established.

Understanding the biological characteristics of weeds that make them invasive will help to prevent the creation of environments where they best establish. Weeds establish in disturbed ground in part because of their rapid seed germination and fast growth (as compared to certain native plants) allowing them a competitive advantage. To counter this, disturbance or destruction of existing vegetation should be avoided. Such disturbance, resulting in bare soil and lack of competing vegetation, creates an ideal environment for weed establishment. When disturbance is necessary, as it often is for new construction and maintenance of existing structures and roadway), it is essential that the area is revegetated with native or non-invasive species immediately following the end of disturbance. Disturbed and revegetated areas should be monitored for weed establishment for several years. The area must be augmented with water when environmental conditions require, increasing the chance of survival for the new seeds.

The following prevention objectives are specific to the MOA and were compiled based on discussions among the members of the ANC-CWMA, as well as the following documents: Integrated Weed Management Strategy Focusing on Early Detection/Rapid Response for the Kenai Peninsula – Cooperative Weed Management Area (2007)**,** and the USDA Forest Service Guide to Noxious Weed Prevention Practices (2001).

Objectives: Prevention

Specify Best Management Practices (BMPs) for MOA and individual landowner projects and practices including specifics for the transportation sector, nurseries, tourists, and residents. This Plan does not suggest that BMPs are mandatory for owners or managers of private land, but landowners and managers that choose to follow BMPs will minimize the introduction and impact of invasive plants on their land. The BMPs outlined in Appendix 3 are a series of guidelines or minimum standards of effective, practical methods which prevent or reduce the introduction, establishment, and spread of invasive plants. BMPs offer site-specific prevention or control options. There may be more than one appropriate BMP for at any given site. A thorough understanding of BMPs and the flexibility in their application is of vital importance in selecting which practices to use. The practices must be effective and feasible (including technological, economic, and

institutional considerations) while avoiding or minimizing adverse impacts to natural and cultural resources and maintaining ecological integrity. Although it is unrealistic to expect that all weeds can be prevented or eliminated, BMPs should be used to minimize the introduction and impact of these species. In the absence of BMPs, weeds spread rapidly beyond management capability through a variety of vectors. Therefore, for example, BMPs may be different for the Department of Transportation (DOT), MOA maintenance department, construction crews, recreationists, and land owners.

Encourage the adoption of BMPs by all citizens, agencies, and businesses. Strategies include providing certifications for weed free products and businesses and free advertising for businesses that are "invasive species free." Educate homeowners and park users through free BMP clinics and brochures, as well as signs in parklands and along trails.

Require the adoption of invasive weed prevention and control measures in the Municipality of Anchorage Standards and Specifications (MASS)[6]. Ordinances must be written and approved, and enforcement personnel must be available to ensure that MASS are being followed.

***Maintain weed free areas*.** Identify, map, manage and maintain areas that are currently only vegetated by native and non-invasive species. Prioritize public lands, roadsides, water ways, and gravel pits, and closely manage disturbance in these areas. Maintain canopy shade and native undergrowth whenever reasonable and appropriate to inhibit growth of invasive plants.

For all projects involving revegetation, use naturally occurring revegetation where seed source and site conditions are favorable. When naturally occurring revegetation conditions are not favorable use native or non-invasive plant species. Give preference to plant materials from the local environment of the project area to maximize adaptation to that environment and to maintain local genetic composition.

Avoid or minimize human and vehicular passage in heavily infested areas.

[6] http://www.muni.org/Departments/purchasing/Pages/Mass.aspx

IV. EARLY DETECTION and RAPID RESPONSE (EDRR)

Purple loosestrife in Westchester Lagoon, Anchorage, AK.

Early detection and rapid response (EDRR) is a management approach designed to find small populations of invasive weeds and eradicate them before they spread to take advantage of the relative ease of control for small infestations. This strategy includes surveys, collection, identification, risk assessment, and response to new and emerging species. It is designed to ensure the timely implementation of effective management measures for the protection of MOA natural areas. This approach, as defined by the National Invasive Species Council (2003), is widely recognized as an effective strategy for preventing, controlling, and eradicating weeds once they are established. EDRR efforts should be focused first on lands that are not already infested with the species of concern, to keep “clean” lands free of weeds. Figure 1 is an adaptation of the conceptual EDRR framework proposed in Invasive Plant Early Detection and Rapid Response in British Columbia: An Initial Framework (2006).

Table 2: Framework of an EDRR Model

Process/Step	Role/Responsibility
1. Surveillance	Monitor for invasions with ongoing communication, education, and information sharing
2. Infestation Reporting	a. Report invasions to CES and AKNHP b. CES & AKNHP reports to ANC-CWMA and stakeholders c. Identify new (to the MOA) species
3. Infestation Distribution	Confirm the extent and distribution of the new infestation
4. Weed Risk Analysis	Assess environmental and economic risk; make recommendations. AKNHP ranking system may simplify this
5. Decision Making	Final decision by stakeholders on response and allocation of resources
6. Infestation Management	Stakeholders finalize and implement management plan
7. Communication	Regular updates to ANC-CWMA and AKEPIC
8. Monitoring/Outcome	Evaluate success of EDRR objectives, adapt strategies if necessary, and communicate the outcomes
9. Prevention	Implement prevention measures (see "Prevention" section of this Plan)

Through the efforts of many individuals and agencies, several of the necessary elements of an EDRR system are currently in place for the MOA, including baseline municipality-wide surveys[7], a non-native plant list for Anchorage and the State of Alaska, an invasive plant "watch" list (Appendix 2), and an invasive plant ranking system. There are individuals with invasive plant ID expertise, organized stakeholders, ongoing education on priority EDRR species, interested and active citizens, and a reporting database (AKEPIC). These efforts must be ongoing to stay abreast of new infestations and movements of known populations. Current knowledge of infestations is important for the development and adaptation of effective management strategies.

The following EDRR objectives were compiled based on discussions among the members of the ANC-CWMA, as well as the following documents: Integrated Weed Management Strategy Focusing on Early Detection/Rapid Response for the Kenai Peninsula – Cooperative Weed Management Area (2007), and the USDA Forest Service Guide to Noxious Weed Prevention Practices (2001).

[7] http://akweeds.uaa.alaska.edu/

Objectives: Early Detection and Rapid Response

Identify and resolve gaps in the current invasive weed inventory. Most of the data currently available are two or more years old and were not systematically collected. An updated and ongoing inventory of invasive weeds and their locations is imperative for management and setting management objectives, prescribing treatment methods, and prioritizing critical habitats to be protected.

Utilize the invasive plant "Watch list" (Appendix 2) of weeds that are currently not found within the MOA to implement prevention and/or EDRR programs in the event of an introduction.

Utilize ANC-CWMA signatories and cooperators to update inventory data, identify new invasive weeds, monitor known infestations and prioritize habitats for protection. Focus first on weed free areas, data gaps, outlying areas, habitat edges, and vectors such as road and waterways. Efforts of the ANC-CWMA will be complemented by the efforts of the Invasive Weed Program Coordinator, private volunteers, hired contractors, and student interns.

Educate municipal, state, and federal employees, landscapers and gardeners on weed identification and reporting. Hold workshops for employees that work in the field. Offer the workshops free of charge to landscapers, gardeners, and nurseries.

Gino Graziano maps purple loosestrive and reed canarygrass.

V. CONTROL

There is often a continuum between EDRR and control, and the line is between these two goals in the MOA is blurry. The likelihood of eradication is higher in the EDRR stage than in the control stage an infestation, given the generally smaller populations targeted in EDRR. EDRR efforts should have a large focus on "clean" lands with few or no infestations of the target species while control efforts should be focused first on the perimeters, travel corridors, and outlying populations of known infestations.

Canada thistle gone to seed in Anchorage, AK.

A single technique is rarely adequate for successful control of multiple species or infestations. Integrated Pest Management (IPM) takes an ecosystems approach to pest management that focuses on the biology of pests and their relationship to the environment. Strategies for IPM include the application of **mechanical, biological, cultural, and chemical controls**. These strategies are used to develop management techniques that limit the impact and spread of the pest. Integrated Pest Management strives to manage pest damage through the most economical means and with the least possible hazard to people, property, and the environment.

This Plan supports the application of an Integrated Weed Management (IWM) approach to control. IWM takes Integrated Pest Management principles and applies them to weed management. When used together, these principles are more effective for control than any single option. With IWM, all control options are considered. The use of all feasible and appropriate options, with respect to a particular species, in combination typically results in the most successful control program. IWM is species-specific (tailored to exploit the weaknesses of a particular weed species), site-specific, and designed to be practical and safe for humans and the environment. Specific treatment prescriptions are determined by the biology of the particular plant species, site characteristics, and management objectives.

CES can provide IWM recommendations and can be reached at (907) 786-6300. IWM control methods are well known for many species found in the MOA and must be prescribed on a species and infestation specific basis. AKNHP has compiled the natural history, distribution, and management recommendations for selected weeds found within the MOA (Cortes-Burns and Flagstad 2009). Successful control or

eradication of infestations typically requires several years of treatment and follow-up monitoring. Control of an infestation is generally considered successful when no occurrence of the species has been documented for five consecutive years of annual monitoring.

A prioritized list of weeds that have been detected in the MOA to date has been compiled based on the current AKEPIC data, an in-person round table meeting and subsequent discussions among professionals with invasive plant knowledge representing the following agencies, groups, and organizations: Alaska Department of Transportation; Alaska Natural Heritage Program; Anchorage Park Foundation; Bureau of Land Management; citizen volunteers; Municipality of Anchorage (Division of Parks and Recreation); National Park Service; Natural Resources Conservation Services; State of Alaska (Division of Agriculture, Forestry, and State Parks); University of Alaska Fairbanks Cooperative Extension Service; U.S. Fish and Wildlife Service; U.S. Forest Service.

107 non-native plant species currently known to occur in the Municipality were evaluated in this prioritization process. Considerations for placement included (but were not limited to):

1. Alaska Natural Heritage Program invasiveness ranking (http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm)
2. Number of infestations recorded in the Alaska Exotic Plant Information Clearinghouse database (AKEPIC; http://akweeds.uaa.alaska.edu/)
3. Known infestations undocumented in AKEPIC
4. Biology and difficulty of treatment of each plant
5. Public perception of each plant and the ramifications of the list placement
6. Status as ornamental, garden, nuisance, and/or crop plant

This list is designed to be used as a resource for developing weed control, monitoring, and research projects. It is a working list and must be revisited periodically, as needed, as more data become available. Weed control priorities in the MOA as of January 2010 are described in Table 1. The listed prioritization is a guideline and depends on financial and labor resources. The MOA must develop guidelines for controlling A and B-listed plants. The guidelines should be in a language easily understood and useful to the general public as well as professionals. The management priority of each species in Table 1 may depend on context:

- Any non-native plant documented only in gardens, planters, or pots in the Municipality are not on the list. The ornamental or garden plants that have made this list are those that have escaped cultivation in Alaska and/or have been proven to be invasive in other cold climates. **This definition is what differentiates orange hawkweed from broccoli.**

- Putting a species on the C or U-list does not imply abandoning all management. The U-list is an opportunity to list speicies that may pose a threat but have not yet presented a real problem in the Municipality. These species could represent projects for

volunteers and/or other reasonably inexpensive plant management projects. Questions regarding the management of specific species on this list may be directed to CES at (907) 786-6300.

Table 3: Prioritized management list of non-native plants in the Municipality of Anchorage

A-list: Non-native plant species that are considered invasive and have a limited distribution in the Municipality of Anchorage. Eradication of these species from the Municipality is the highest priority for management.

Species	Common name	AKNHP Rank
Polygonum cuspidatum	Japanese knotweed	87
Polygonum x *bohemicum*	bohemian knotweed	87
Centaurea stoebe	spotted knapweed	86
Lythrum salicaria	purple loosestrife	84
Impatiens glandulifera	ornamental jewelweed	82
Bromus tectorum	cheatgrass, downy brome	78
Medicago sativa ssp. *falcata*.	yellow alfalfa	64
Senecio jacobea	tansy ragwort, stinky Willie	63
Cirsium vulgare	bull thistle	61
Hypericum perforatum	common St. Johnswort	52
Tragopogon dubius	yellow salsify, goatsbeard	50
Myosotis scorpioides	marsh forget-me-not	Not ranked
Thlaspi arvense	pennycress	Not ranked

B-list: Non-native plant species that are considered invasive and relatively widespread in the Municipality of Anchorage. Preventing the spread of these species outside of the Municipality and into critical habitats within the Municipality is a high priority for management. Control and containment efforts must be focused along transportation corridors, nearby or on public lands, and on outlying infestations.

Species	Common name	AKNHP Rank
Phalaris arundinacea	reed canarygrass	83
Melilotus alba	white sweetclover	81
Hieracium aurantiacum	orange hawkweed	79
Cirsium arvense	Canada thistle	76
Prunus padus	European birdcherry	74

Species	Common name	AKNHP Rank
Sonchus arvensis	perennial sowthistle	73
Vicia cracca	bird vetch	73
Linaria vulgaris	butter and eggs	69
Melilotus officinalis	yellow sweet clover	69
Campanula rapunculoides	creeping bellflower	64
Bromus inermis spp. *inermis*	smooth brome	62
Leucanthemum vulgare	ox-eye daisy	61
Tanacetum vulgare	common tansy	57
Lupinus polyphyllus	large-leaf lupine	55
Ranunculus repens	creeping buttercup	54
Hieracium umbellatum	narrow-leaf hawkweed	51
Silene latifolia ssp. *alba*	bladder campion	45
Prunus virginiana	choke cherry	Not ranked
Ranunculus acris	tall buttercup	Not ranked

C-list: Non-native plant species that are widespread in the Municipality of Anchorage and the State of Alaska. Control of these plants is encouraged where practical to reach desired site conditions. Monitoring of these species for invasiveness is recommended where feasible.

Species	Common name	AKNHP Rank
Caragana arborescens	Siberian peashrub	66
Hordeum jubatum	foxtail barley	63
Elymus repens	quackgrass	59
Sorbus aucuparia	European mountain ash	59
Trifolium repens	white clover	59
Taraxacum officinale ssp. *officinale*	common dandelion	58
Trifolium hybridum	alsike clover	57
Crepis tectorum	narrow leaf hawksbeard	54
Phleum pratense	Timothy	54
Trifolium pratense	red clover	53
Poa pratensis spp. *pratensis* & spp. *irragata*	Kentucky & spreading bluegrass	52
Rumex acetosella	sheep sorel	51

Species	Common name	AKNHP Rank
Medicago lupulina	black medic	48
Rumex crispus	curled dock	48
Tripleurospermum inodorum	scentless false mayweed	48
Poa annua	annual bluegrass	46
Polygonum aviculare	Prostrate knotweed	45
Plantago major	common plantain	44
Anthemis cotula	stinking chamomile	41
Lolium perenne ssp. *perenne*	perennial rye grass	41
Capsella bursa-pastoris	shepherd's purse	40
Galeopsis bifida & *G. tetrahit*	splitlip hempnettle	40
Poa compressa	Canada bluegrass	39
Chenopodium album	lamb's quarters	37
Cerastium fontanum spp. *vulgare*	mouse-ear chickweed	36
Senecio vulgaris	common groundsel	36
Matricaria discoidea	pineappleweed	32
Spergula arvensis	Corn spurry	32
Lepidium densiflorum	common pepperweed	25
Alopecurus pratensis	meadow foxtail	Not ranked
Bromus hordeaceus	soft brome	Not ranked
Erucastrum gallicum	common dogmustard	Not ranked
Erysimum cheiranthoides	wormseed wallflower	Not ranked
Lolium perenne ssp. *multiflorum*	Italian rye grass	Not ranked
Papaver rhoeas	corn poppy	Not ranked
Polygonum lapathifolium	willow weed	Not ranked
Rosa rugosa	rugosa rose	Not ranked
Stellaria media	common chickweed	Not ranked
Viola tricolor	pansy	Not ranked

U-List: Non-native plant species that are of unknown invasiveness and priority in the Municipality of Anchorage. There are fewer than 10 recorded populations of each species in the AKEPIC database, and so swift action **may be** more critical than further study. A plant on the U list indicates that more information about state-wide distribution, observable impacts, spread rate, invasiveness is essential. Control and

eradication efforts should not divert substantial resources from high priority species (A & B lists) but should otherwise be initiated at the earliest opportunity.

Species	Common name	AKNHP Rank
Descurainia pinnata	western tansy mustard	41
Amaranthus retroflexus	redroot pigweed	Not ranked
Astragalus cicer	chickpea milkvetch	Not ranked
Berteroa incana	hoary false madwort	Not ranked
Brassica napus	turnip	Not ranked
Cerastium glomeratum	sticky chickweed	Not ranked
Cerastium tomentosum	snow in summer	Not ranked
Chaenorhinum minus	dwarf snapdragon	Not ranked
Conyza canadensis	Canadian horseweed	Not ranked
Coronilla varia	crownvetch	Not ranked
Elymus sibiricus	Siberian wild rye	Not ranked
Erodium cicutarium	redstem stork's bill	Not ranked
Euphrasia nemorosa	common eyebright	Not ranked
Hypochoeris radicata	cat's-ears	Not ranked
Leontodon autumnalis	fall dandelion	Not ranked
Linaria pinifolia	pineneedle toadflax	Not ranked
Lotus corniculatus	birdsfoot trefoil	Not ranked
Lychnis chalcedonica	maltesecross	Not ranked
Papaver nudicaule	Iceland poppy	Not ranked
Phalaris canariensis	Canary grass	Not ranked
Poa trivialis	rough bluegrass	Not ranked
Polygonum convolvulus	black bindweed	Not ranked
Polygonum persicaria	lady's-thumb	Not ranked
Raphanus sativus	cultivated radish	Not ranked
Rumex longifolius	garden dock	Not ranked
Senecio sylvaticus	woodland ragwort	Not ranked
Silene dioica	red catchfly	Not ranked
Silene latifolia	bladder campion	Not ranked

Species	Common name	AKNHP Rank
Sonchus asper	spiny sowthistle	Not ranked
Sonchus oleraceous	common sowthistle	Not ranked
Sorbaria sorbifolia	false spiraea	Not ranked
Spergularia rubra	purple sand spurry	Not ranked
Trifolium aureum	golden clover	Not ranked
Veronica peregrina ssp. *peregrina*	neckweed	Not ranked
Veronica serpyllifolia	thyme-leaf speedwell	Not ranked

Control Methods and Objectives

Land management goals must be determined before choosing a control strategy for any species or infestation. Due to the acute specificity of control objectives, few are outlined in this Plan. Land managers for each park and infestation much determine the specific goals and objectives for that situation. In general, control projects should be prioritized depending on funding and resources. Projects should focus on eradicating A-list species (Table 1) from the MOA and containing B-list species to prevent the spread of these species outside of the MOA and into "clean" lands within the MOA.

Control projects within the MOA will be determined annually by the ANC-CWMA and cooperators.

The ABC-U prioritized management list of non-native plants in the MOA should be revisited and revised annually or as necessary to ensure that control projects and funding is being prioritized appropriately.

A comprehensive map of all A and B-list infestations should be updated biannually or as necessary.

Choosing appropriate control actions requires a detailed knowledge of the biology and ecology of the target species. The selected control actions should be ones that are applied at the most effective time; least damaging to non-target species; safest for humans and the environment; and most likely to be effective, easily implemented, and cost-effective. The following control options will be considered on a site-specific and species-specific basis.

Mechanical Control

The use of mechanical methods for weed control can be effective on small infestations of annual, biennial and some perennial species without underground reserves. Used in conjunction with chemical control, hand pulling can also be effective when treating large

infestations of woody species such as *Prunus padus*. Hand pulling, digging, mowing, tilling, and burning are commonly used to remove or destroy plants or interfere with plant reproduction. Effective treatment must typically take place before seed production which varies by species but is generally by early July in the MOA. Plants must be removed from the site and destroyed, typically by incineration, landfill (except for species with seeds that can be easily dispersed en route) or, in select cases, burial. Repeated mowing or tilling during the growing season is required for many species, although this approach is not recommended for species that reproduce vegetatively. The maintenance staff of the MOA Parks and Recreation department will consult with local and regional weed experts to develop mow schedules each season that will most effectively reduce infestations in public parks.

Cultural Control

Cultural control practices are human activities that purposefully enhance and maintain the growth of desired vegetation. Cultural techniques manipulate the plant community through tilling (cutting through and turning over the soil), seeding, fertilizing, irrigating, and/or retaining canopy cover. Practices that retain, enhance, or introduce desirable plant species that out-compete weeds can be valuable prevention and control measures. Grazing and fire prescriptions that are designed to maintain or enhance vegetation or soil cover can slow the spread of weeds. Minimizing the extent and duration of disturbances and exposed soil and getting non-invasive vegetation established quickly during construction and management can also reduce the risk of establishment. Educating stakeholders and those involved in disturbance activities is an important part of establishing cultural control practices in a management area.

Cultural controls are best suited for gardens, farms, large restoration projects, or revegetating heavily disturbed areas. BMPs must be applied during projects employing cultural control techniques so as not to accidentally defeat the purpose of the control. After planting desirable species, weed species may germinate and establish if there is not adequate follow-up for monitoring and control. Inspecting and cleaning equipment before entering a disturbed site can significantly reduce the risk of importing seeds from infested sites to disturbed soils. For an detailed BMP recommendations refer to Appendix 3. Cost-share programs, such as those available through Natural Resources Conservation Service (NRCS), that assist landowners in developing and implementing quality programs can be effective cultural control.

Chemical Control

Herbicides, i.e. chemicals that kill plants or plant parts, are an effective and efficient tool for weed control. There are dozens of kinds of herbicides; some are derived from plants and others are manufactured synthetically. Herbicides are often grouped by activity, use, chemical family, or mode of action. See Appendix 4 for a brief description of the modes of action of different herbicides and a list of commonly used herbicides for weed control showing active ingredients and trade names. The choice of the best herbicide to use depends on the species of the target plant, surrounding plants, environmental conditions, land use, soil qualities, human and wildlife exposure, and distance to below and above-ground water sources.

Herbicides often provide the only effective and feasible control of rhizomatous species, infestations in remote areas, and on species for which hand pulling or cutting is not effective or feasible. Depending on the type of chemical used, herbicides have the least amount of impact on non-target species if they are used in a monoculture setting. Additionally, if applied in a specific manner according to the label, herbicides can be extremely effective in selectively removing weeds that are also mixed in with native vegetation. This approach reduces the amount of revegetation needed after the treatment is complete.

When used inappropriately, herbicides may damage or kill non-target plants; weeds may develop a resistance to certain herbicides; and herbicides may move beyond the area in which they were applied. Herbicide toxicity to humans and animals ranges from minimal to considerable, the latter being especially true when misused or in the event of an accident. Certain herbicides may not be used around or on water, an important consideration for weeds such as reed canarygrass and purple loosestrife that grow in wetlands or riparian areas. Some are classified as "restricted-use herbicides," whose application is limited by federal and state regulations. The MOA has specific rules and regulations in AMC 15.75[8]. Contact CES for direction on herbicide use in the MOA. Any herbicide label is a legal document. **THE LABEL IS THE LAW.** Alaska state regulations (18 AAC 90.300)[9] require pesticide applicators to be licensed and certified in order to:

1. Use, or supervise the use of, any pesticide for commercial purposes (on property other than the applicator's);
2. Provide information or consultation about commercial pesticide use;
3. Use, or supervise the use of, a pesticide at a school or public place;
4. Use, supervise the use of, purchase, or sell any restricted-use pesticide.

Herbicides are a particularly important method of treatment for certain species when complete eradication of a population is the management objective. Treatment at the earliest stage of invasion will greatly reduce the future need for additional herbicide applications. Chemical control methods, along with appropriate mechanical and cultural practices, are likely to be the most appropriate control methods for large infestations and for difficult to control perennial species in the MOA.

Biological Control

Biological control of weeds requires the deliberate introduction and establishment of a natural enemy of a particular species to reduce the target plant's competitive or reproductive capacities. Insects are the most common agents used although plant pathogens, such as fungi, are also effective. Grazers including goats and sheep have been found to be valuable assets in reducing densities and limiting the spread of some species. The use of biocontrol agents alone often does not lead to eradication, but instead reduces population density and spread to

[8] http://library5.municode.com/default-now/home.htm?infobase=12717&doc_action=whatsnew

[9] For more information on pesticide application in Alaska refer to the Alaska Department of Environmental Conservation website at http://www.dec.state.ak.us/eh/pest/cpa.htm

environmentally and economically acceptable levels when other methods become cost effective. Biological control can be a slow process, often requiring decades for discernable results, and it is most effective on dense weed infestations over large areas. As such, this is not expected to be a treatment option in the near future for the MOA, and no specific biological control objectives are outlined in this Plan.

VI. MONITORING

Monitoring (periodic observation and documentation) is vital to a successful weed control program and, like education, EDRR, and control, is an ongoing, dynamic process. The effectiveness of a weed control program can be evaluated with collection and analysis of information that determines the progress in meeting resource management objectives (Elzinga et al. 1998). A monitoring program can determine which objectives are not being met, which actions need to be modified, and which actions should be ceased because they are not working. Monitoring is essential for adaptive weed management.

The challenge of a monitoring program is to find a balance between the resources expended and the value of the information obtained. There is a direct relationship between the time required to collect information and the ability to determine if objectives are being met. Monitoring alone usually does not determine cause and effect; data can determine if a species decreased in abundance, but it cannot definitely determine if control actions *caused* the decline. Determining cause-and-effect requires replicated, controlled experiments, in which all relevant factors are closely controlled except for one that is varied (see the Research section of this document). Management goals, the prioritized species list, and recent invasive plant survey data are the most appropriate tools to use in deciding which, land, species, and infestations should be monitored for invasiveness, new introductions, and efficacy of treatment.

Choosing appropriate monitoring methods depends on the management objectives. **The AKEPIC protocol should be used as the standard for weed data collection in the MOA**[10]. Additional information such as polygon based mapping and photographs are often essential for effective monitoring programs.

The following monitoring objectives were compiled based on discussions among the members of the ANC-CWMA, as well as the following documents: Integrated Weed Management Strategy Focusing on Early Detection/Rapid Response for the Kenai Peninsula – Cooperative Weed Management Area (2007), the Strategic Plan for Noxious and Invasive Plant Management in Alaska (2001), and Creating an Integrated Weed Management Plan: A Handbook for Owners and Managers of Lands with Natural Values (2000).

Objectives: Monitoring

[10] http://akweeds.uaa.alaska.edu/

Establish at least a minimal level of monitoring for each high-priority weed species and infestation in the MOA.

Take and maintain photographic records of infestations over time. Photographs can be useful in documenting changes in weed populations over time, especially if they are taken from permanent locations (photo points) each time. Photographs work best for monitoring species which can be easily distinguished from other plants during flowering such as orange hawkweed (*Hieracium aurantiacum*), purple loosestrife, yellow toadflax (*Linaria vulgaris*), and spotted knapweed. The following is an excerpt on establishing photo points, adapted from Creating an Integrated Weed Management Plan: A Handbook for Owners and Managers of Lands with Natural Values (2000):

Select the location of the photo point so that all or nearly all of the infestation can be seen from the photo point. Mark the location of the photo point with a permanent marker or GPS point to enable it to be relocated for subsequent monitoring photographs. Some convenient permanent markers include metal fence posts or 2-foot lengths of 5/8-inch rebar driven into the ground and covered with an aluminum cap to prevent injury to people and wildlife. Take photographs when the target weed is most visible, usually at peak flowering. If possible, include obvious background features such as fences, trees, cliffs, and distant mountains as an aid to repeating the photograph with the same scene every year. Carry prints of last year's photographs mounted in plastic sleeves in the field to help frame the scenes correctly and to provide instant visual comparisons of weed abundance. Note the locations of the photo points on the map with an arrow showing the direction of the photograph, and give each point a unique number. Keep a log of pictures taken, matching the number of the photo with the number of the photo point and the scene being photographed. Enter the photo point number and the date on each photo file name as soon as possible.

Record infestation acreage and treatments in GIS or spreadsheet form to allow for graphical tracking of results over time. All records should be uploaded to AKEPIC for statewide tracking.

Include monitoring requirements for MOA contract work to ensure that weeds are searched for before and not introduced during MOA projects and that they are controlled if found. See Appendix 3 of this document for BMPs regarding monitoring and the Municipality of Anchorage Standards and Specifications[11] for information on specific requirements for contractors.

[11] http://www.muni.org/Departments/project_management/Pages/MASS.aspx

VII. RESEARCH

Research provides a scientific foundation for effective, sustainable, ecologically-based weed management. Understanding the fundamental principles governing plant population dynamics is crucial for successful weed management. The MOA needs research on weed issues including risk and impact assessment, prevention, weed ecology, plant population and community dynamics (modeling), IWM, and restoration. More effective weed management strategies must be developed to protect Alaska's natural areas, and the sharing of knowledge and information between researchers and land managers is vital for integrating new scientific knowledge into management. Management techniques that work in other parts of North America may be less effective or even harmful in Alaska. There is a need to identify which species have the greatest potential for establishment and spread in Alaska. Understanding how new invasive plants are introduced is critical to preventing other species from arriving through the same vector. The cost and impact of weeds given Alaska's unique conditions need to be determined. The MOA, as the epicenter of weed introductions in Alaska, has a responsibility to spearhead and support these kinds of research.

Research should focus on topics such as (but not limited to): restoration, enhancement and protection of greenbelts and parklands, and protecting native fish, wildlife, and plant populations. Studies should address plant ecological, physiological, or genetic processes that affect population success, population sustainability, competitive ability and invasiveness. All studies should address how weeds adapt to novel Alaskan environments and should be shared statewide through the Alaska Committee for Noxious and Invasive Plants Management (CNIPM).

The following research objectives were compiled based on discussions among the members of the ANC-CWMA, as well as the following documents: the Strategic Plan for Noxious and Invasive Plant Management in Alaska (2001), and the Montana Weed Management Plan (2008).

Objectives: Research

Quantify current and potential effects of weeds on the MOA's parkland ecosystems, including biodiversity change, nutrient cycling, hydrologic cycling, and energy flow. Develop models to estimate ecosystem change in response to weed invasion. Develop improved understanding about the relationships between soils, plants, and other key site properties that may influence the methods and outcomes of restoration efforts.

Identify and prioritize research needs for funding. Agencies, universities, and scientific, agricultural, horticultural, and recreational groups will be involved in identifying research needs. The ANC-CWMA will develop a process for gaining input. Research institutions will be encouraged to develop and initiate basic and applied research studies that are applicable to best management practices.

Conduct a municipality-wide economic assessment to ascertain the costs associated with the current state and potential spread of weeds. The economic assessment will evaluate recreational, aesthetic, environmental and health related costs and develop cost:benefit analysis tools for weed management strategies. It will be used to help people understand, in real numbers, the threats posed by weeds. The assessment will be used to encourage the public and elected officials to support and fund weed management and educational programs.

Systematically determine if unranked weeds on the ABC-U and Watch Lists may be problematic or become problematic. The AKEPIC invasiveness ranking system is a key tool for determining problematic species and, along with distribution data, is a foundation for this Plan.

Use simple, controlled experiments to examine population responses to mowing, pulling, tarping, and other management techniques. Investigate interactions among management strategies. Develop decision-support systems to forecast population dynamics to increase weed management efficiency.

Improve the effectiveness and use of herbicides by investigating response and persistence of desirable vegetation as well as the target weed(s). The reactions of weeds to herbicides in Alaska could be different than elsewhere in North America. Develop decision-support tools and demonstration sites for effective herbicide use.

Assess existing and potential pathways of invasion through inventory, survey and monitoring of established weeds. Determine relationships and interactions between environmental conditions, biodiversity, weed population dynamics, seed dispersal, disturbances, mowing, and other known or potential drivers of invasion. Identify invasion routes and mechanisms and develop models predicting invasion.

PLAN IMPLEMENTATION

I. Organization of Invasive Plant Management in Anchorage

Goal: Create and maintain a sustainable invasive plant management program in the Municipality of Anchorage

Objectives	Action Items	Anticipated Start	Cost Estimate	Funding Source	Evaluation Methods/ Milestones
Ensure all invasive plant programs, activities, and communications within the MOA are coordinated among state, local, and federal agencies & the private sector	• Hire an Invasive Plant Program Coordinator • Adopt the Anchorage Invasive Plant Management Plan • Maintain active CWMA • Maintain working relationship with Municipal Forester	2009 Ongoing	$100k for salary & benefits Office space & technical support	Federal and State cooperative agreements & grants	1. Hire a coordinator for a permanent position 2. Locate this position within MOA or Partner organization
Develop a communication strategy for invasive plant management in the MOA	• Incorporate consultation, input, and support from stakeholders to facilitate stewardship • Develop early alert program for cooperators & the community share the locations of new infestations • Continue CWMA efforts to educate stakeholders on how to respond to infestations	2010	To be determined	Federal, State, Municipality, ASWCD, and private landowner cooperative agreements and grants	1. Active CWMA as demonstrated by agency and citizen participation
Support communication and programs with private landowners	• Support ASWCD in private landowner programs • Maintain regular communication between ASWCD and the CWMA	2010	To be determined	AACD	1. ASWCD board members and CWMA partners regularly attend and communicate at monthly meetings

Prevent the spread of invasive weeds in Anchorage	• Develop species-specific EDRR plans	2010	To be determined	Federal, State, MOA, ASWCD, and private landowner cooperative agreements & grants	1. EDRR plans are developed for each species on the "A" list of the "Prioritized Management List of Non-native Plants in the Municipality of Anchorage"

II. Education and Outreach

Goal: Increase public and professional cognizance of invasive plants and their associated impacts. Educate about early detection, prevention, control, and how to minimize anthropomorphic roles in the establishment and spread of weeds.

Objectives	Action Items	Anticipated Start	Cost Estimate	Funding Source	Evaluation Methods/ Milestones
Illustrate to decision makers the budgetary implications of NOT responding to invasive plants of concern Provide outreach to Community Councils with information on weeds	• Prepare briefing packages that includes AKEPIC infestation location information • Host "weed tours" for elected officials and community council members • Prepare a presentation for the public and decision-makers	2011	$10 for printing materials CWMA staff time	State, Federal, local grants	1. Distribute a briefing package to and schedule a weed tour with all local elected officials and community councils
Regular media outreach	• Record a regular public radio and television spot during summer • Generate monthly newspaper article • Distribute brochures and flyers at public events • Distribute Public Service Announcements to the media • Host weed tours for media	2010 Ongoing	$20k for PSA development and distribution	State, Federal, local grants	1. Regular PSA airplay June-September 2. Regular attendance of CWMA members at public events

Post and maintain weed identification signs at public use areas	• Highlight current interpretive signs addressing invasive weeds • Develop interpretive signs to alert the public to invasive weeds and the efforts of the CWMA • Encourage educators and other groups to use parks and other public spaces as outdoor classrooms.	2010	CWMA staff time	CES AKNHP	1. *Prunus padus* interpretive sign in Valley of the Moon Park 2. Campbell creek interpretive trail signs are used in outdoor classroom lessons
Continue the Citizen Weed Warriors volunteer program	• Conduct periodic weed pull events with extensive media coverage	2010 Ongoing	$30k	USFWS Weed Warriors Grant	1. At least four weed pull events are advertised in the local media
Partner with garden suppliers, big box stores, and retail nurseries to educate consumers about weeds	• Request that garden stores host volunteers to address concerns, offer landscaping suggestions, & provide alternatives to practices that spread weeds	2011	CWMA staff time Volunteer time	N/A	1. At least two volunteer events are hosted
Identify knowledgeable individuals as “weed trainers”	• Develop a training program to establish individuals as “weed trainers” • Provide “weed trainers” with tools to be weed-fighting ambassadors to their colleagues and neighbors	2011	To be determined	CES	1. A weed trainer workshop is held to train individuals on weed identification and outreach

III. Prevention

Goal: Prevent the introduction of new invasive plant species to the MOA and prevent the spread of known infestations into weed free lands. Use Best Management Practices (BMPs) during MOA activities and encourage private landowners to use BMPs. Develop design criteria standards that reduce the impact of invasive plant vectors.

Objectives	Action Items	Anticipated Start	Cost Estimate	Funding Source	Evaluation Methods/ Milestones
Encourage the adoption of invasive plant Best Management Practices by all citizens, agencies, and businesses	• Provide certifications for weed free products and businesses and free advertising for businesses that are "weed free." • Educate homeowners and park users through free BMP clinics and brochures	2011	$5k for clinics and advertising	Cooperation among Federal, State, and Municipality sources	1. Hold at least one BMP clinic for Municipality employees and have it open to the public 2. Develop a certification process for businesses
Adopt invasive weed prevention and control measures in MOA Standards and Specifications (MASS)	• Hire a contractor to determine the most efficient and effective ways to incorporate invasive plant prevention and management into MASS	2012	$30k contract funds	Cooperation among Federal and State funds	1. Adopt invasive plant prevention strategies into MASS
Maintain weed free areas	• Hire an intern or technician to aid the Program Coordinator in Identify and map areas that are currently only vegetated by native and non-invasive species • Prioritize public lands and gravel pits for close management of disturbance • Maintain canopy shade and native plants	2012	$5k to hire mapping intern Staff time of Program Coordinator	Cooperation among Federal and State funds	1. Update Anchorage Invasive Plant Management Plan with information and critical habitat maps
Prevent the spread of invasive weeds in Anchorage	• Develop species-specific EDRR plans	2010	To be determined	Federal, State, Municipality, ASWCD, and private landowner cooperative agreements and grants	1. EDRR plans are developed for each species on the "A" list of the "Prioritized Management List of Non-native Plants in the Municipality of Anchorage"

IV. Early Detection and Rapid Response

Goal: Continually update weed and critical habitat survey and maps of known infestations. Promote early detection and rapid response (EDRR) practices for all MOA agencies. The primary long term goals of EDRR are detecting, identifying, reporting, and immediately eradicating or controlling suspected new plant species with populations in the MOA.

Objectives	Action Items	Anticipated Start	Cost Estimate	Funding Source	Evaluation Methods/ Milestones
Prevent the spread of invasive weeds in Anchorage	• Develop species-specific EDRR plans	2010	To be determined	Federal, State, Municipality, ASWCD, and private landowner cooperative agreements and grants	1. EDRR plans are developed for each species on the "A" list of the "Prioritized Management List of Non-native Plants in the Municipality of Anchorage"
Identify and resolve gaps in the current invasive weed inventory	• Hire a contractor to survey for invasive weeds on all main roads in the MOA	2011	$75k	USFS	1. Survey is completed 2. All data is uploaded to AKEPIC 3. A report with findings and maps is made available to the MOA and the public
Utilize the invasive plant "Watch List" (Appendix 3) as a guide for species to utilize prevention and/or EDRR practices	• Include the "Watch List" species in the 2011 MOA invasive plant survey • Publish the top ranked "Watch List" for the public	2011	$5k for development and printing costs	Cooperation among Federal and State funds	1. "Watch List" species are surveyed for and identified 2. Brochures are developed, published and distributed at events such as the AK State Fair
Utilize CWMA cooperators to update inventory data, identify new species, monitor infestations, and prioritize habitats for protection.	• Prioritize this objective as an agenda item at each CWMA meeting, especially during the growing season	2010	CWMA staff time	Federal, State, Municipality, ASWCD, and private landowner cooperation	1. A representative from each CWMA cooperator updates the group of new findings at monthly CWMA meetings
Educate municipal, state, and federal employees, landscapers, and gardeners on weed identification and reporting	• Hold workshops for employees working in the field • Offer workshops for free to landscapers, gardeners, and nurseries	2010	$10k for 10 workshops	Cooperation among Federal and State funds	1. Hire AKNHP, CES, or other knowledgeable instructors for workshops

V. Control

Goal: Prioritize weed species, infestations, and uninfested areas for control work within the MOA. Focus on Integrated Weed Management (IWM) strategies for control.

Objectives	Action Items	Anticipated Start	Cost Estimate	Funding Source	Evaluation Methods/ Milestones
Annually, or as necessary, revise and update the "Prioritized Management List of Non-native Plants in the Municipality of Anchorage"	• Hold a meeting, open to representatives of all invasive plant professionals, after the summer field season to discuss potential revisions	2010	Personnel time	State, Federal, MOA, ASWCD, non-profit groups, private citizens	1. The list is updated and made available to the MOA and public
Control projects within the MOA will be determined annually, before the start of the growing season	• Use AKEPIC data, the Invasive Plant Management Plan, and other available data to determine control priorities	2011	75k for control efforts Program Coordinator staff time	Cooperation among State, Federal, MOA, and ASWCD	1. Infestations of the "A" and "B" list species and infestations in priority areas are controlled and monitored

VI. and VII. Monitoring and Research

Goals: Develop a network of professionals and trained community members to monitor known infestations. Maintain data in publicly accessible databases. Restore ecosystems to a more natural state following the removal of infestations. Facilitate appropriate research activities to ensure weed management programs are based on sound science. Adapt funding, priorities and strategies based on research findings.

Objectives	Action Items	Anticipated Start	Cost Estimate	Funding Source	Evaluation Methods/ Milestones
Establish at least a minimal level of monitoring for each high-priority weed species and infestation in the MOA	• Use the data produced by the 2011 MOA invasive plant survey to determine priority infestations • Hire an annual technician to monitor & control infestations	2012	$8k	Cooperation among State and Federal funds	1. Control recommendations are produced, for priority infestations 2. Photographic records are produced for each infestation 3. Acreage and treatment methods are recorded for each infestation
Include monitoring and control requirements for MOA contract work	• Hire a contractor to determine the most efficient and effective ways to incorporate invasive plant monitoring into MOA contract work	2012	$30k contract funds; can be same contractor as "Prevention"	Cooperation among Federal and State funds	1. Invasive plant monitoring and control requirements are adopted into MOA contracts
Identify and prioritize research needs for funding	• Develop a process for gaining input from professionals and citizens to identify research needs • Encourage research institutions to develop & initiate research studies	2011	$5k to develop input process	State, Federal, MOA, ASWCD, non-profit groups, and Universities	1. A database for research findings and needs in the MOA is developed and shared among professionals and with the public
Quantify current and potential effects of weeds on the MOA's parkland ecosystems	• Hire a contractor to do predictive mapping and studies based on various infestation scenarios	2013	$50k	Special grants from State and Federal funds	1. Models are produced that improves understanding about the relationships between soils, plants, and other site characteristics of parklands in the MOA

Conduct a municipality-wide economic assessment to ascertain the cost associated with the current state and potential spread of weeds	• Hire a contractor to evaluate recreational, aesthetic, environmental, and health related costs	2012	$50k	Special grants from State and Federal funds	1. Cost:Benefit analysis tools are available for weed management 2. Share the economic assessment with the public and elected officials to win support for weed management and educational funding

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APPENDIX 1

NON-NATIVE PLANTS IN ALASKA RANKED BY THE ALASKA NATURAL HERITAGE PROGRAM INVASIVENESS RANKING SYSTEM

The Alaska Natural Heritage Program (AKNHP) and cooperators developed an invasiveness ranking system for non native plants in Alaska (Carlson et al. 2008). The species in **red bold** are recorded in AKEPIC to be within the MOA as of June 2009.

Species	Common Name	AKNHP Rank
Myriophyllum spicatum	Eurasian watermilfoil	90
Polygonum cuspidatum	**Japanese knotweed**	**87**
Centaurea stoebe	**spotted knapweed**	**86**
Lythrum salicaria & L. virgatum	**purple loosestrife**	**84**
Phalaris arundinacea	**reed canarygrass**	**83**
Impatiens glandulifera	**ornamental jewelweed**	**82**
Melilotus alba	**white sweet clover**	**80**
Nymphaea odorata ssp. *odorata*	white waterlilly	80
Hieracium aurantiacum	**orange hawkweed**	**79**
Bromus tectorum	**cheatgrass, downy brome**	**78**
Rubus discolor	Himalyan blackberry	77
Cirsium arvense	**Canada thistle**	**76**
Prunus padus	**European birdcherry**	**74**
Vicia cracca	**bird vetch, dog pea**	**73**
Alliaria petiolata	garlic mustard	70
Cytisus scoparius	English broom	69
Linaria vulgaris	**butter and eggs**	**69**
Caragana arborescens	**Siberian peashrub**	**66**
Lonicera tatarica	**bush honeysuckle**	**66**
Melilotus officinalis	**yellow sweet clover**	**65**
Campanula rapunculoides	**creeping bellflower**	**64**
Medicago sativa* ssp. *falcata	**yellow alfalfa**	**64**

Species	Common Name	AKNHP Rank
Hordeum jubatum	**foxtail barley**	**63**
Senecio jacobaea	**tansy ragwort**	**63**
Bromus inermis* ssp. *inermis	**smooth brome**	**62**
Cirsium vulgare	**bull thistle**	**61**
Leucanthemum vulgare	**ox-eye daisy**	**61**
Sonchus arvensis* ssp. *uliginosus	**perrennial southistle**	**61**
Hordeum murinum ssp. leporinum	leporinum barley	60
Elymus repens	**quackgrass**	**59**
Medicago sativa ssp. *sativa*	alfalfa	59
Sorbus aucuparia	**European moutain ash**	**59**
Trifolium repens	**white clover**	**59**
Convolvulus arvensis	field bindweed, morning glory	58
Taraxacum officinale* spp. *officinale	**common dandelion**	**58**
Gypsophila paniculata	baby's breath	57
Tanacetum vulgare	**common tansy**	**57**
Trifolium hybridum	**alsike clover**	**57**
Phleum pratense	**timothy**	**56**
Crepis tectorum	**narrow-leaf hawks beard**	**54**
Ranunculus repens	**creeping buttercup**	**54**
Stellaria media	**common chickweed**	**54**
Dactylis glomerata	orchardgrass	53
Trifolium pratense	**red clover**	**53**
Vicia villosa	winter vetch	53
Hypericum perforatum	**St. Johnswort**	**52**
Poa pratensis ssp. *pratensis*	rough bluegrass	52
Verbascum thapsus	common mullein	52
Digitalis purpurea	purple foxglove	51
Rumex acetosella	**sheep sorel**	**51**
Fallopia convolvulus	black bindweed	50
Tragopogon dubius	**yellow salsify, goatsbeard**	**50**
Glechoma hederacea	ground ivy	48

Species	Common Name	AKNHP Rank
Medicago lupulina	**bleck medic, hop clover**	**48**
Rumex crispus	**curled dock**	**48**
Tripleurospermum inodorum	**scentless mayweed**	**48**
Persicaria maculosa & P. lapathifolia	spotted ladysthumb	47
Achillea ptarmica	Sneezewort	46
Hieracium umbellatum	**narrowleaf hawkweed**	**46**
Poa annua	**annual bluegrass**	**46**
Polygonum aviculare	**prostrate knotweed**	**45**
Silene latifolia	**bladder campion**	**45**
Lappula squarrosa Dumort	European stickweed	44
Plantago major	**common plantain**	**44**
Cotula coronopifolia	common brassbuttons	42
Stellaria media (disturbed sites)	common chickweed	42
Anthemis cotula	**mayweed, stinking chamomile**	**41**
Descurainia pinnata	**western tansy mustard**	**41**
Hesperis matronalis	dame's rocket	41
Lolium perenne* ssp. *multiflorum	**perennial rye grass**	**41**
Capsella bursa-pastoris	**shepherd's purse**	**40**
Galeopsis bifida* and *G. tetrahit	**splitlip hemp-nettle**	**40**
Cerastium fontanum	**common mouse-ear chickweed**	**39**
Poa compressa	**Canada bluegrass**	**39**
Chenopodium album	**lamb's quarters**	**35**
Senecio vulgaris	**common groundsel**	**35**
Matricaria discoidea	**pineappleweed**	**32**
Mycelis muralis	wall lettuce	32
Spergula arvensis	**Spurry**	**32**
Lepidium densiflorum	**common pepperweed**	**25**

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APPENDIX 2

2010 MUNICIPALITY OF ANCHORAGE INVASIVE PLANT WATCH LIST

A. Invasive plants that have not been recorded in AKEPIC for the MOA but have been found elsewhere in Alaska

Species	Common Name	AKNHP Rank
Myriophyllum spicatum	Eurasian watermilfoil	90
Heracleum mantegazzianum	giant hogweed	81
Nymphaea odorata ssp. *odorata*	white waterlilly	80
Rubus discolor	Himalyan blackberry	77
Alliaria petiolata	garlic mustard	70
Cytisus scoparius	English broom	69
Lonicera tatarica	bush honeysuckle	66
Hordeum murinum ssp. *Leporinum*	leporinum barley	60
Medicago sativa ssp. *Sativa*	alfalfa	59
Convolvulus arvensis	field bindweed, morning glory	58
Gypsophila paniculata	baby's breath	57
Stellaria media (sea bird colonies)	common chickweed	54
Dactylis glomerata	orchardgrass	53
Vicia villosa	winter vetch	53
Poa pratensis ssp. *pratensis*	rough bluegrass	52
Verbascum thapsus	common mullein	52
Digitalis purpurea	purple foxglove	51
Fallopia convolvulus	black bindweed	50
Glechoma hederacea	ground ivy	48
Persicaria maculosa & P. lapathifolia	ladysthumb	47
Achillea ptarmica	sneezewort	46
Lappula squarrosa	European stickweed	44
Cotula coronopifolia	common brassbuttons	42
Hesperis matronalis	dame's rocket	41
Mycelis muralis	wall lettuce	32

B. Invasive plants that have not been recorded in Alaska but whose biology indicates a strong likelihood that they could appear in Alaskan ecosystems.

Species	Common Name	AKNHP Rank
Spartaina alterniflora, *S. angelica*, *S. densiflora*, *S. patens*	Atlantic cordgrass, saltmarsh grass, smooth cordgrass	86
Hydrilla verticillata	Hydrilla	80
Lepidium latifolium	perennial pepperweed, tall whitetop	72
Brachypodium sylvaticum	false-brome	70
Alnus glutinosa	European alder, black alder	61
Carduus nutans, *C. acanthoides*, *C. pycnocephalus, C. tenuiflorus*	musk thistle, plumeless thistle, Italian thistle	61
Potentilla recta	sulphur cinquefoil	57
Linaria dalmatica	Dalmatian toadflax	55
Zostera japonica	dwarf eelgrass	51

References

Carlson, M. L., Lapina, I. V., Shephard, M., Conn, J. S., Densmore, R., Spencer, P., Heys, J., Riley, J. and J. Nielsen. 2008. Invasiveness Ranking System for Non-Native Plants of Alaska. USDA Forest Service, R10, R10-TP-143. 218 pp.

APPENDIX 3
BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) are a series of guidelines or minimum standards of practical methods designed to prevent or reduce the introduction, establishment, and spread of weeds. This Plan does not suggest that BMPs are mandatory for owners or managers of private land, but landowners and managers that choose to follow BMPs will minimize the introduction and impact of invasive plants on their land. These practices must be effective and feasible while avoiding or minimizing adverse impacts to natural and cultural resources and maintaining ecological integrity. BMPs should achieve a balance between preventing and controlling weeds and the maintenance and development of land and road systems.

A thorough understanding of BMPs and the flexibility in their application are of vital importance in selecting which practices to use. BMPs offer site specific prevention or control and there may be more than one correct BMP to utilize at any give site. Therefore, BMPs may be different for the Department of Transportation (DOT), MOA maintenance department, construction crews, recreationists, and land owners. The intent of this guide is to promote better weed management on both public and private lands in the MOA. This appendix outlines environmentally responsible weed management methods which, when applied properly, minimize adverse impacts on ecosystems. Unusual situations may arise or strategies other than those recommended here may be more appropriate. In most cases, common sense is most often the best guide. BMPs are intended as concepts to be tailored by individuals or user groups.

The document is structured as in the following example, adapted from the Wisconsin Council on Forestry Forest Invasives document entitled: Best Management Practices for Preventing the Spread of Invasive Species by Outdoor Recreation Activities in Wisconsin:

Section Number: Example

BMP E-1: Weed BMPs are in bold and underlined with a number indicating the section and the BMP. These statements describe voluntary practices that reduce the impact of invasive species.

Suggestions:

- BMP Suggestions are listed below the BMP Statement.
- BMP Suggestions give more information about why the BMP is important.
- BMP Suggestions introduce items that could be used to address the BMP; they will not apply to every species or situation, and the user does not *necessarily* have to follow them to address the BMP (i.e., they are optional).

Section 1: Project Design and Planning

BMP P-1: Survey for weeds during the design phase of the project. The survey should be consistent with the extent and intensity of planned operations. Knowing which weeds are present, and where, is necessary to calculate risks and plan for appropriate management.
Suggestions:

- Integrate surveys into normal environmental assessments.
- The extent and intensity of the survey should reflect the potential threat posed by weeds that are in or are likely to occur in the area.
- The survey should include areas within and around the project vicinity, and at likely introduction sites such as access points, parking lots, and staging areas.
- The survey should include a buffer in accordance with disposal mechanisms of weeds present, accounting for wind, water, etc.
- Coordinate among multi-use entities for the same project area.

BMP P-2: Assess the threat of each weed infestation and plan for management accordingly.
Suggestions:

- Whenever possible, operations should be modified to avoid the further spread of weeds.
- Allocate time and resources for post-treatment follow-up control measures.
- Plan for management actions based on:
    1. Invasiveness of the weed species[12];
    2. Severity of the current infestation
        a. Modify project plans to limit movement of soil and equipment from infested project areas to non-infested areas;
    3. Additional habitat at risk for invasion;
    4. Economic and environmental impacts of the infestation and control actions.

BMP P-3: Prior to construction, plan activities to limit the potential for introduction and spread of weeds.
Suggestions:

- Planning includes developing budgets, schedules, and management options.
- Consider the likely response of weedy species when prescribing activities that result in soil disturbance or increased sunlight.

[12] Alaska Natural Heritage Program weed ranking project: http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm

- Time construction activities for optimum weed control
    1. Should control efforts occur prior to, after or concurrent with the activity?
    2. Can the activity be postponed until an infestation can be treated?
       *Note that effective pre-treatments may need to occur one or more years prior to the activity.
    3. What time of the season will minimize introduction and movement weeds?
- Plan for appropriate cleaning of equipment. Make prior arrangements for cleaning in conjunction with construction activities.
- Exclude weed infestations from activity boundaries.
- Plan to enter areas with weed infestations last.
- Avoid creating soil and site conditions that promote invasive plant germination and establishment. Minimize soil disturbance to no more than needed to meet project objectives.
    1. Consider the impacts of different types of equipment.
    2. Plan to retain soil and native vegetation in and around the activity area to the greatest extent possible.
- Whenever possible, plan to work under conditions that minimize the risk of spread, e.g., frozen ground, snow cover, absence of seeds/propagules, etc.

BMP P-4: Select appropriate species for revegetation and landscaping activities. DO NOT plant species known or suspected to be invasive in Alaska.

Suggestions:

- **Do not sell, purchase, or plant weeds or their propagules.** Table BMP1 is a list of species that are invasive in Alaska and should never be planted in the MOA. The table consists of species in the "A-list" and "B-list" of the ABC-U prioritized management list of non-native plants in the Municipality of Anchorage.This is not an all inclusive list. *Questions regarding specific species should be directed to the University of Alaska Cooperative Extension Services at (907) 786-6300.*

Table BMP1

Species	Common name
Campanula rapunculoides	creeping bellflower
Centaurea stoebe	spotted knapweed
Cirsium arvense	Canada thistle
Cirsium vulgare	bull thistle
Hieracium aurantiacum	orange hawkweed
Hieracium umbellatum	narrowleaf hawkweed
Hypericum perforatum	common St. Johnswort

Species	Common name
Impatiens glandulifera	ornamental jewelweed
Leucanthemum vulgare	ox-eye daisy
Linaria vulgaris	butter and eggs
Lupinus polyphyllus	large-leaf lupine
Lythrum salicaria	purple loosestrife
Medicago sativa ssp. *falcata*	yellow alfalfa
Melilotus alba	white sweet clover
Melilotus officinalis	yellow sweet clover
Myosotis scorpioides	marsh forget-me-not
Phalaris arundinacea	reed canarygrass
Polygonum cuspidatum	Japanese knotweed
Polygonum x *bohemicum*	bohemian knotweed
Prunus padus	European birdcherry
Prunus virginiana	choke cherry
Ranunculus acris	tall buttercup
Ranunculus repens	creeping buttercup
Senecio jacobea	tansy ragwort, stinky Willie
Silene latifolia ssp. *alba*	bladder campion
Sonchus arvensis	perennial sowthistle
Tanacetum vulgare	common tansy
Thlaspi arvense	pennycress
Tragopogon dubius	yellow salsify, goatsbeard
Vicia cracca	bird vetch, dog pea

- Identify sources of native and appropriate nonnative materials. Contact the Alaska Plant Materials Center at 907-745-4496 or visit http://dnr.alaska.gov/ag/NEWintroduction.htm for more information and an up-to-date Directory of Alaska Native Plant Sources
- When seeding and/or planting, use native species or non-native species that are not invasive.

BMP P-5: Do not purchase or sell plant or landscape material that suspected to be *infested* with weeds or their propagules.

Section 2: Soil Disturbance and Stabilization

BMP S-1: Minimize or avoid unnecessary soil disturbance. Use existing roads, access points, staging areas and alternative construction.
Ground disturbance may uproot existing vegetation and expose soil, creating a seedbed for weeds that overwhelm desirable vegetation.
Suggestions:

- After a soil disturbance, encourage prompt regeneration of desirable vegetation or cover exposed soil with a layer of mulch to reduce germination or introduction of weeds.
- Monitor work sites for weeds for a minimum of two years after project completion. Always treat new infestations.

BMP S-2: Minimize the introduction and spread of weeds during soil disturbance activities.
Suggestions:

- Excavated material from weed infested areas may be reused within the exact limits of the infestation.
- Excavated material that contains weedy plant material and is not reused within the limits of the infestation should be stockpiled until the remaining weedy material is destroyed.
- Store topsoil along the perimeter of the project for later use within the project site. If the stored topsoil will sit for longer than one growing season, seed it a native or non-invasive seed mix.

BMP S-3: Stabilize disturbed soils as soon as possible.
Suggestions:

- Materials such as fill, loam, mulch, hay, rip-rap, and gravel should ***not*** be brought into project areas from sites where weeds are known to occur. If the absence of weedy plant parts in these materials cannot be guaranteed, work sites should be monitored for the emergence of weeds for a minimum of two years after project completion.
- Use weed-free mulch, sand, and gravel. Weed free materials may not be necessary for buried layers

BMP S-4: Use non-invasive or native seeds and plants for revegetation. DO NOT plant species known or suspected to be invasive in Alaska.
Suggestions:

- **Do not sell, purchase, or plant weeds or their propagules.** Table BMP1 is a list of species that are invasive in Alaska and should never be planted in the MOA. The table consists of species in the "A-list" and "B-list" of the ABC-U prioritized management list of non-native plants in the Municipality of Anchorage. This is not an all inclusive list. *Questions regarding specific species should be directed to the University of Alaska Cooperative Extension Services at (907) 786-6300.*
- Identify sources of native and appropriate nonnative materials. *Contact the Alaska Plant Materials Center at 907-745-4496 or visit http://dnr.alaska.gov/ag/NEWintroduction.htm for more information and an up-to-date Directory of Alaska Native Plant Sources*

- When seeding and/or planting, use native species or non-native species that are not invasive. Use a non-persistent cover crop, such as annual rye or oats that can be used to temporarily stabilize the soil and discourage the establishment of invasive weeds.

Section 3: Movement and Maintenance of Equipment

BMP M-1: If work in areas containing weeds cannot be avoided, maintenance and construction equipment should be used in weed free areas first, then transported to infested areas whenever possible.

BMP M-2: Prior to moving equipment out of an infested area clean soils and propagules from exterior surfaces, to the extent practical.

Suggestions:

- All equipment, machinery, and hand tools should be cleaned of all visible soil and plant material before leaving the project site.
- Equipment should be cleaned at the sight of the infestation.
- Methods of cleaning include, but are not limited to (use most effective method that is practical):
    1. Brush, broom, or other hand tools (used without water);
    2. Car washes;
    3. High pressure air (diesel trucks may have air tank);
    4. Steam cleaning
- Do not clean equipment in or near water ways.

BMP M-3: Clean equipment during routine equipment maintenance activities.

BMP M-4: Use staging areas that are weed free to avoid spreading propagules.

Section 4: Revegetation and Landscaping BMP

BMP V-1 Use non-invasive or native seeds and plants for revegetation. DO NOT plant species known or suspected to be invasive in Alaska.

Suggestions:

- **Do not sell, purchase, or plant weeds or their propagules.** Table BMP1 is a list of species that are invasive in Alaska and should never be planted in the MOA. The table consists of species in the "A-list" and "B-list" of the ABC-U prioritized management list of non-native plants in the Municipality of Anchorage. This is not an all inclusive list. *Questions regarding specific species should be directed to the University of Alaska Cooperative Extension Services at (907) 786-6300.*

- Identify sources of native and appropriate nonnative materials. *Contact the Alaska Plant Materials Center at 907-745-4496 or visit http://dnr.alaska.gov/ag/NEWintroduction.htm for more information and an up-to-date Directory of Alaska Native Plant Sources*
- When seeding and/or planting, use native species or non-native species that are not invasive. Use a non-persistent cover crop, such as annual rye or oats that can be used to temporarily stabilize the soil and discourage the establishment of invasive weeds.

BMP V-2: Do not purchase, use, or sell plant or landscape material that are suspected to be *infested* with weeds or their propagules.

BMP V-3: Select plant materials that are site appropriate, healthy, and less susceptible to highly competitive weeds or other damaging pests and diseases. Diversify the planting material within the context of the project.
BMP V-4: Avoid unnecessary soil disturbance. See Section 2: Soil Disturbance and Stabilization.

BMP V-5: Inspect and clean clothing, footwear, and gear for soils and weed propagules before and after activities.
Suggestions:

- Carry appropriate cleaning equipment (i.e. wire brush, small screwdriver, boot brush) to help remove soil and plant propagules.
- Preferred locations for cleaning are those where weeds are already established and that are easily monitored for new infestations.
- Do not clean clothing, footwear, or gear in or near waterways.

BMP V-6: Prior to moving equipment out of an infested area clean soils and propagules from exterior surfaces, to the extent practical.
Suggestions:

- All equipment, machinery, and hand tools should be cleaned of all visible soil and plant material before leaving the project site.
- Equipment should be cleaned at the sight of the infestation.
- Methods of cleaning include, but are not limited to (use most effective method that is practical):
    1. Brush, broom, or other hand tools (used without water);
    2. Car washes;
    3. High pressure air (diesel trucks may have air tank);
    4. Steam cleaning
- Do not clean equipment in or near waterways.

BMP V-7: Revegetate disturbed soils as soon as feasible to minimize weed establishment.
Suggestions:

- Prior to revegetating, scout for and manage weeds that are germinating or resprouting within disturbed areas.
    1. Treatment options include herbicide use, tilling under, mowing, etc., and may be site or species specific.

- Mulching may aid revegetation. Use weed-free mulch.
- Utilize cover crops as temporary cover when there is a delay between disturbance and planting.

BMP V-8: Where site conditions permit, allow natural revegetation to occur.

Suggestions:

- Situations in which natural revegetation may occur include:
    1. The adjacent landscape contains no weeds.
    2. The adjacent landscape contains few weeds and the topsoil has been left intact.
    3. The adjacent landscape contains few weeds and the topsoil has been segregated and replaced during construction.
    4. The adjacent landscape is extensively infested by weeds and active revegetation will likely fail.
- While assessing the likelihood of natural revegetation, consider:
    1. Soil type
    2. Moisture levels
    3. Time of year

BMP V-9: Monitor and maintain revegetation sites.

Suggestions:

- Ensure that native or other non-invasive species have been used.
- Allow time and resources for post-activity follow-up control measures, due to persistent seed bank and resprouting.

BMP Section 5: Disposal of Vegetation and Infested Landscape Material

BMP D-1: Infested soils and weedy plant material must be covered for off site transportation.

BMP D-2: Avoid the use of wood chips, compost or other mulch that may contain weeds or their propagules.

BMP D-3: When weeds are cut or removed from a site, the spread of viable plant material must be avoided by rendering plant material nonviable.

The following methods can be used to destroy plant material:

- *Drying/Liquefying*: For large amounts of plant material or for plants with rigid stems, place the material on asphalt, tarps, or heavy plastic, and cover with tarps or heavy plastic to prevent the material from blowing away. For smaller amounts of plant material or for plants with pliable stems, bag the material in heavy-duty (3-mil or thicker) garbage bags. Keep plant material covered or

bagged for at least one month. Material is nonviable when it is partially decomposed, very slimy, or brittle. Once material is nonviable, it can be disposed of in a landfill or brush pile.

- *Brush Piles*: Plant material from most invasive plants can be piled on site to dry out. Care must be taken to pile stems so that cut surfaces are not in contact with the soil. **NOT recommended for:** Any weed with seeds or fruit attached, unless plants can be piled within the limits of the infestation.
- *Burying*: Plant material from most weeds can be buried a minimum of three feet below grade. This method is best used on a site that already has disturbed soils.
- *Burning*: Plant material should be taken to a designated burn pile or incinerator. All necessary permits must be obtained before burning.
- *Herbicide*: Herbicide applications must be carried out by a licensed applicator with a permit from the Alaska Department of Environmental Conservation. Care must be taken to apply the proper herbicide of the most appropriate phonological stage.

Section 6: Excavated Material

BMP E-1: Excavated material taken from sites with weed infestations must not be used away from the site of the infestation until all viable plant material is destroyed. See Section 5: Disposal of Vegetation and Infested Landscape Material, BMP D-3.
Suggestions:

- Excavated material from areas containing invasive plants may be reused within the *exact* limits of the infestation.

BMP E-2: Any excavated material that contains viable plant material and is not reused within the limits of the infestation must be stockpiled on an impervious surface until all viable plant material is destroyed OR the material must be disposed of by burying a minimum of three feet below grade.

BMP E-3: Infested soils and weedy plant material must be covered for off site transportation.

Section 7: Mowing

BMP Mow-1: Some weeds such as purple loosestrife, oxeye daisy, Japanese knotweed, bird vetch, and European bird cherry, have the ability to sprout from stem and root fragments. For a complete list of species that can sprout from stem and roots fragments, contact *University of Alaska Cooperative Extension Services at (907) 786-6300.* **Mowing small populations of these plants should be avoided.** Other control options should be utilized.
Suggestions:

- Stake roadside infestations of these plants as “do not mow.”

- **Mowing large populations of these plants can be a viable management technique if it done before seed set and the plant material is bagged and disposed of after mowing.**
- All plant material must be rendered nonviable and extra care should be taken to avoid spreading plant fragments (Section 5: Disposal of Vegetation and Infested Landscape Material).

BMP Mow-2: Mowing weedy areas should occur prior to seed maturation.

BMP Mow-3: Mowing equipment should be cleaned daily and prior to transport to prevent the spread of propagules. This is particularly important if mowing occurs after seed maturation (See section 3: Movement and Maintenance of Equipment, BMP M-2).

Section 8: Private Land Owners

BMP L-1: **Learn which plants are non-native and considered invasive in the Anchorage area and inventory your property for weed infestations.** Refer to Table 1 in the Municipality of Anchorage Invasive Plant Management Plan, or online: http://www.uaf.edu/ces/cnipm/plants.html and http://www.uaf.edu/ces/ipm/invasiveplants.html.

BMP L-2: DO NOT plant species known or suspected to be invasive in Alaska.
Suggestions:

- **Do not sell, purchase, or plant weeds or their propagules.** Table BMP1 is a list of species that are invasive in Alaska and should never be planted in the MOA. The table consists of species in the "A-list" and "B-list" of the ABC-U prioritized management list of non-native plants in the Municipality of Anchorage. This is not an all inclusive list. *Questions regarding specific species should be directed to the University of Alaska Cooperative Extension Services at (907) 786-6300.*
- Identify sources of native and appropriate nonnative materials. *Contact the Alaska Plant Materials Center at 907-745-4496 or visit http://dnr.alaska.gov/ag/NEWintroduction.htm for more information and an up-to-date Directory of Alaska Native Plant Sources*

BMP L-3: **Avoid creating conditions that promote weed germination and establishment.**
Suggestions:

- Minimize soil disturbance.
- Retain shade to the extent possible to suppress weeds.
- Retain native vegetation and topsoil as much as possible.

BMP L-4: Require all equipment to be cleaned and inspected for weeds and their propagules before arriving on your property.
Suggestions:

- Mark off known infestations and request equipment operators to work in these areas last.

BMP L-5: Salvage weed-seed-free topsoil and replace it on disturbed areas.

BMP L-6: Do not purchase, sell, or use landscape material that is suspected to be infested with weeds or their propagules.

BMP L-7: Chip local, non-invasive brush for mulch.
Suggestions:
- Mature seeds in the brush can help restore localized vegetation on the site.

BMP L-8: Use certified weed-free hay or straw.

BMP L-9: Inspect all ground-disturbing projects for at least three growing seasons following completion of the project.
Suggestions:
- Weed seeds often last 5 to 50 years in the soil and pieces of root as small as ½ inch can start a new plant and a new infestation.
- Plan for follow-up treatments if weeds are detected.

BMP L-10: Educate neighbors about the impacts caused by weeds, including the effects on property values.

Section 9: Recreation

BMP R-1: Learn which plants are non-native and considered invasive in the Anchorage area. Refer to Table 1 in the Municipality of Anchorage Invasive Plant Management Plan or online: http://www.uaf.edu/ces/cnipm/plants.html and http://www.uaf.edu/ces/ipm/invasiveplants.html

BMP R-2: Wear outer layers of clothing and footwear that are not "weed seed-friendly."
Suggestions:
- When appropriate (i.e. on dry, paved trails) wear low-tread footwear that does not hold soils, seeds, or other plant parts.
- Wear disposable shoe covers over footwear in infested areas or consider dedicating a pair of foot ware for use only on infested properties.
- Avoid exposing Velcro, bulky knits (*e.g.*, wool, fleece), pants with cuffs, and other fabrics or clothing styles that can carry seeds.

BMP R-3: Inspect and clean hair, clothing, footwear, and gear for soils, weeds and their propagules before and after recreating.

Suggestions:

- Use a stiff brush, stick, or small screwdriver to help remove soils, seeds, and plant parts.
- Cover or pull back long hair.
- Preferred locations for cleaning are those where:
    1. Invasive species are already established.
    2. Gear is unloaded and loaded
- Do not clean clothing, footwear, or gear in or near waterways.

BMP R-4: Prior to moving bicycles, equipment, vehicles, and trailers onto and off of an activity area, spray, scrape, or brush soils, seeds, and plant parts, from exterior surfaces.

Suggestions:

- Spray the undercarriage of all vehicles.
- Preferred locations for cleaning are those where:
    1. Invasive species are already established.
    2. Gear is unloaded and loaded
- Do not clean equipment, vehicles, or trailers in or near waterways.

BMP R-5: Inspect and remove soils, seeds, and plant parts from the coat and feet of animals and their clothing/gear before and after recreating.

Suggestions:

- Carry a grooming brush, shedding blade, small scissors, hoof knife, etc. to help remove soil and weed propagules from animals.
- Preferred locations for cleaning are those where:
    1. Invasive species are already established.
    2. Gear and animals are unloaded and loaded
- Do not clean animals in or near waterways.

BMP R-6: Properly dispose of soils, seeds, and plant parts found during inspection and cleaning. See Section 5: Disposal of Vegetation and Infested Landscape Material

BMP R-7: Stay on designated trails, roads, or other developed areas.

Suggestions:

- Minimize soil disturbance

- Destruction of native plants favors weeds.
- Avoid trails that are wet or muddy. If wet areas are encountered, go through them rather than around (if possible).

BMP R-8: When off trail, avoid areas that appear to be infested with weeds.
Suggestions:
- The chances of transporting soils, seeds, plant parts increase in heavily infested areas.
- Direct contact with some weeds can affect adversely human and animal health, including skin and eye irritation.

BMP R-9: Report weed infestations. To report weeds online: http://akweeds.uaa.alaska.edu/ or http://www.anchorageparkfoundation.org/projects/weedswarriors.htm, or contact Alaska Cooperative Extension Services at (907) 786-6300.

BMP R-10: Properly dispose of all animal waste.

BMP R-11: Do not pick plants. Discarded flower or seed heads can spread weed seeds.

BMP R12: When using off-road vehicles, minimize soil displacement from the trail/roadway and soil degradation.
Suggestions:
- Avoid sudden stops and quick directional changes with acceleration or braking.
- Stay on the trail/roadway to not widen it so there is little or no compaction or impact outside the trail/roadway.
- In the winter, ride only when there is adequate snow cover and when the trail is firm or frozen.

REFERENCES

Perron, C. New Hampshire Department of Transportation. 2008. Best Management Practices for Roadside Invasive Plants. 33pp. http://www.nh.gov/dot/bureaus/environment/documents.htm

Wisconsin Council on Forestry Forest Invasives Leadership Team. 2009. Best Management Practices for Preventing the Spread of Invasive Species by Outdoor Recreation Activities in Wisconsin. 42pp. http://dnr.wi.gov/forestry/usesof/bmp/pdf/FinalDraft-RecreationBMPS-090204.pdf

Wisconsin Council on Forestry Forest Invasives Leadership Team. 2008. Best Management Practices for Transportation and Utility Rights-of-Way. 61pp.

APPENDIX 4

A. HERBICIDE MODES OF ACTION

Herbicide use is an important part of Integrated Weed Management. Herbicides are variable; their use depends on the species of the target plant, surrounding plants, environmental conditions, land use, soil qualities, human and wildlife exposure, and distance to water sources. Depending on the herbicide, these chemicals may be biologically or synthetically based. Herbicides are often grouped by their mode of action (the manner in which the herbicide affects a plant). Herbicides that have the same mode-of-action will have the same translocation (movement) pattern and produce similar injury symptoms. Species specificity and behavior are often similar for herbicides with the same mode-of-action. The following is a brief description of the modes of action of foliar and soil applied herbicides, followed by a list of commonly used herbicides for weed control, with active ingredients, and trade names.

FOLIAR-APPLIED HERBICIDES

Mode-of-Action	Movement	Chemistry Group	Control Target	Notable Symptoms
Symplastic	Downward			
		Auxin Growth Regulators	broadleafs and grasses	immediate bending/twisting of leaves; abnormal roots; delayed flowers
		Amino Acid Inhibitors (aromatic)	annuals and perrenials	yellowing of new growth; days or weeks to die
		Amino Acid Inhibitors (branched chain)	broadleaf annuals and grasses	stunted root growth; odd plant coloring; weeks or months to die
		Grass Meristem Destroyers	most grasses	tissue destruction near nodes of plants
Apoplastic	Upward			
		Photosynthetic Inhibitors	general vegetation control	chlorosis followed by tissue death; old growth affected first
Contact	No movement; react at point of contact			
		Cell Membrane Disruptors	non-specific	yellowing of tissue within hours, complete death within a week

SOIL-APPLIED HERBICIDES

Mode-of-Action	Control Target	Notable Symptoms	Soil Persistence
Root Inhibitors	Pre-emergence seedling grasses	club-shaped, stunted, or purple roots; no root growth or nutrient absorbtion	Generally not water soluble; do not readily leach from soils
Shoot Inhibitors	Pre-emergence to control seedling grasses, some broadleaf plants, and some perennials from tubers and rhizomes	twisted, dark-green shoots and leaves	Can persist in the soil for months

B. COMMONLY USED, ALASKA DEC-APPROVED HERBICIDES WITH ACTIVE INGREDIENTS AND TRADE NAMES

Herbicide Classification	Chemical Name	Herbicide Trade Name
Auxin Growth Regulators		
	2,4-D	2,4-D/Vigoro/Sta-Green
	2,4-DP	Whiteout
	clopyralid	Redeem/ Lontrel
	dicamba	Arctic Gro/Bandini/Vigoro
	MCPA	MCPA/Solve
	MCPP	MCPP/Winterizer
	triclopyr	Garlon
Amino Acid Inhibitors		
Aromatic		
	glyphosate	Roundup Ultra/ Rodeo/ Accord
Branched-Chain		
	chlorsulfuron	Glean/Telar/Landmark
	imazapyr	Imazapyr/Lineage/Sarhara DG
	imazethapyr	Tackle
	metsulfuron	Ally/Cimarron
	nicosulfuron	Stout
	sulfometuron	Oust/Landmark/Throttle
	thifensulfuron	Harmony/Stout
	tribenuron	Harmony/Nimble/T-Square

Herbicide Classification	Chemical Name	Herbicide Trade Name
Chlorophyll Pigment Inhibitors		
	fluridone	Sonar
Grass Meristem Destroyers		
	clethodim	Intensity
	fenoxaprop	Acclaim
	quizalofop	Assure II
	sethoxydim	Grass Getter
Photosynthetic Inhibitors		
	hexazinone	Velpar/Velossa/Westar
	metribuzin	Sencor/ Metribuzin DF
	prometon	Pramitol/Total Kill
	simazine	Pramitol
Cell Membrane Disruptors		
	crisquat	Gramoxone/Paraquat
	diquat	Spectracide/Roundup
	oxyfluorfen	Goal
Root Inhibitors		
	benefin	Green Thumb
	oryzalin	Surflan/Weed Impede
	pendimethalin	Prowl/Pendulum/Turf Builder
	prodiamine	Eliminator/ Turfking
	trifluralin	Biobarrier/Miracle-Gro/Treflan
Shoot Inhibitors		
	dimethenamid	Frontier

References

Ross, M.A. and D. J. Childs. 1996. Herbicide mode-of-action summary. Cooperative Extension Service Publication WS-23, Purdue University, West Lafayette, IN. http://www.agcom.purdue.edu/AgCom/Pubs/WS/WS-23.html

State of Alaska Departnemtn of Environmental Conservation Pesticide Control Program: http://www.dec.state.ak.us/eh/pest/index.htm