Lassen Volcanic

National Park Service
U.S. Department of the Interior

Lassen Volcanic National Park

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Weed Management Plan
and
Environmental Assessment

March 2008

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1.0 INTRODUCTION

1.1 PURPOSE AND NEED FOR TAKING ACTION

The increase in distribution and dominance of exotic species has lead to competition with native species and the disruption of ecological systems (Vitousek 1986; Lovich and others 1994). Unique geomorphic sites and plant communities are particularly vulnerable to the invasion of exotic species. Systems limited by water and nutrients, such as arid lands, riparian areas, and springs play an integral role in flora and fauna composition and are the primary sites for disturbance by agriculture, ranching, and urbanization (Asplund and Gooch 1988; Atchley and others 1999). The disruption of the geomorphological and hydrological processes by land-use practices affect the diversity of the physical environment.

Successful exotic species have several characteristics in common: (1) their native habitat and the "reception" area are similar in climate, plant lifeforms, and soil; (2) they have a generalized seed dispersal mechanism (wind, water, or animal) allowing it to be carried to the "reception" area and spread; (3) they are successful in areas where few native species reproduce successfully by seed (Baker 1986); (4) they have rapid growth, flowers early, and produces a large number of seeds; (5) they have a wide range of phenotypic "plasticity" (6) its germination "polymorphism" allows some seeds to germinate immediately and others to germinate much later; and (7) their seeds have the ability to establish within a wide range of photoperiods and temperature conditions (Baker 1965; Mulligan 1965; Pimental 1986).

Communities with a high frequency of disturbance and/or are adjacent to disturbed land, such as grasslands, riparian areas, waterways, roadsides, sand dunes, and some forests, are highly susceptible to the establishment of exotic species. Resource extraction and housing developments are common disturbances (Baker 1986). Elton (1958) first suggested the link between disturbance and species invasion with little understanding of why disturbed and island communities are more susceptible than undisturbed and non-island communities (Orians 1986). Disturbance may alter inter-species competition, predator-prey relationships, and physical stresses by increasing levels of certain resources (Orians 1986). The "invader" has an advantage over more sensitive species when these factors are present. The disturbance history of a community will often determine the distribution of a species (Brown and Brown 1996).

The increasing rate in which native plant species are being displaced by exotic plant species is of concern to both scientific and non-scientific communities. Numerous conferences and organizations have been established to address this issue which some scientists consider one of the foremost challenges of resource managers and the single greatest threat to biodiversity on a global scale (Lovich and others 1994). The number of studies published on exotic species has sharply increased since the mid-1980s. For example, the Journal of Ecological Abstracts has published approximately 100 new articles each year on this subject from 1993-1995 compared to the 872 total published from 1973-1993 (Pyšek 1995b).

Lassen Volcanic National Park (LVNP) proposes to implement a plan to manage invasive (weedy) plants and native plant species within the Park boundaries. Although LVNP has a relatively low number of exotic species compared to other National Parks in California, most infested sites are in habitats with very high native biological diversity (riparian areas and meadows) and there is considerable potential for further spread. Currently, no native species are considered "weedy". Some, cattail and white fir (*Typha* spp. and *Abies concolor)* have the potential to negatively impact rare plants and desired vegetation communities. LVNP is in an opportunistic management position to be proactive and prevent larger infestations from occurring and reducing the risk of new invasions.

· **This document follows the style and format of *Ecological Applications.***

The purpose of The Lassen Volcanic National Park Weed Management Plan (LVNP WMP) is to:

- Decrease weed plant cover and increase native plant cover
- Document and standardize best management practices to more effectively meet goals and objectives
- Provide options or tools to managers in reducing the threat to natural and cultural resources
- Use monitoring to more effectively implement and adapt management practices
- Determine the minimum tool/treatment or combinations of treatments that support Wilderness Values to restore functioning native plant communities
- Develop a document that will meet required federal and state environmental compliance
- Develop a document will provide future direction for weed-related projects that fall under its scope
- Restore native plant communities and wildlife habitat to reduce the park resources dedicated to weed removal

National Park Service (NPS) Director's Order 12 (DO-12): Conservation Planning, Environmental Impact Analysis, and Decision-making defines the term *need* as: the existing condition that should be changed, problems that should be remedied, decisions that should be made, and policies or mandates that should be implemented. Based on this definition, the following needs have been identified for this project:

Existing conditions that should be changed:

Exotic plants threaten natural and cultural resources, including cultural landscapes and wilderness, within the park and there is no planning document in place to guide their management.

Control of invasive weeds within wilderness is needed in order to preserve and restore the characteristics that are vital to the wilderness experience.

Problems that should be remedied:

Resource managers need to be able to select and implement the most appropriate management tools in the future.

Decisions that should be made:

A comprehensive evaluation of potential impacts associated with exotic plant management is needed to determine the appropriate methods of weed management for LVNP.

Standardized survey, treatment, and monitoring methods need to be determined and implemented.

A standardized decision-making process is needed so that management decisions can be easily communicated and explained to the public.

Policies or mandates that should be implemented:

A WMP is needed to ensure that relevant policies and mandates are implemented (see Chapters 1.3, 1.4, 1.5, and 2.1 of this document for further discussion about policies and mandates).

1.2 DEFINITIONS

In Pyšek's (1995a) review of 1172 papers on exotic species studies, he found 14 terms were used to describe a species' status or dynamics of its behavior. Most of these papers did not define these terms. Species are considered native if their occurrence in an ecosystem is independent of human activities and if it arrived before the Neolithic period (ca. 5000-6000 years B.C.) even if introduced by humans. Before the Neolithic period, human-caused species dispersal can be considered equivalent to animal-caused. The following terminology is based on a species' status as native/non-native and by whether or not it is expanding (Webb 1985). Terms underlined will be used consistently throughout this document.

Native (indigenous) species arrived in an area independent of human activities or before the neolithic period.
Exotic (introduced, alien, adventive, weed) species reached an area by neolithic or post-neolithic human activities, or via domestic animals.
Invasive (naturalized, weed) species are exotics whose abundance or distribution is increasing.
Expanding species are native species whose abundance and distribution are increasing.

The NPS defines exotic species as "those species that occupy or could occupy park lands directly or indirectly as the result of deliberate or accidental human activities… Because an exotic species did not evolve in concert with the species native to the place, the exotic species is not a natural component of the natural ecosystem at that place. Genetically modified organisms exist solely due to human activities and therefore are managed as exotic species in parks "(NPS 2006, 4.4.1.3). This definition allows the distinction between changes caused by natural range expansions of native species and those caused by human introduced species.

For clarity and consistency, the definitions and terms outlined by the NPS shall be used throughout this document. Native species are defined as "all species that have occurred, now occur, or may occur as a result of natural processes on lands designated as units of the National Park system. Native species in a place are evolving in concert with each other. "

Appendix 8.14 contains a full glossary of terms used within this document.

1.3 BACKGROUND

1.3.1 The Park

LVNP is located approximately 50 miles (80 kilometers) from Redding and Red Bluff, California and 32 miles (51.5 kilometers) from Chester, California, it was established by an Act of Congress on August 9, 1916 (39 Stat. 442)

> ". . . for recreation purposes by the public and for the preservation from injury or spoliation of all timber, mineral deposits and natural curiosities or wonders within said park and their retention in their natural condition and to… provide against the wanton destruction of the fish and game found within said park and against their capture or destruction. . ."

Incorporated into the Park were the previously designated Cinder Cone and Lassen Peak National Monuments, which were established in 1907 as part of the Lassen Peak Forest Reserve. Portions of the Park lie in four different counties (Tehama, Plumas, Lassen and Shasta), with most being in Shasta County.

Lassen Volcanic National Park covers approximately 166.2 square miles (106,368 acres) of the southernmost peaks of the Cascade Mountain range just north of the Sierra Nevada (Appendix 8.1). Elevations in the Park vary from 5,300 feet (1,616 meters) at Warner Valley to 10,247 feet (3,123 meters) atop Lassen Peak. Because the Park is located near the junction of two mountain ranges and comes close to the Great Basin Province as well, plant diversity is great and the Park contains overlapping ranges of species common to each of these unique areas. According to the General Management Plan (NPS 2003), the diversity of geologic formations and chemical and textural compositions of lava have also resulted in a wide diversity of plants in these communities and many anomalies to the altitudinal life zones. This results in exceptionally high biodiversity in the Park, with 779 species of plants, 57 species of mammals, 215 species of birds, 15 species of reptiles and amphibians and an unknown number of invertebrate species.

1.3.2 Exotic Species

The *Flora of Lassen Volcanic National Park* provides a comprehensive treatment of all species in LVNP and has been recently revised (Oswald and others 1995). A recent reassessment of exotic species that either occur within the Park or immediately adjacent recorded 59 species (Appendix 8.2). This list includes four species which do not currently exist within the Park but have a high potential for spread and are anticipated to be a potential problem in the future. These include squarrose knapweed (*Centaurea virgata)* found near Old Station, spotted knapweed (*Centaurea stoebe*) near Lake Almanor, Scotch broom (moving up from foothills), and yellow star thistle (Hwy 89 and 36 outside of Park). Currently, several invasive species are targeted for management in the Park. Bull thistle (*Cirsium vulgare*) and woolly mullein (*Verbascum thapsus*) are the two most widespread weeds in the Park. Intermediate wheatgrass (*Elytrigia intermedia ssp. intermedia*) and smooth brome (*Bromus inermis*) are found in the southwest corner of the Park near the old ski slope. These 4 species are the main targets of the Park's current weed treatment activities. In addition, oxeye daisy (*Leucanthemum vulgare*), dalmation toadflax (*Linaria genistifolia ssp. dalmatica*), St. John's Wort (*Hypericum perforatum*), foxglove (*Digitalis purpurea*), and chicory (*Chicorium intybus*) are targets of treatment efforts at the Park headquarters in Mineral. Yellow salsify (*Tragopogon dubium*) is widely distributed but not abundant in disturbed areas. Other exotic species such as dandelion (*Taraxacum officinale*) and self-heal (*Prunella vulgaris*) are found in moist or disturbed areas of the Park, but are not currently targeted for treatment. Surveys in 2003 found a population of five Canada thistle (*Cirsium arvense*) on the west shore of Snag Lake, but a repeated survey in 2005 discovered no plants. Canada thistle is also found in the sewage mounds area near the southwest Park entrance. A stray Himalayan Blackberry (*Rubus aremeniacus*) is being targeted at headquarters, Terminal Geyser, and Manzanita Lake. Reed canary grass (*Phalaris arundinacea*) and tall wheatgrass (*Elytrigia elongata*) were found at the Warner Valley horse corral, but their status as weeds in California is unclear. Cheatgrass (*Bromus tectorum*) was mapped in 2005 on the edge of Butte Lake and at the Manzanita Lake ranger station.

An ecological assessment that was completed in 2007 found that a total of 59 exotic species occur within the Park or immediately adjacent to the Park such that they posed a threat of spreading into it (Klinger 2007). NatureServe, in cooperation with The Nature Conservancy and the U.S. National Park Service, developed the Invasive Species Assessment Protocol as a tool for assessing, categorizing, and listing non-native invasive vascular plants according to their impact on native species and natural biodiversity in a large geographical area such as a nation, state, province, or ecological region. The protocol is designed to make the process of assessing and listing invasive plants objective and systematic, and to incorporate scientific documentation of the information used to determine each species' rank (Appendix 8.2).

1.4 COMPLIANCE

This plan has been prepared in compliance with:

The National Environmental Policy Act (NEPA) of 1969 (42 United States Code (USC) 4321 et seq.), which requires an environmental analysis for major Federal Actions having the potential to impact the quality of the human environment;

Council of Environmental Quality Regulations at 40 Code of Federal Regulations (CFR) 1500-1508, which implement the requirements of NEPA;

The National Historic Preservation Act (NHPA) (16 USC 470 et seq.), which requires protection of historic properties significant to the Nation's heritage;

The Wilderness Act (16 USC 1131 et seq.), which requires the preservation of wilderness character and wilderness resources in an unimpaired condition for the park's 78,982 acres of Congressionally designated wilderness;

The Endangered Species Act of 1973 (ESA) (19 U.S.C. 1536 (c), 50 CFR 402), which requires that the effects of any agency action that may affect endangered, threatened, or proposed species must be evaluated in consultation with either the United States Fish & Wildlife Service (USFWS) or National Marine & Fisheries Study (NMFS), as appropriate;

Clean Water Act of 1972, as amended (CWA) (33 USC 1251-1387), which requires the protection of the chemical, physical, and biological integrity of the Nation's waters;

Executive Order 11990, "Protection of Wetlands", which requires federal agencies to avoid, where possible, impacts on wetlands;

NPS Conservation Planning, Environmental Impact Analysis, and Decision Making: Director's Order #12 and Handbook;

NPS Director's Order #77- 7: Integrated Pest Management requires proposed pest management activities be conducted according to the IPM process therein; and

Lassen Volcanic National Park General Management Plan (2002) wherein the management of 25,000 acres proposed to be designated as Wilderness is defined.

This plan was developed over 4 years with internal and external interdisciplinary input, and reviewed by appropriate subject matter experts in collaboration with adjacent communities, interest groups, state and federal agencies.

1.5 LEGAL AUTHORITIES FOR THIS PLAN

The management of NPS programs is guided by the Constitution, public laws, treaties, proclamations, Executive Orders, regulations, and directives of the Secretary of the Interior and the Assistant Secretary for Fish and Wildlife and Parks.

NPS policy guidelines, planning documents, and actions plans, such as this Weed Management Plan, must be consistent with these higher authorities, and with appropriate delegations of authority. Authority to implement this plan is found in 16 USC 1 through 4 (National Park Service Organic Act), and delegations of authority found in Part 245 of the Department of the Interior Manual.

1.6 PRIMARY ISSUES

The primary issues driving the actions considered in this EA include: (1) soils, (2) water resources, (3) wetlands, (4) vegetation, (5) wildlife, (6) special status species, (7) archeology (8) visitor experience, (9) park operations, and (10) wilderness values.

2.0 RELATIONSHIP TO OTHER LAND MANAGEMENT POLICIES

2.1 NATIONAL PARK POLICY

NPS *Management Policies* 2006 (NPS 2006) is the basic Service-wide policy document of the National Park Service. It is the highest of three levels of guidance documents in the NPS Directives System. The Directives System is designed to provide NPS management and staff with information on NPS policy and required and/or recommended actions, as well as any other information that will help them manage parks and programs effectively.

According to the Management Policies (NPS 2006), plans should be "feasible and effective" and managers should:

> "(1) evaluate the species' current or potential impact on park resources; (2) develop and implement exotic species management plans according to established planning procedures; (3) consult, as appropriate, with federal, tribal, local, and state agencies as well as other interested groups; and (4) invite public review and comment, where appropriate."

Section 4.4.4 *Management of Exotic Species* directs that:
Exotic species will not be allowed to displace native species if displacement can be prevented. All exotic plant and animal species that are not maintained to meet an identified park purpose will be managed—up to and including eradication—if (1) control is prudent and feasible, and (2) the exotic species :

- Interferes with natural processes and the perpetuation of natural features, native species or natural habitats or
- disrupts the genetic integrity of native species, or
- disrupts the accurate presentation of a cultural landscape, or
- damages cultural resources, or
- significantly hampers the management of park or adjacent lands, or
- poses a public health hazard as advised by the U. S. Public Health Service (which includes the Centers for Disease Control and the NPS public health program), or
- creates a hazard to public safety.

High priority will be given to managing exotic species that have, or potentially could have, a substantial impact on park resources, and that can reasonably be expected to be successfully controlled. Lower priority will be given to exotic species that have almost no impact on park resources or that probably cannot be successfully controlled. Where an exotic species cannot be successfully eliminated, managers will seek to contain the exotic species to prevent further spread or resource damage."

Management plans should be "feasible and effective" and managers should design programs that "avoid causing significant damage to native species, natural ecological communities, natural ecological processes, cultural resources, and human health and safety". Basically, only remove the target species if leaving them unchecked will cause more damage.

Section 4.4.2.1 *NPS Actions That Remove Native Plants and Animals* covers removal of native species using similar methods as those used for exotic species . The NPS Management Policy states that:
"Whenever the Service identifies a possible need for reducing the size of a park plant or animal population, the Service will use scientifically valid resource information obtained through consultation with technical experts, literature review, inventory, monitoring, or research to evaluate the identified need for population management; the Service will document it in the appropriate park management plan".

The Service will manage such removals to prevent them from interfering broadly with:

- natural habitats, abundances, and distributions of native species
- natural processes
- rare, threatened, and endangered plant or animal species or their critical habitats
- scientific study, interpretation, environmental education, or other public benefits
- opportunities to restore depressed populations of native species breeding or spawning grounds

2.2 GENERAL AND RESOURCE MANAGEMENT PLANS GOALS AND OBJECTIVES

LVNP's General Management Plan (GMP) was completed with the signing of a Record of Decision on February 25, 2002 and a final printing of the document occurring in June of 2003 (NPS 2003). Desired Future Conditions identified in the GMP will guide subsequent updates of this WMP. Goals identified in the GMP are:

Conservation of natural resources
To conserve the park's natural resources by developing management zones and prescriptions to protect resources from the adverse human influences while allowing those types of uses and development that do not significantly impair park resources.

Wilderness
Natural resources are to be pristine and fully regulated by natural, dynamic processes. It should remain "uninfluenced by human activities except as may be needed to restore natural conditions, e.g. removal of invasive and disruptive non-native species." (NPS 1999)

Research programs
To secure adequate information, through research or other means, to facilitate protection of park resources and management of visitor activities in ways that minimize impacts on the park's environment.

Interpretation
To foster an understanding and appreciation of the dynamic, natural processes that formed these ecological communities.

Cultural resources
To identify, inventory, evaluate, preserve, monitor, and interpret the park's cultural resources in a manner consistent with the requirements of historic preservation law and National Park Service policies.

LVNP's Resource Management Plan (RMP) identifies several resource management goals that are directly linked to weed management (NPS 1999):

> Prevent the spread and introduction of exotic species. Eliminate or control known exotic species within the park.
>
> Areas not identified as archeological sites or managed for cultural landscape values that have been disturbed by past development or management activities are to be, to the extent possible, restored to natural contours and natural plant communities.

Maintain or restore indigenous flora, fauna, and natural communities to the extent possible, to achieve species diversity and community structure which would have been created by natural events and processes.

Protect rare species by measures aimed at preserving habitat and preventing extirpation but which minimize adverse influences on other indigenous species.

Work cooperatively with other agencies to minimize, mitigate or prevent resource damages by human influences resulting from activities inside and outside of the park boundary.

Protect, to the degree practical, and when it is not detrimental to park resources, the visiting public from known resource hazards by reducing hazards and/or to advise the public of potential risks.

In areas designated as "cultural zones", identify and restore elements of the historic landscape (historic landscape plantings, walkways and historic structures) to give an accurate representation of the historic period without endangering natural resources.

LVNP's Fire Management Plan (FMP) also identifies several resource management goals that are directly related to weed management (NPS 2005a). They are:

Take special precautions to preserve and perpetuate sensitive, rare, threatened, or endangered plant/animal species.

Research the role of fire in the park's fire-adapted environment (e.g. plant and animal community composition shift post-fire, extent and distribution changes post-fire).

2.3 HOW THIS PLAN WILL MEET GMP, RMP AND FMP GOALS

The WMP is a detailed, action program to implement Integrated Pest Management (IPM) policies and resource management objectives outlined in higher authority policies and plans (i.e. NPS Management Policies, GMP, RMP). It will meet the GMP, RMP and FMP goals by:

Implementing an adaptive and integrated management plan to reduce exotic plant populations within the park.

Restoring native plant communities and wildlife habitat through weed and fire management.

Minimizing, mitigating, or preventing adverse weed impacts by guiding the development of agreements with federal and state agencies, volunteer, and non-profit groups.

Preventing the spread and introduction of weeds by developing educational programs and products for park staff and visitors.

Compiling research on the phenology, treatment, and invasive characteristics of target species.

3.0 ALTERNATIVES

3.1 ALTERNATIVE 1 – NO ACTION ALTERNATIVE, CONTINUE WITH CURRENT MANAGEMENT PROGRAMS

The current weed invasive plant program at LVNP is implemented through a joint effort by the Natural Resource Management Division and the Fire Management Program. Prior to 1998 there was no systematic plan for managing exotic plants in LVNP. As a result, inventory and eradication efforts were localized and fragmentary and there was no central source of documentation to support a unified weed management strategy. In 1998, LVNP began to implement an informal exotic plant management program consisting of three main components: 1) ecological risk assessment, 2) field inventory and mapping of infestations, and 3) site specific management plans to facilitate control, restoration, and ecological monitoring. This program has been informal in that it has not ever been documented in a written plan.

The following is a description of the current weed invasive plant program in LVNP. Alternative 1 includes the following strategies:

Prevent the introduction and spread of invasive weedy plants through public education and proactive management.

Survey and map weedy vegetation and assess its potential for invasiveness and ecological displacement as an early-detection tool.

Treat infested areas using the most effective tools with minimum impact.

Monitor populations and treatment areas to gauge program effectiveness.

Adapt management strategies based on monitoring results.

Effective exotic plant management requires a vigilant, long-term program. The initial goal of this program is to create a foundation which facilitates long-term exotic plant management by in-house staff. Adaptive management integrates several strategies to more effectively reduce weed populations.

Additionally, some non-native vegetation is associated with historic resources and cultural landscapes. This vegetation is managed in a manner that is consistent with the cultural resource management guidelines and is typically done on a case-by-case basis.

3.1.1 Prevention

Prevention measures include general weed education for both employees and visitors through bulletin boards and presentations. Many people do not understand the importance of weed control or the concept of exotic species. Educational posters and videos are tools to create a forum for discussion. The extra assistance in finding new populations is key to early-detection. In addition, Fire, Maintenance, and Natural Resources Management Divisions each have a copy of *Vehicle Cleaning Technology for Controlling the Spread of Noxious Weeds and Invasive Species* (USFS 2005) to reduce the transport and introduction by park employees and are encouraged to implement the standards.

Prevention also involves collaboration with other government agencies and non-government organizations (NGOs). Park representatives regularly attend meetings of the four Cooperative Weed Management Areas (Tehama, Shasta, Plumas-Sierra, Lassen WMA). Together, we apply for grants,

organize educational tools, and share information with the community by publishing brochures and staffing booths at county fairs.

3.1.2 Survey

Surveys to determine the distribution and abundance of weedy species are focused on developed areas, road corridors, the park boundary and within the watersheds of existing and proposed prescribed burn units. Areas of the Park determined to be most at risk and most sensitive to exotic plant invasions were stratified based on existing knowledge of weed locations, the physical characteristics of the Park, the biological requirements of high priority exotic species, the biological diversity of different habitats potentially at risk, distance to developments (e.g., roads and campgrounds), and recent disturbance history (e.g,. fires and floods).

A survey is performed by walking in a regular grid pattern over an area such that any weed species will be noticed. The distance at which two members of a survey crew are separated from each other varies from about 5m to 50m depending on the visibility through the vegetation. Potentially suitable habitat, such as, areas that are moist or disturbed, are surveyed more closely. When an infestation is found, the species, number of plants and percentage of reproductive plants are noted. The location and extent of each infestation is recorded by a GPS unit and entered into the Weed Information Management System (WIMS) database. Survey protocol is detailed in the *Protocol for weed survey, treatment, and monitoring in Lassen Volcanic National Park* (LVNP 2006) in Appendix 8.4.

Collaboration and cooperation with surrounding landowners is also important. Park staff is in constant contact with other WMA participants regarding new and moving infestations. For example, the Redding East Noxious Weed District Biologist from the California Department of Food and Agriculture (CDFA) surveyed the main park road and adjacent roads on Forest Service and private land north of the Park for spotted knapweed (*Centaurea stoebe*). CDFA also provides periodic updates on weed locations along highways. In addition, the Lassen Special Weeds Action Team (SWAT) from the Lassen Cooperative WMA donates a 3-person crew to assist park staff with surveying proposed burn units (LCSWAT 2006).

3.1.3 Treat

Weed treatment is one component of overall site management and restoration program. Rather than focusing on each individual species, the program focuses on long-term goals and objectives for the plant community and wildlife habitat. The objectives of implementing this strategy are:

(1) keep sites free of species that are not yet established but may be pests in adjacent properties;

(2) set priorities for the treatment of weeds that have already established on the site, according to the best literature and technical expertise;

(3) set conservation targets that will restore native plant communities and wildlife habitat;

(4) create an adaptive management plan that will take into consideration monitoring data and be modified accordingly.

Three kinds of treatments would be used under Alternative 1:

1. No treatment
Species of low priority may not be treated immediately based on its invasiveness.

2. Cultural Treatments
Cultural treatments are practices that promote the growth of desirable plants and reduce the

opportunities for exotic plants to grow. Examples include prevention, irrigation, prescribed fire, and seeding of native plant species.

3. Mechanical/Manual Treatments
These treatments cause physical damage to or removal of part or all of the plant. Examples of these treatments include hand pulling, cutting, grubbing, haying and mowing. The minimum tools approach would be utilized for the mechanical and manual treatments. Minimum tools could include pick mattocks, clippers, Japanese farmer's knives, Pulaski's, shovels and weed wrenches for more shrub-like weeds.

Manual removal of target plant species is mostly practiced due to the relatively low density of many infestations and the minimal impact on the surrounding vegetation; however, each treatment is discussed for highlighted weeds (Appendix 8.5). The location and extent of each treatment is recorded by and entered into the Weed Information Management System (WIMS) database. Treatment for each protocol is detailed in the *Protocol for weed survey, treatment, and monitoring in Lassen Volcanic National Park* (LVNP 2006) and in Appendix 8.4. Site prioritization is made following field reviews by the ecologist to assess site specific plant phenology, soil moisture, and logistic constraints.

3.1.4 Monitor

Monitoring can be a cost-effective tool to detect early stages of encroachment, track species distribution, and gauge the success of removal methods. The Latin root of the word monitor is "to warn" (Guralnik 1982) and that is the primary goal of a monitoring program. Data from monitoring programs often publicly, politically, and economically justify certain management practices, such as management-ignited fires and herbicide use. Labeled "adaptive management", monitoring chronicles the success or progress in achieving management objectives (Elzinga and others 1998).

In order to effectively and efficiently evaluate a species, ecological process, or resource management plan, managers must establish monitoring programs. They will identify research needs and determine the effects of policies and external variables (Stohlgren and others 1995; Bakker and others 1996). Palmer's (1987) evaluation of inventory, survey, and demographic monitoring programs throughout the U.S. revealed weaknesses in the many stages of establishing a program, such as a lack of internal or external review before and after implementation and ill-defined direction or objectives.

Many of the monitoring studies evaluated by Palmer (1987) lacked an appropriate scientific design. For example, seed production, which can restrict the population growth of particular species, was often overlooked. Seedlings, often a key to managing the population, were not considered in most studies. Population fecundity in size-dependent species was also not addressed in a majority of the studies. Pilot studies are essential in the sampling stage to determine the effectiveness and accuracy of the study design. Many of the studies did not adhere to the statistical limits of their data analysis, including, randomization, before/after or control/ treatment, pseudoreplication, and independence of sites.

Determining the appropriate analysis and reviewing the statistical validity of methods at an early stage could prevent inadequate sampling methods and deter costs in terms of money, time, and resources. Data analysis methods were cited in 67 of the 109 projects reviewed, with only 5 projects determining statistical analysis at the planning stage. Analysis is necessary if the data will be presented to the scientific community or in a court of law.

Palmer (1987) recommended reports be produced at each stage of the monitoring process. Only 20% of the studies had plans to write a proposal, report, or publish their findings. This lack of contributions to monitoring literature decreases cooperation between organizations and agencies since problems and successes of one study may aid in the efficiency and accuracy of another.

Our comprehensive monitoring plan includes the following:

- Monitoring the occurrence and spread of exotic plant species in high risk areas
- Monitoring the effectiveness of yearly treatments
- Installing permanent plots to collect baseline long-term data on the distribution and composition of exotic species and native plant communities. Pre- and post-treatment data is collected on species composition, density, cover, and the regeneration characteristics of both exotic and native plants. Seasonal crews assist the seasonal botanist in the installation and initial measurement of permanent monitoring plots mentioned above.
- Developing a broader series of permanent photo plots for monitoring general plant successional patterns in each area. These photos provide an extensive qualitative baseline reference to assess pre- and post-treatment conditions, and complement the quantitative monitoring efforts described above.
- Use biotic and abiotic characteristics of each site to evaluate the likelihood of infestations in areas that have not been surveyed and to re-evaluate the risk assessment model currently in place.
- House records in one relational GIS database (programming is maintained by The Nature Conservancy) called the Weed Management Information System (WIMS).
- Provide detailed, step-by-step directions on the monitoring protocol (Appendix 8.4 and 8.6).

3.1.5 Adaptive Management

We use an adaptive management strategy. First, we establish and record the goals for the site. Second, we identify species that block us from reaching these goals and assign them priorities based on the severity of their impacts. Third, we consider methods for controlling them or otherwise diminishing their impacts and, if necessary, re-order priorities based on likely impacts on target and non-target species. Fourth, we develop weed control plans based on this information. Fifth, the plan is implemented, and results of our management actions monitored. Sixth, we evaluate the effectiveness of our methods in light of the site goals, and use this information to modify and improve control priorities, methods and plans. Finally, we start the cycle again by establishing new/modified goals (Appendix 8.4 and 8.7).

3.2 ALTERNATIVE 2 – PREFERRED ALTERNATIVE, INTEGRATED PEST MANAGEMENT PLAN

Alternative 2 is the preferred alternative. It builds upon Alternative 1 with 4 additions. First, it would include the use of chemical treatments. Second, it would provide for fire treatments. Third, it would provide a set process for determining the strategies, treatments, and prioritization of species in the future if new exotic species are discovered. Fourth, Best Management Practices (BMP) would be implemented. Therefore, Alternative 2 is the same as Alternative 1 with the following additions:

3.2.1 Chemical Treatments

Chemical treatments include applying herbicides as prescribed by their labels and herbicide use protocol and Best Management Practices (Appendix 8.8), using a variety of application methods. Determining the right course of action in weed management can be difficult; there are many tools and techniques available, all with pros and cons. The decision to use herbicides is often a calculated risk which is not to be taken lightly. Knowing when to begin management action is the key to catching an infestation before successful control becomes unfeasible. As with medicine, herbicides must be used

judiciously to be safe and effective. Herbicides are any chemical substance that is used specifically to kill, prevent, repel, destroy, or mitigate a plant. Modern systemic herbicides are frequently used to control invasive plants. Many of the modern herbicides that are used in natural areas target specific plant processes or pathways and are relatively harmless to the environment. They are applied to the aboveground part of the plant and are transported throughout the plant to the root system. Selective application methods include foliar spray or wicking, cut stump applications, and basal bark applications to standing shrubs and thin-barked trees. Each technique is designed to minimize the amount of herbicide used as well as the risk of damage to non-target plants (Hillmer and Liedke 2003, Tu and others 2001, Windus and Kromer 2001). No use of aerial applications for chemical treatments is proposed.

Currently, parks must obtain approval from the Regional or National Integrated Pest Management (IPM) Coordinator before using pesticides. This process helps ensure that the appropriate pesticides are used in the appropriate areas. For example, a Regional IPM Coordinator would not approve the use of pesticides that do not have an aquatic label in areas located in or adjacent to water. Parks are also required to use pesticides in accordance with label guidelines.

Evaluating site conditions

Prior to herbicide application, assessing the target species, seasonal timing of the application, the presence of desirable species and communities, accessibility for the applicator and equipment, soil types, weather conditions, location of surface water, depth to groundwater, and the site's sensitivity to trampling from herbicide application must be considered (Windus and Kromer 2001). The Relative Aquifer Vulernability Evaluation (RAVE) model is one method of evaluating the impacts of herbicide application to water resources (Appendix 8.9). The RAVE system includes a model that addresses irrigation systems developed by Montana State University (MSU 1999) and one that addresses natural precipitation systems developed by the Forest Service (Forest Service 1992). The original RAVE system, titled "RAVE: Relative Aquifer Vulnerability Evaluation," was developed by the MSU Extension Service (MSU 1990). This system was developed for farming situations that use irrigation. The Forest Service has modified this original RAVE system so it can also be used for non-irrigated areas that only receive natural precipitation. This version of the RAVE system is titled *RAVE: Relative Aquifer VulnerabilityEvaluation (as adapted from Montana Department of Agriculture and Environmental Management Division)* (Forest Service 1992). Appendix 8.9 also includes a supplemental table to be used with either RAVE system. This table, developed by the Regional IPM Program for the Intermountain Region, provides additional information on pesticides that would be used under the preferred alternative (NPS 2005b).

To determine the potential for ground water contamination, the RAVE system considers several factors: irrigation practice, depth to ground water, distance to surface water, percent organic matter, pesticide application frequency, pesticide application method, pesticide leachability, and topographic position. Values are assigned to each of these factors and then totaled. The total value is then compared to a "scorecard interpretation scale" to determine the potential for ground water contamination by an individual pesticide. Higher scores indicate a higher vulnerability of ground water to pesticide application.

If a pesticide is determined to have a high potential for ground water contamination, an alternative pesticide or alternative application method is selected and results are compared. The alternative that has the lowest potential for ground water contamination and that has an acceptable score is then selected.

Which Herbicides?

Only those pesticides that have been registered by the USEPA and CalEPA would be used under the preferred alternative. In natural areas, herbicides are selected based on their effectiveness against the target weed. Preference will be given to herbicides that are unlikely to move offsite through the air or water, non-toxic to people and other organisms, not persistent in the environment and relatively easy

to apply. In some circumstances, however, a single application of a more toxic or persistent chemical that eradicates a weed may be preferable to repeated applications of a safer product which removes a smaller percentage of the total number of invasive plants but results in a larger total application of herbicide. A balance must be struck between the strength or effectiveness of the product and the total negative impact to the environment (Tu and others 2001). The information used to make these decisions comes from the herbicide labeling, experienced land managers, herbicide dealers, and other experts. Recommended treatments for targeted species are outlined in Appendix 8.5.

Pesticides are classified according to their mode of action, which is determined by the active ingredients. Active ingredients considered used under the preferred alternative are summarized in **Table 3.2.1-1**. Common trade names are provided in parentheses after the active ingredient. This is not a comprehensive list of trade names, and under the LVNP WMP, any registered pesticide trade name that contain the active ingredients listed in Table 3.2.1-1 may be used. Pesticides containing active ingredients that are not listed on Table 3.2.1-1 may also be used under the LVNP WPM/EA. However, the use of any pesticide must meet all conditions outlined in this document and must also be approved by the Regional or National IPM Coordinator.

An adjuvant is a substance added to a pesticide to aid its action, but has no pesticide action by itself. Some pesticides require the addition of an adjuvant to work effectively. Surfactants are adjuvants used in conjunction with pesticides to increase absorption. A surfactant is a surface-active ingredient that lowers surface tension of the solvent in which it is dissolved or the tension between two immiscible liquids. Safety procedures and MSDSs must be kept on site for all adjuvants used under the LVNP WMP.

Each pesticide varies in terms of its chemical and biological behavior in the environment. Factors that affect pesticide behavior in the environment include pesticide properties, soil characteristics, and climatic conditions. Factors that influence the behavior of pesticides in the environment are summarized below (Miller and Westra 1998).

Acid or base strength - refers to whether a pesticide has basic, acidic, or non-ionizable properties. This factor determines the ability of a pesticide to exist in soil water or be retained onto soil solids. In general, pesticides whose pH is close to the pH of soil are strongly retained and are not subject to runoff, erosion, and/or leaching. In contrast, herbicides whose pH is not close to that of the soil are less strongly retained and are subject to runoff, erosion, and/or leaching. These pesticides are also more available for plant uptake than those pesticides that are strongly retained onto soil solids.

Water solubility - refers to how readily a pesticide dissolves in water and determines the extent to which a pesticide is in the solution (water) phase or the solid phase. A pesticide that is water soluble generally is not retained by soil.

Volatility - refers to the tendency of a pesticide molecule to become a vapor. Pesticides with high vapor pressures are likely to escape from the soil and volatilize in the atmosphere.

Soil retention - is an index of the binding capacity of the pesticide molecule to soil organic matter and clay. In general, pesticides with high soil retention are strongly bound to soil and are not subject to leaching. Those not exhibiting high soil retention are not strongly bound and are subject to leaching.

Soil persistence - refers the longevity of a pesticide molecule, typically expressed in terms of a half-life, as determined under normal conditions in the region where the pesticide would be used.

These factors influence the environmental fate and effects of a pesticide, including its residual soil activity, persistence, volatilization, water solubility, and potential for leaching into groundwater. Table 3.2.1-2 summarizes potential environmental fate and effects of proposed pesticides under this alternative. Once a pesticide has been selected, the resource manager would submit a pesticide use

request using the Intranet-based IPM System. In general, the Regional IPM Coordinator would be responsible for reviewing and approving proposed pesticide uses. However, review and approval from a National IPM Coordinator would be required for pesticide uses that involve aquatic applications or situations in which the applied pesticide could reasonably be expected to get into waters or wetlands.

TABLE 3.2.1-1 Summary of Active Ingredients for proposed herbicides (NPS 2005b)

Active Ingredients	Registered Use	Target Plants	Mode of Action	Method of Application
Glyphosate Products(Roundup Pro Roundup Ultra, Rodeo, GlyPro, Accord)	General Use	Grasses, herbaceous plants including deep-rooted perennial exotic plants, brush, some broadleaf trees and shrubs, and some conifers. Does not control all broadleaf woody plants.	Absorbed by leaves and rapidly moves through the plant. It acts by preventing the plant from producing an essential amino acid. This reduces the production of protein in the plant, and inhibits plant growth.	Backpack or handheld sprayer, wipe application, frill treatment, cut stump treatment.
Aminopyralid (Milestone)	General Use	Semi-selective, broad spectrum. Most effective on members of the sunflower/composite, pea/legume, and nightshade families. Less effective on grasses.	Auxin-like plant-growth regulator that alters or disrupts growth by binding to receptors. Leads to mortality or decreased vigor.	Backpack or handheld sprayer, wipe application, frill and cut stump treatments.
Chlorosulfuron (Telar)	General Use	Broadleaf plants and some annual grasses.	Absorbed by the leaves and roots and moves rapidly through the plan. Prevents the plant from producing an essential amino acid.	Hand-held sprayer.
Clopyralid (Transline)	General Use	Annual and perennial broadleaf herbs, especially knapweeds, thistles, and other members of the sunflower, legume, and knotweed families	Absorbed by the leaves and roots of the exotic plant and moves rapidly through the plant. It affects plant cell respiration and growth.	Hand-held sprayer.

TABLE 3.2.1-2 Environmental fate and effects of proposed herbicides (NPS 2005b; Tu and others 2005)

Active Ingredient	Persistence in soil	Residual soil activity	Volatilization and potential by-products from burning	Solubility	Potential for leaching	Surface water	Toxicity
Glyphosate Products(Roundup, Pro Roundup Ultra, Rodeo, GlyPro, Accord)	Half-life can range from 3 to 130 days. Soil microorganisms break down glyphosate. Surfactant in Roundup has a half-life of less than 1 week.	Generally not active in soil. It is not usually absorbed from the soil by plants.	Does not evaporate easily. Major products from burning treated vegetation include phosporus pentoxide, acetonitril, carbon dioxide, and water. None of these compounds are known to be a health threat at levels that would be found in a vegetation fire.	Dissolves easily in water.	The potential for leaching is low. Glyphosate and the surfactant in Roundup are strongly absorbed by soil particles. Half-life for glyphosate in water ranges from 35 to 65 days. The surfactant half-life ranges from 3 to 4 weeks.	Very low concentrations of glyphosate have been observed in surface water following heavy rains, up to 3 weeks after application.	**Soil microorganisms – Glyphosate and the surfactant have no known effects.** Plants – **Contact with non-target plants may injure or kill plants. Aquatic animals – Glyphosate is no more than slightly toxic to fish, and practically non-toxic to aquatic invertebrate animals. It does not bioaccumulate in fish. The Accord and Rodeo formulations are practically non-toxic to frewshwater fish and aquatic invertebrate animals. The Roundup formulation is moderately to slightly toxic to freshwater fish and aquatic invertebrate animals. Terrestrial animals – Glyphosate is practically non-toxic to bees.**

TABLE 3.2.1-2 Environmental fate and effects of proposed herbicides continued (NPS 2005b; Tu and others 2005)

Active Ingredient	Persistence in soil	Residual soil activity	Volatilization and potential by-products from burning	Solubility	Potential for leaching	Surface water	Toxicity
Aminopyralid[1] (Milestone)	Foliar halftime in the field ranges from 8-19 days. Soil halftime ranges 5-89 days Degrades slowly and is mobile in the environment. Primarily degrades aerobically by metabolism in the soil.	Weakly adsorbs to soil.	No available data.	High water solubility. Runoff a concern in primarily clay soils depending on rainfall	The potential for leaching is low. Halftime in water ranges 127-447 days without sunlight. Halftime of 0.6 days in water with sunlight .	Relatively rapid breakdown reduces potential for run-off	Soil microorganisms – Low toxicity. Plants – contact with non-target plants will injure or kill plants. Aquatic animals – Practically non-toxic to most aquatic fish, animals including amphibians. Terrestrial animals – Low toxicity to birds and mammals. Not thought to bioaccumulate in fat tissue. Low toxicity to bees and earthworms.
Chlorosulfuron (Telar)	Half-life is one month for slightly acidic soil (pH 5.6-6.7) to three months for alkaline soils (pH 7.3).	Active in soil, is usually absorbed from soil by plants.	Does not evaporate easily. No information is available on potential by-products from burning.	Telar may be dispensed as a suspension in water with constant agitation.	High potential for leaching in permeable soils. There is less potential for leaching in soils with pH below 6.0. Potential for groundwater contamination is low due to low use rates and the dispersion of residues with leaching.	No information available.	Soil microorganisms – no effect. Plants – contact with non-target plants may injure or kill plants. Aquatic animals – Practically non-toxic to most fish and other aquatic invertebrate animals. Terrestrial animals – Practically non-toxic to birds and mammals. Low toxicity to bees and beetles.

[1] SERA (Syracuse Environmental Research Associates, 2007. Aminopyralid Human Health and Ecological Risk Assessment – FINAL REPORT. Prepared for USDA, Forest Service and U.S. Park Service. USDA Forest Service Contract: **AG-3187-C-06-0010.**

[1] U.S. Environmental Protection Agency (US EPA)

2005a Pesticide Fact Sheet: Aminopyralid. United States Environmental Protection Agency, US Office of Prevention, Pesticides, Environmental Protection, and Toxic Substances Agency.

2005b Environmental Fate and Ecological Risk Assessment for the Registration of Aminopyralid, US Office of Prevention, Pesticides, Environmental Protection, and Toxic Substances Agency.

TABLE 3.2.1-2 Environmental fate and effects of proposed herbicides continued (NPS 2005b; Tu and others 2005)

Active Ingredient	Persistence in soil	Residual soil activity	Volatilization and potential by-products from burning	Solubility	Potential for leaching	Surface water	Toxicity
Clopyralid (Transline)	May be present in anaerobic soils or soils with low microorganisms. Half-life is 15-287 days.	Active in soil, is usually absorbed from soil by plants. Soil microorganisms break down Clopyralid.	Does not evaporate easily. No information is available on potential by-products from burning.	Highly soluble in water.	Because it is highly soluble in water, does not absorb to soil particles, and is not radily decomposed in soils, it may leach into ground water. Ground water may be contaminated if clopyralid is applied to areas where soils are very permeable and water table is shallow.	Because it is highly soluable in water, there is potential for surface waters to be contaminated if clopyralid is applied directly to bodies of water or wetlands.	Soil microorganisms – no information is available. Plants – contact with non-target plants may injure or kill plants. Aquatic animals – low toxicity to fish aquatic invertebrate animals. It does not bioaccumulate in fat tissues. Terrestrial animals – low toxicity to birds and mammals. Not toxic to bees.

pesticide uses that may affect rare, threatened, or endangered species or associated critical habitat; pesticide use involving aerial application; pesticide use on 400 or more contiguous acres, use of a restricted-use pesticide as defined by the USEPA.

3.2.2 Fire Treatments

One method of fire treatment that has been in use for over 50 years is wilting. Wilting is a method of killing weeds with a brief application of heat (about 900°C). Plants are not actually burned with this technique, but heated with a flame produced by a propane torch. Effective wilting is based on heating the plant just enough to destroy cell structure in the plant leaf so the weed will no longer put energy towards growth. Wilting is most effective when weeds are young. See Appendix 8.10 for protocol.

Several sizes of hand-held propane torches (spot-burners) and tractor mounted burners are available. With the right size of nozzle or head, some heat applicators can also be used to target weeds selectively in a heterogeneous native/non-native community.

High temperatures tear apart plant cells and destroy proteins in the cells. It is only necessary to heat the leaf long enough to destroy the waxy cuticle of the leaf and disrupt the cells. Torching or boiling the plants until damage can be seen immediately is unnecessary and may stimulate re-growth of some established perennials such as morning glory (*Convolvulus* ssp.). Effects of heating may be visible in as little as an hour or take up to several days to show.

Seedlings, annuals, young perennials and germinating seeds are most susceptible to heat damage. They are usually killed by a single treatment. None of the heat treatments penetrate into the soil or below a layer of gravel, therefore they do not kill the roots of established perennials. Perennials may require three or more treatments in a season to deplete the roots and kill the plant. Careful commitment of resources to monitor and retreat must be integrated into the annual planning efforts.

Broadleaf weeds are more easily damaged by heat than grasses are. The growing tips of grasses are encased in a heat resistant sheath, which makes it possible to selectively control weeds in turf using a spot-burner.

Wilting using a propane torch has been used successfully at several Michigan preserves. Wilting was reported to successfully reduce the baby's breath (*Gypsophila panicula*) seedlings population by 90%. It also killed most seedlings/saplings of buckthorn (*Rhamnus* spp.), where the adult plants have already been removed. In contrast, hand-pulling the seedlings required more time and labor (Tu and others 2001).

The FMP (2005a) includes Best Management Practices for preventing an increase in the number of weeds in a known weed area and/or an increase in the size of the area in which they occur. Mitigation Measures in the FMP require burn units be surveyed for weeds before the units are managed with fire.

3.2.3 Decision-making Tools for Determining Treatment of Future Species

New species and new treatments will need to be addressed on a case-by-case basis. The Decision-making Tool, adapted from the Northern Great Plains Exotic Plant Management Plan and Environmental Assessment (NPS 2005b), guides land managers in determining the most appropriate treatment (Appendix 8.7). As the need for herbicides not listed in this EA arise, a Pesticide Use Proposal (PUP) will be submitted to the Regional Integrated Pest Management Office for approval.

3.2.4 Best Management Practices

The Best Management Practices (BMP) will be guidelines for Park operations, including, fire, maintenance, and patrol (Appendix 8.11). Prevention is the most cost-effective and successful tool in weed management (Sheley and others 1999; Lodge and others 2006). More effective methods of prevention are urgently needed so introductions will not exacerbate the economic and resource burden. Targeting transportation pathways (vehicles) could simultaneously prevent multiple species introductions (Lodge and others 2006). LVNP will be implementing guidelines developed by the Working Together Against Weeds Workgroup (an interdisciplinary group of National Park Service staff from the Pacific West Region). The BMPs are still in draft form; therefore, the plan will temporarily implement BMPs developed by the Eastern Region US Forest Service and the Midwest Region NPS (Appendix 8.11).

3.3 ALTERNATIVES CONSIDERED BUT REJECTED

Biological treatments were considered but ultimately rejected as a viable alternative for this plan. Biological treatments are being applied on adjacent lands, by various land management agencies but will not be applied within the Park. Klamathweed *(Hypericum perforatum)* is the only known targeted weed species in this area with a biological treatment. The small size of the current population, coupled with the uncertainty of the potential long-term impacts on native vegetation and insects, has lead park staff to determine that risk outweighs the potential benefit.

3.4 ENVIRONMENTALLY PREFERRED ALTERNATIVE

In accordance with Director's Order-12, *Conservation Planning, Environmental Impact Analysis, and Decision-making*, the NPS is required to identify the "environmentally preferred alternative" in all environmental documents. The environmentally preferred alternative is determined by applying the criteria suggested in the National Environmental Policy Act (NEPA) of 1969, which is guided by the Council on Environmental Quality (CEQ). The CEQ (46 FR 18026 - 46 FR 18038) provides direction that "[t]he environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101", which considers

- fulfilling the responsibilities of each generation as trustee of the environment for succeeding generations;
- assuring for all generations safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
- attaining the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
- preserving important historic, cultural and natural aspects of our national heritage and maintaining, wherever possible, an environment that supports diversity and variety of individual choice;
- achieving a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and
- enhancing the quality of renewable resources and approaching the maximum attainable recycling of depletable resources (NEPA Section 101(b)).

Generally, these criteria mean the environmentally preferable alternative is the alternative that causes the least damage to the biological and physical environment and that best protects, preserves, and enhances historic, cultural, and natural resources (46 FR 18026 – 46 FR 18038).

As described in this Environmental Assessment, the proposed action is also the environmentally preferred alternative. The proposed action increases the effectiveness of the treatments; therefore, it

reduces the staff and volunteer hours spent repeatedly disturbing soils, plants, and animals over a long time period in a concentrated area. The proposed action achieves the greatest balance between providing the necessary weed removal and protecting all of the park's resources.

4.0 AFFECTED ENVIRONMENT

4.1 PHYSICAL RESOURCES

4.1.1Soils

The soils within Lassen Volcanic National Park are generally rocky, shallow, rapidly drained and strongly acidic. They are almost exclusively volcanic in origin. Depths vary from several feet in limited lower elevation meadows to thin or nonexistent in the higher elevations. Because of their rock porous nature, the soils are rather resistant to erosion. However, soil erosion does occur in conjunction with some heavily used trails.

Soils in the Warner Valley area that support commercial horse rides are volcanic in origin as elsewhere in the park and vary in depth from thin layers in higher elevation areas or on exposed ridges to deeper well formed soils along the valley floor.

Detailed soil information comes from a few small development projects and is site specific. A comprehensive soil survey has never been completed for the entire park. However, a park-wide soil survey was started by the Natural Resource Conservation Service in the summer of 2006 and continued through 2007. A soil map is expected in 2010.

4.1.2 Water resources

Lassen Volcanic National Park contains portions of five drainage basins. Four of the drainage basins (nearly the entire park) flow into the Sacramento River and eventually to the Pacific Ocean. A small area on the eastside of the park flows into the landlocked Eagle Lake drainage basin. The northern half of the park is the Hat Creek drainage, which ultimately feeds into the northern Sacramento River system via the Pit River. The western and southern portions of the park also flow to the Sacramento River via three main channels: the southeast portion of the park drains via the Upper North Fork of the Feather River, which is dammed approximately 18 miles outside the park at Lake Almanor; and the west and southwest portions of the park flow into Battle Creek and Mill Creek, respectively. Mill Creek currently has no dams blocking anadromous fish and is one of very few stream courses remaining in California to have its biologic integrity preserved from its origin in northern California to the Sacramento River. As a result, Mill Creek has been identified as a potential Wild and Scenic River (NPS 2003).

The park contains over 200 lakes and ponds and 15 perennial streams. Inventory data on aquatic life in these water bodies, however, is very limited. Some lakes have been significantly modified by past programs of stocking non-native sport fish, which continued until the early 1970s.

Some of the natural drainage systems in the park have been altered. The most obvious of these are Manzanita and Reflection Lakes. Manzanita Lake was created from the Chaos Crags rock fall avalanche 300 years ago and was enlarged with a dam in 1911 for a small hydropower operation. Water was also diverted from Manzanita Creek to Reflection Lake, originally a closed basin lake, to provide water- generated power and to improve fish production. Natural drainage patterns in Warner Valley's Drakesbad Meadow were also altered by early ranchers to more evenly distribute water in the meadow for livestock grazing. Dream Lake Dam was built in Warner Valley in the 1930s as part of the Drakesbad Guest Ranch prior to park ownership in the late 1950s.

Water quality is generally considered to be excellent because Lassen Volcanic National Park is located at the top of its watersheds. Aside from park developed areas, no other development affects park waters. Water quality data has been sporadically collected over the years, including some data from hydrothermal areas at Sulphur Works, Bumpass Hell and Devil's Kitchen.

Surface water from a total of six sources (Butte Lake, Manzanita Creek, Lost Creek, East Fork Hat Creek, Forest Creek, and Martin Creek) and two springs (Drakesbad Springs and Warner Valley Springs) is treated to provide drinking water for park visitors and staff. Drinking water is monitored daily to ensure a safe supply for human use.

Periodic sampling and testing is also performed in park waters where existing sewage systems or human use levels are such that contamination is a possibility. A Sanitary Survey in 1997 tested for temperature, pH, turbidity, dissolved oxygen, coliform bacteria, giardia, cryptosporidium and flow rates for five watersheds. This survey provided baseline data for a water quality monitoring program that will continue every five years to better understand the impact of visitation on water quality and ambient water quality and water intakes. Broad based chemical analysis and testing for herbicides and pesticides was also conducted in five watersheds (Forest Creek, North Fork of Hat Creek, Lost Creek, Manzanita Creek and Flat Iron Ridge Spring) over the last twelve years. No herbicides have ever been detected in any of the park's watersheds.

A level I baseline water quality inventory was completed for the park by the US Geological Survey in 2005 (Currens and others 2006). In addition, water quality monitoring at selected backcountry lakes and streams will begin in 2008 and continue every 3-6 years under the auspices of the NPS Inventory and Monitoring Program (protocol under development).

Two water treatment plants at the southwest entrance station (Forest Creek) and at Manzanita Lake (Manzanita Creek) provide domestic water supply of approximately 30,000 gallons per day and 62,000 gallons per day, respectively. Lost, East Fork of Hat Creek, and Martin Creeks provide water for park uses.

4.2 BIOLOGICAL RESOURCES

4.2.1 Wetlands

Wetlands are a critical resource in the park supporting a high diversity of species. National Wetlands Inventory (NWI) maps were produced in 1989 for the park and surrounding National Forest lands, though most of these maps have not been digitized or ground-truthed for accuracy. In 2005 and 2007, an ecological assessment and classification was conducted on 68 wetlands (Adamus and others 2007). Based on several rough estimates for vegetation types, wet meadow and riparian/alder zones total over 2,000 acres in the park. Of this acreage, several wet meadow wetland complexes are significant in size, including Drakesbad Meadow, Kings Creek Meadow and Dersch Meadows. Drakesbad Meadow in Warner Valley was identified as a fen (groundwater supported peatland) in 2000 because it has organic soils more than 40 cm thick. At approximately 35 acres, this spring-fed complex is the largest wetland in the Park. Fens occur throughout the Rocky Mountains but there are very few reports of peat lands occurring in the Cascades (California, Oregon and Washington) or the Sierra Nevada (California). There are hundreds of smaller wetlands throughout the park; many are associated with lakes and ponds and can be found throughout the park's wilderness.

Major wetland complexes are:
Dersch Meadow
Kings Creek Meadow
Summit Lake Meadow
Kings Creek
Lost Creek
Butte Creek
Hat Creek

Of these areas, the three meadows are considered palustrine (freshwater not associated with lakes, but rather with persistent groundwater), persistent emergent wetlands (dominated by an array of grass-like plants and true grasses) and the four creeks are considered upper perennial riverine wetlands (Johnson personal communication 2005).

Palustrine wetlands include all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and some saltwater wetlands. Palustrine wetlands include those areas called marshes, bogs, fens and prairies as well as shallow permanent or intermittent ponds. Palustrine wetlands are further classified as forested, emergent wetland persistent, and scrub-shrub wetlands (Cowardin and others 1979).

Dersch Meadow (a scrub-shrub palustrine emergent wetland) contains an overstory of alder and willow, and an understory of grasses, sedges and rushes. Scrub-shrub wetlands generally contain an overstory of trees (approximately 20%) and an understory of shrubs (60%) with the trees usually less than 20 feet tall (Cowardin and others 1979).

Summit Lake and Kings Creek meadows are classic sedge-dominated wet meadows, with Kings Creek shown as an example of this type of wetland in the USFWS guide to *Wetlands and Deepwater Habitats of the United States* (Cowardin and others 1979) (Plate 66).

Riverine wetlands include all wetlands and deepwater habitats contained within a channel, except for wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens and those near salt water. Water is usually, but not always flowing in the channel and these wetlands may also be surrounded on their floodplain by other kinds of palustrine wetlands (Cowardin and others 1979).

Lost, Hat , Butte and Kings Creek are upper perennial streams with seasonally flooded margins including small pockets of wetlands and scrub-shrub wetlands on the boundary of their riverine and upland habitats.

Wetland boundaries for Dersch and Kings Creek meadows were ground-truthed in summer 2002, using Global Positioning System (GPS) devices. These boundaries were analyzed with respect to the proposed road rehabilitation environmental assessment occurring in their vicinity (NPS 2005c). Wetland boundaries have also been delineated for the Summit Lake Ranger Station, Hat Creek, Lost Creek and other areas affected by the proposed project.

4.2.2 Vegetation

Most of the park below 7,900 ft (2,400 m) is forested, with the distribution of conifers affected by elevation (Parker 1991). Management decisions are based on requirements for desired plant communities and processes. Four major plant communities and two minor plant communities within the park are detailed below.

Red Fir Forest: Red fir forest is the most widespread forest type in the park and is a common upper montane forest type throughout the Sierra Nevada and in the southern Cascades. In the Park, red fir forest is found from 6,500 - 8,000 ft (2,400 - 2,900 m) and covers some 35,000 acres, about one third of the Park. In red fir forests, red fir (*Abies magnifica*) is the sole dominant tree in the canopy, but lodgepole pine (*Pinus contorta* ssp. *murrayana*), Jeffrey pine (*Pinus jeffreyi*), mountain hemlock (*Tsuga mertensiana*), sugar pine (*Pinus lambertiana*), western white pine (*Pinus monticola*) or white fir (*Abies concolor*) may be present in small numbers. Shrubs and flowers include arrowleaf balsamroot (*Balamorhiza saggittata*), mule's ear (*Wyethia mollis*) and greenleaf manzanita (*Arctostaphylos patula*).

Depending on soil type and elevation, mountain hemlock may be a component of either the Red Fir Forest or the Subalpine Forest. Mountain hemlock is usually found on nutrient-poor sites with

coarser textured soils than red-fir dominated sites (Parker 1991). The pre-successional lodgepole pine stands often occur from 6,200 - 7,500 ft (1,900 - 2,300 m) and are most common on flat, valley bottom sites or lower slopes, often near the margins of meadows and lakes.

Yellow Pine Forest: This forest type is found below 6,000 ft (1,900 m) usually with a mix of species including sugar pine, Jeffrey pine, white fir, ponderosa pine (*Pinus ponderosa*), western white pine, incense cedar (*Calocedrus decurrens*) and even red fir. The soils associated with these forest types have significantly higher potassium, calcium, and magnesium than most other Lassen Park forest types (Parker 1991).

Subalpine Forest: The subalpine forest, at the upper end of the park's coniferous forests in elevation (above 8,500 ft or 3,100 m) is dominated by mountain hemlock and whitebark pine (*Pinus albicaulis*), a highly weather resistant pine that may grow as high as 10,000 ft or 3,600 m. Shrubs and flowers include currants (*Ribes* sp.), willow (*Salix* sp.), lupine (*Lupinus* sp.), senecio (*Senecio* sp.), pearly everlasting (*Anaphalis margaritacea*), rubber rabbitbrush (*Chrysothamnus nauseosus*), and pine mat manzanita (*Arctostaphylos nevadensis*).

Alpine Meadows and Fellfields: These areas, located above timberline, are carpeted with colorful wildflowers, including spreading phlox (*Phlox diffusa*), phacelia (*Phacelia* sp.), stonecrops (*Sedum* sp,), alpine saxifrage (*Saxifraga tolmei*), cinquefoils (*Potentilla* sp.), penstemons (*Penstemon* sp.), alpine daisy (*Erigeron compositus*), and buckwheats (*Eriogonum* sp.).

Montane Chaparral or Brushland: Pinder and others (1997) found that most chaparral species in the park occur below 7,500 ft (2,300 m) on relatively dry sites. These scattered shrub fields, which comprise approximately 10% of the park are dominated by greenleaf and pinemat manzanita (*Arctostaphylos patula and A. nevadensis)*, snowbrush ceanothus *(Ceanothus velutinus*), and bush or California chinquapin *(Castanopsis sempervirens)* as well as currant (*Ribes* sp.), gooseberry (*Ribes* sp.), serviceberry (*Amelanchier* sp.), bitter cherry (*Prunus* sp.).

Wet Meadows: Herbaceous communities are scattered throughout the park and range from densely vegetated, wet meadows near seeps, streams and lakes that contain primarily grass and grass-like species including sedges *(Carex spp.),* and perennial grasses, including Thurber's bentgrass (*Agrostis thuberiana*), tufted hairgrass *(Deschampsia caespitosa*), and Pullup muhly (*Muhlenbergia filiformis*) (Taylor 1990); to less densely vegetated areas composed of mostly broad-leaved plants such as satin lupine *(Lupinus obtusilobus),* mule's ears, sagebrush (*Artemisia douglasiana*), and mountain alder (*Alnus tenuifolia*) that occur on steep slopes or in larger gaps within forested areas (Pinder and others 1997). Forbs include monkeyflower (*Mimulus* sp.), bog laurel (*Kalmia* sp.), California corn lily (*Veratrum californicum*), alpine shooting star (*Dodecatheon alpinum*) and lupine.

The Lassen Peak Smelowskia (*Smelowskia ovalis var. congesta)* is the only known endemic plant species within the park.

4.2.3 Wildlife

More than 280 native species of terrestrial and aquatic animals have been recorded in the park area, including approximately 57 species of mammals, 215 species of birds and 15 species of amphibians and reptiles. Little is known about the distribution and abundance of most wildlife species.

Small mammals include the deer mouse, five species of shrew, Allen's shadow and yellow-pine chipmunk, Douglas squirrel, Northern flying squirrel, mountain beaver, golden-mantled ground squirrel, yellow-bellied marmot and pika. Small and medium-sized carnivores include the long-tailed weasel, pine marten, raccoon, river otter, bobcat, Sierra Nevada red fox and coyote. Large mammals include the black bear, black-tailed deer and mountain lion. In addition, seven species of bats occur in the park.

Of the birds approximately 96 species are known to nest in the park. Raptors include the Northern Goshawk, Cooper's Hawk, Red-tailed Hawk, Sharp-shinned Hawk, Peregrine Falcon, Golden Eagle, Bald Eagle, Northern Saw-whet Owl, California Spotted Owl, Great Horned Owl, and Northern Pygmy Owl. Other bird species include the Gray Jay, Clark's Nutcracker, Red-breasted Sapsucker, Common Flicker, Pileated Woodpecker, Steller's Jay, Oregon Junco, Warbling Vireo, Audubon's Warbler, Wilson's Warbler, Hermit Warbler, Fox Sparrow, and Song Sparrow.

Amphibians include the Western toad, Pacific tree frog, Cascades frog and long-toed salamander. Reptiles include the western terrestrial common garter snake, northern alligator lizard, rubber boa and sagebrush lizard.

Although most park lakes are naturally barren, 6 native (or of unknown origin) species of fish occur in the park, including rainbow trout, Tahoe sucker, tui chub, fathead minnow, speckled dace, and Lahontan redside. In addition , there are a number of introduced fish, including brook trout, golden shiner and brown trout. Stocking of hatchery-reared rainbow and brown trout occurred from the park's establishment until 1972.

Manzanita Lake fishery has been state designated as a "blue ribbon" fishery. The lake contains rainbow trout, brown trout and brook trout . Fishing at Manzanita Lake is catch and release and angler surveys are conducted annually. Manzanita Creek is closed to fishing. Lost Creek, Hat Creek, and Kings Creek have populations of non-native brook trout.

The park also contains a wide variety of known and unknown invertebrates, including insects, spiders and worms.

4.2.4 Special status species

Federally Listed Species

Bald Eagle (*Haliaeetus leucocephalus*). Until recently, the Bald Eagle was the one species listed on the Threatened and Endangered species list known to occur within Lassen Volcanic National Park. In 2007, however, Bald eagles were removed from the list. The Park will continue, however, to treat Bald Eagles as a special status species. Bald Eagles build their nests in trees greater than 30 inches in diameter, within a ¼ - ½ mile from a fish-providing water source. Because of scarce food supply and relatively harsh nesting season climatic conditions, the park has extremely marginal Bald Eagle nesting habitat. There is one known Bald Eagle nesting pair in Lassen Volcanic National Park at Snag Lake. This pair along with a nest was discovered in 1980. This nest was monitored until 2001 when the nest tree fell over during the winter of 2000/2001. This pair of Bald Eagles has been monitored annually from 2002 to the present. The pair has been observed at Snag Lake in subsequent years but no new nest has been found although young Bald Eagles have been observed. Surveys are currently being conducted to locate a new nest in the Snag/Butte Lake area. Hunting territory for this pair comprises most of the eastern half of the park. The only other known Bald Eagle activity in the park is seasonal foraging use of the Manzanita Lake area by Bald Eagles believed to nest outside of the park.

The other 7 Federally listed species described below have not been found in Lassen Volcanic National Park and suitable habitat does not exist in the areas proposed to have increased activity in this EA.

California Red-legged Frog (*Rana aurora*). This species has not been positively identified within Lassen Volcanic National Park. It inhabits elevations from sea level to about 5,000 feet. Nearly all of the known occurrences are from below 3,500 feet. California red-legged frogs spend most of their lives in and near sheltered backwaters of ponds, marshes, springs, streams, and reservoirs. Deep

pools with dense stands of overhanging willows and an intermixed fringe of cattails are considered optimal habitat.

Delta Smelt *((Hypomesus transpacificus)* and Central Valley steelhead (*Oncorhynchus mykiss*). These species occur or spawn in the Sacramento River and its tributaries. No streams within Lassen Volcanic National Park have been found to support these species.

Critical habitat, Central Valley steelhead (*Oncorhynchus mykiss*) . Lassen Volcanic National Park does not contain critical habitat for this species.

Winter-run Chinook Salmon *(Oncorhynchus tshawytscha)*. This species is found only in the upper Sacramento River. No streams within Lassen Volcanic National Park have been found to support this species.

Central Valley Spring-run Chinook Salmon *(Oncorhynchus tshawytscha)*. This species is found within the Sacramento River and its tributaries – Butte, Big Chico, Deer, and Mill Creeks. These salmon enter the Sacramento River between February and June. They move upstream and enter the tributaries between February and July, peaking in May and June, where they stay in pools until spawning occurs in mid-August to mid-October (September peak). There are no current records of spring-run chinook salmon within the section of Mill Creek that is within Lassen Volcanic National Park.

Critical Habitat, Central Valley Spring-run Chinook Salmon (*Oncorhynchus tshawytscha).* Lassen Volcanic National Park does not contain critical habitat for this species.

Shasta crayfish *(Pacifastacus fortis)*. This species is only known from Shasta County in lower elevation waters outside of Lassen Volcanic National Park where they inhabit cool, clear, spring-fed lakes, rivers, and streams and most are found in still and moderately flowing waters.

Conservancy fairy shrimp (*Branchinecta conservation*). This species is found in vernal pools within the Central Valley of California. There are eight known populations within the central valley of California.

Candidate Species

Pacific fisher (*Martes pennanti pacifica*) are believed to be extirpated from Lassen Volcanic National Park and typically avoid areas with human activity and development.

State listed Wildlife

California wolverine (*Gulo gulo luteus*) (California threatened) are believed to be extirpated from Lassen Volcanic National Park and typically avoid developed areas. Surveys for this species have occurred throughout the State over the past 10 years with no confirmed detections statewide.

Sierra Nevada red fox (*Vulpes vulpes necator*) (California threatened). They generally occur above 5,000 feet in forest and fell fields but may visit lower elevation areas as well in summer. There are currently no known den sites and most of the sightings have been in developed areas along the main park road within Lassen Volcanic National Park. This species is known to beg at parking areas and campgrounds throughout the park. A study was done on this species within Lassen Volcanic National Park and surrounding areas from 1997 to 2004. Five Sierra Nevada red foxes were captured and radio collared with this project. During the study, three of the collared red foxes died. Two of natural causes and one was fatally wounded by a domestic dog attack. Since the study, the batteries in the radio collars on the remaining foxes have died so the location and status of these foxes is

unknown. From 2004 to 2007 there have been four sightings of a fox in the same area near Lassen Peak. It is assumed this is the same individual since it was observed in exactly the same area for four years. No radio collar has been visible on this individual.

American Peregrine Falcon (*Falco peregrinus anatum*) (California endangered). There is one known Peregrine Falcon nest (monitored annually by park staff since 1997) located on U.S. Forest Service land bordering Lassen Volcanic National Park's western boundary (Blue Lake Canyon). Peregrine Falcons can be seen hunting in the higher elevations around Lassen Peak in the late summer and early fall as well.

Greater Sandhill Crane (*Grus canadensis*) (California threatened). This species is found in wetland habitats such as meadows, pastures, grain fields, bogs, fens, marshes and fields. There have been sightings in Kings Creek Meadow, Cameron Meadow, Spencer Meadow, Snag Lake, Horseshoe Lake, and Warner Valley in Lassen Volcanic National Park although no reproduction has been confirmed. Most sightings of this species is in the fall when they are seen flying over Lassen Volcanic National Park during migration.

Little Willow Flycatcher (*Empidonax traillii brewsteri*) (California endangered). This species nests in dense willow thickets in montane meadows and along streams. Records indicate this species historically bred in Sulfur Creek Meadows and around Snag Lake in Lassen Volcanic National Park. This species is currently found in the Warner Valley area of Lassen Volcanic National Park where a breeding pair was discovered in 2004.

Species of Park Concern

American marten (*Martes americana*). Martens require a variety of different aged stands, particularly old growth conifers and snags which provide cavities for denning and nesting. This species is found in the old growth areas of Lassen Volcanic National Park.

Sierra Nevada snowshoe hare (*Lepus americanus tahoensis*) occur in thickets of brush, pine, fir, and riparian vegetation within Lassen Volcanic National Park.

Seven bat species have been identified by the USFWS as likely to occur in the park – pale Townsend's big-eared bat (*Corynorhinus (=Plecotus) townsendii pallescens*), spotted bat (*Euderma maculatum*), small-footed myotis (*Myotis ciliolabrum*), fringed myotis (*Myotis thysanodes*), long-legged myotis (*Myotis volans*), Yuma myotis (*Myotis yumanensis*), and long-eared myotis (*Myotis evotis*). Only the latter four, however, have been positively identified in the park. These species likely depend on late successional old-growth forest, where they roost beneath loose bark or in cavities. Other landscape features more commonly associated with day roosts, hibernacula, and maternity colonies (such as significant lava tubes, caves, and abandoned mines) are largely absent from the park. Cliff and rock slopes are also possible habitat areas.

Cascades frog (*Rana cascadae*) inhabits lakes and meadows in the park. Numerous amphibian studies have shown this species to be declining throughout the Sierra Nevada and Cascade ranges. A fish and amphibian survey during the summer of 2004 found this species to occupy some of the ponds in the Juniper Lake area.

California Spotted Owl (*Strix occidentalis occidentalis)* is associated with multi-storied coniferous forests with greater than 70% canopy cover and large trees (>30 inches in diameter) used for nesting. There are currently four known nesting pairs and one pair that have been confirmed as non-nesting in Lassen Volcanic National Park. The four nests are located on the north side of Prospect Peak, the south side of Prospect Peak, Crags Campground area, and Terminal Geyser. The non-nesting pair is located in Warner Valley.

American Dipper (*Cinclus mexicanus*) requires clear fast-moving water. It is confined to clear, clean streams and rivers with rocky shores and bottoms in mountains. This species does occur in Lassen Volcanic National Park.

Northwestern pond turtle (*Clemmys marmorata marmorata*) use slow streams, ponds, lakes, and wetlands and associated uplands from sea level to 6,000 feet. This species has been documented historically in Lassen Volcanic National Park in the Manzanita Lake, Reflection Lake area. There have been no recent sightings of this species in Lassen Volcanic National Park.

Prairie Falcon (*Falco mexicanus*) requires sheltered cliff ledges for cover. There are historic breeding records of this species at Eagle Peak.

Vaux's Swift *(Chaetura vauxi)* requires hollow trees and snags for nesting and roosting. It shows an apparent preference for foraging over rivers and lakes. It has been documented in Lassen Volcanic National Park.

Rufous Hummingbird (*Selasphorus rufus*) does not breed in Lassen Volcanic National Park but are found in the park during spring and fall migration. They are found in open meadow areas where they forage on wildflower nectar.

Northern Goshawk (*Accipiter gentilis*) is a secretive species found in mature or old growth coniferous forests within the park. Park staff has confirmed this species to nest in the park.

Plants

There are 20 known special status plant species found within the park according to the California Native Plant Society (Appendix 8.12). None of the species are on the CA Fish and Game or US Fish and Wildlife lists. Species are included on this list because they are rare, localized, or declining throughout their range. Almost all special status plants are found in the high elevation subalpine zone. Comprehensive monitoring plans have only been developed for three of the species on Lassen Peak that receive high visitor use, but plans are needed for other at-risk species as well. Golden draba and Mt. Lassen smelowskia are considered rare, threatened, or endangered in California.

4.3 ARCHEOLOGY

Archeological sites are distributed throughout the Park, from elevations of 5,500 feet to 7,000 feet. These cultural resources include a large village, lithic workshops and numerous smaller seasonal camps. Many sites, because of their seasonal, high elevation nature, have limited deposits.

Little is known of the early part of the prehistoric chronology of Lassen Volcanic National Park. This may be because large areas suitable for use as seasonal campsites have been covered by the eruptions of Lassen Peak during and prior to the early 20th century. There appears to be more evidence of prehistoric aboriginal use in the southern part of the Park (most likely due to the volcanic disturbance in the north). These southern sites are generally low in elevation (often in the open valleys), near fresh water, and in areas that support game and other wild resources. The lack of early sites represented in the archeological record appears to be partly due to the limited numbers of cultural resource inventories and test excavations conducted in the area.

To date, approximately five percent of the Park has been surveyed for archeological resources and 92 archeological sites have been recorded, ten of which are listed as the Sulphur Creek Archeological District on the National Register of Historic Places.

4.4 VISITOR EXPERIENCES

4.4.1 Visitor use access/opportunities

Recreational activities available at Lassen Volcanic National Park include auto touring, hiking, backpacking, camping, horseback riding, fishing, skiing, snowshoeing, ranger talks, and guided walks/tours. The park has over 150 miles of maintained hiking trails including 17 miles of the National Scenic Pacific Crest Trail. Stock use by horses is permitted in the backcountry areas of the park, although most visitors travel by foot. Fishing is allowed in all streams and lakes with the exception of Manzanita Creek above Manzanita Lake. The park has extensive backcountry skiing as well as snowshoe use available; however, winter use currently comprises only about 10 percent of the park's total. Winter use is expected to increase, however, when the construction of the year-round Southwest Visitor Center is completed in 2008.

Ranger talks, guided walks/talks, and Junior Ranger and Firefighter programs are scheduled from early July through early September. While some of the activities take place only a few days a week, others run up to 7 days a week. They take place in various places across the park: Loomis Museum, Manzanita Lake Amphitheater, and the Discovery Center. Other interpretation includes handouts, wayside exhibits and roving interpreters.

Rustic lodging is available at Drakesbad Guest Ranch, in the southeast corner of the park. Drakesbad, however, is not located within the corridor of the main park road, where the majority of visitors go. The only option for overnight stays within the park along the main park road corridor is camping. No lodging is open during the winter months. The Southwest campground is the only campground open year-round. Backcountry snow camping is allowed.

Walk-up food services are available at the Southwest Visitor Center and the camper store at Manzanita Lake. Sit-down dining is available through an "American Plan" to guests at Drakesbad, and by reservation for other visitors. Currently, no food service is available during the winter months, but will become available at the Southwest Visitor Center, with potentially limited hours, when it is completed.

Commercial services such as food, gifts, educational sales, and rustic lodging are an integral part of making the visitor experience an enjoyable one at Lassen Volcanic National Park.

An average of 3,325 overnight stays per year have occurred in the backcountry over the last 10 years.

4.4.2 Visitor and employee safety

Lassen Volcanic National Park has a comprehensive fire management program and Emergency Action Plan (EAP) dedicated to ensuring the safety of the public and Park employees. Numerous safety measures are followed to maintain the highest safety standards possible for Park visitors, employees, and residents, and landowners/residents living adjacent to the Park.

Park personnel follow several safety standards and best management practices to minimize their exposure to hazardous equipment and conditions while working. Hazardous conditions include smoke, burning organic material, diurnal fluctuations in temperature and humidity, unsure footing on steep and rocky terrain, insects, and long work periods. Hazardous equipment includes aircraft, motorized vehicles, hand tools, chainsaws and water pumps. Employees regularly review the job hazards identified for each position. The job safety analysis includes a list of potential hazards for each task and provides the proper implementation techniques, personal protective gear, and hazard mitigation measures for every task.

Park personnel are informed of potential threats on a daily basis through an activity report. If there is an imminent threat to human health or safety, the Superintendent can close all or a portion of the Park, including trails and roads.

Public information and education pertaining to weed management is presented through normally scheduled activities throughout the year. Year-round activities include distribution of handouts, brochures, and publications pertaining to the weed program. Information on this program is also incorporated into visitor contacts, interpretive talks, and campfire programs.

4.5 PARK OPERATIONS

Weed management at Lassen Volcanic National Park is just one of the operations that all park divisions are committed to managing. This commitment is emphasized in the General Management Plan as well as the Resources Management Plan. The park utilizes a system where operations are prioritized on a daily, weekly, monthly and even a yearly basis. Park management selects the appropriate management response to all incidents occurring in the park, including medical emergencies, search and rescue, damage to facilities, or official visits from dignitaries. These as well as all other incidents are managed as park priorities and all divisions are involved to ensure these incidents are handled in a safe and efficient manner.

4.6 WILDERNESS VALUES

In October 1972, Congress designated 75% of the park (78,982 acres) as the Lassen Volcanic Wilderness. The 2002 General Management Plan for Lassen Volcanic National Park proposes up to an additional 25,000 acres be included for wilderness designation. Parkland proposed for wilderness expansion is currently managed as wilderness areas with the objective of protecting and conserving the natural resources found within these areas. National Park Service wilderness management policies are based on provisions of the 1916 National Park Service Organic Act, the 1964 Wilderness Act, and legislation establishing individual units of the national park system. These policies establish consistent service-wide direction for the preservation, management, and use of wilderness and prohibit the construction of roads, buildings and other man-made improvements and the use of motorized vehicles in wilderness. All park management activities proposed within wilderness are subject to review following the park's minimum tool decision process (see Appendix 8.13).

Wilderness use at Lassen Volcanic National Park includes such activities as hiking, backpacking, horseback riding, swimming and fishing in the summer, and winter cross country skiing and snowshoeing. The average annual overnight wilderness use in the park is approximately 7,750 person nights per year. There are approximately 150 miles of trail and 15 foot bridges within the park's wilderness. The park includes portions of two Congressionally designated trails, the Nobles Emigrant Trail, a component of the California National Historic Trail, and the border-to-border Pacific Crest National Scenic Trail. There are three historic structures maintained within the wilderness: Mt. Harkness Fire Lookout, and Twin Lakes and Horseshoe Lake patrol cabins.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 CONCEPT OF IMPACT ANALYSIS

The National Environmental Policy Act (NEPA) requires that environmental documents disclose the environmental impacts of the proposed federal action, reasonable alternatives to that action, and any adverse environmental effects that cannot be avoided should the proposed action be implemented. This section analyzes the environmental impacts of two project alternatives on physical and biological resources, archeology, visitor experience, park operations, wilderness values. These analyses provide the basis for comparing the effects of the alternatives. NEPA requires consideration of context, intensity and duration of impacts, indirect impacts, cumulative impacts, and measures to mitigate impacts.

In addition to determining the environmental consequences of the preferred and other alternatives, NPS *Management Policie*s (NPS, 2006) and Director's Order-12, *Conservation Planning, Environmental Impact Analysis, and Decision-making*, require analysis of potential effects to determine if actions would impair park resources. The NPS must consider the impacts of each alternative to determine if the described action would lead to an impairment of resources per the Organic Act and General Authorities Act. If there would be impairment the action may not be approved. An impairment is (the result of) an action that would diminish in strength, value, quality and/or quantity the resources for which the park is responsible. In the context of this document, impairment would be a management action that would harm the integrity of park resources or values, including opportunities that would otherwise be present for the enjoyment of those resources or values. Not all impacts constitute impairment. Severity, duration, and timing of the impact help determine whether the integrity of a park resource or value would be irreparably compromised. These determinations are made for each alternative for all natural and cultural resource topics, but not for visitor experience and park operations.

This Environmental Assessment (EA) analyzes the impacts of two alternatives (including the no-action alternative) on the environment in accordance with the National Environmental Policy Act of 1969, Council on Environmental Quality regulations (Title 40 Code of Federal Regulation Part 1500 *et sequentia*), NPS policies, and other relevant laws and regulations.

Impact Topics Analyzed in this Document. Impacts of the alternatives on the following topics are presented in this EA: (1) soils, (2) water resources, (3) wetlands, (4) vegetation, (5) wildlife, (6) special status species, (7) archeology (8) visitor experience, (9) park operations, and (10) wilderness values.

Impact Topics Dismissed from Further Analysis. The topics listed below either would not be affected or would be affected negligibly by the alternatives evaluated in this EA. Therefore, these topics have been dismissed from further consideration or analysis. Negligible effects are effects that are localized and immeasurable or at the lowest levels of detection.

Prime and Unique Farmlands. None of the alternatives evaluated in this EA would affect prime or unique farmlands, as potentially affected areas are located on NPS property that does not support agriculture.

Air Quality. The Clean Air Act of 1963, as amended, and associated NPS policies require the NPS to protect air quality in parks. Any impacts on air quality would be negligible in a local and regional context.

Floodplains. Any work proposed in floodplains would not alter the functional integrity of the system and, therefore, would have negligible effects to the floodplain.

Geologic/Geothermal Resources. Within the park is a diverse array of volcanic resources including composite volcanoes, shield volcanoes, plug dome volcanoes, tephra cones, lava flows, and active geothermal areas. There would be no impacts to thermal features in any of the alternatives evaluated in this EA.

Historic Structures. There are no changes proposed under either alternative to any historic structures and thus there would be no impacts.

Cultural Landscapes. Lassen Volcanic National Park has several Cultural Landscapes including, but not limited to, the Main Park Road and the Drakesbad Guest Ranch. Cultural resource guidelines for managing these areas will be followed. Further, none of the target weed species have horticultural values nor are they part of the historic planting palette. Thus, the actions evaluated in this EA would not adversely affect cultural landscapes.

Ethnographic Resources. The Lassen area has been described as a meeting point, or "cultural no man's land", for at least four native groups. Use of the area by the Atsugewi, Yana, Yahi, and northern Maidu groups brought a mix of cultural elements characteristic of central and northeastern California with Great Basin-Plateau elements (Treganza 1963:5).

For groups moving through the area, Lassen Peak provided seasonal resources on its slopes and in the open valleys and lakes that border it. Some of the most important resources include mule deer (*Odocoileus hemionus hemionus*), wild sunflower (*Wyethia mollis*), and various tubers. Journey (1970) draws a connection between sites where hopper mortars and pestles have been found and the reliance on wild sunflower as a staple in the late prehistoric and protohistoric diet.

Organized groups of Maidu and Atsugewi are currently located to the southeast and north of the Park. There are no organized groups of Yana orYahi. Although there is a fair amount of written ethnographic data for these American Indian groups, little information about the groups' contemporary use of the Park resources has been obtained. The Park is in the early stages of acquiring and documenting traditional and current use information from the local American Indian communities.

The actions evaluated in this EA would not adversely affect ethnographic resources.

Environmental Justice. The actions evaluated in this EA would not adversely affect socially or economically disadvantaged populations.

The fundamental purpose of the National Park System, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid or minimize to the greatest degree practicable adverse impacts on park resources and values. However, the laws do give the NPS management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the NPS management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the NPS must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgement of the responsible NPS manager, would harm the integrity of park resources or values, including opportunities that otherwise would be present for the enjoyment of those resources or values. An impact to any park resource or value may constitute an impairment. However, an impact would more likely constitute an impairment to the extent it affects a resource or value whose conservation is

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- identified as a goal in the Park's General Management Plan or other relevant NPS planning documents.

5.2 DEFINITION OF TERMS

Type of Impact

Adverse impacts are those that change the affected environment in a manner tending away from the natural range of variability.

Beneficial impacts are those that change the affected environment toward the natural range of variability.

Context of Impact

Direct impacts have an effect that is caused by an action and occurs in the same time and place.

Indirect impacts are those that occur at a different time and/or place than the action. Indirect impacts include changes such as species composition, structure of the vegetation, or range of wildlife. Indirect impacts also include impacts that occur off-site such as erosion-related impacts, or general economic conditions tied to park activities.

Cumulative impacts are those impacts on the environment that result from the incremental (i.e., additive) impact of direct and indirect impacts when added to other past, present, and reasonably foreseeable future actions regardless of who undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Duration of Impact

Duration is a measure of the time period over which the effects of an impact persist. The duration of impacts evaluated in this EA may be one of the following:

Short term impacts are those that can be reversed relatively quickly. Short term impacts typically occur only during implementation and last less than one year; or

Long term impacts are those that are reversed more slowly. Long term impacts typically remain for greater than one year.

Intensity of Impact

Intensity is a measure of the severity of an impact. The intensity of an impact may be:

negligible, when the impact is localized and not measurable or at the lowest level of detection;

minor, when the impact is localized and slight but detectable;

moderate, when the impact is readily apparent and appreciable; or

major, when the impact is severe and highly noticeable.

5.3 IMPACT ANALYSIS

5.3.1 Soils

Alternative 1
Surveying and monitoring areas for weeds could result in negligible levels of soil disturbance due to the footprints left by those conducting the surveys. Treatments, on the other hand can result in the following impacts:

1. Restoration activities, such as reseeding, could cause temporary disturbance to soil. Effects could include compaction of soil and disturbance to upper soil profiles. The effects to soil may be detectable in some areas. However, these changes would be minor, short-term, and localized.
2. Manual and mechanical treatments could cause a temporary disturbance to soils. Operation of equipment for activities such as physical removal of weeds could result in minor, short-term, adverse effects to soils in local areas.
3. Exotic plant management may have overall long-term beneficial effects from rehabilitating native plant communities, which could reduce the potential for soil erosion and sedimentation in disturbed areas.

Alternative 2
Alternative 2 would have all of the same potential impacts as alternative 1, plus the following:

Whenever using herbicides, there is a slight potential for accidental spills that could temporarily contaminate soils. Potential adverse impacts of accidental spills would be minor and short-term. Some herbicides have the potential to persist in soils that are fine-textured, which could lead to herbicide buildup in soils. The majority of soils in the Park, however, are rocky and well-draining; therefore, the risk of herbicide build-up as a result of this treatment at the Park is extremely low.

The heat intensity and duration of fire treatments are low enough to have negligible adverse effects on the soil.

Cumulative Impacts. The primary adverse soil impacts occurring as a result of other past and ongoing actions are compaction and erosion, resulting from development and concentrated visitor use in the Park, and the existence of a number of abandoned sites where soils have been disturbed and revegetation has not been completed. Recent improvements to soils include the restoration of the abandoned downhill ski area and the restoration of disturbed lands such as those at Baldwin Quarry, Lake Helen Picnic Area, and Sulphur Works. There have also been several projects that have had both minor beneficial and adverse impacts on soils. Those projects include the construction of the Southwest Entrance Station, the construction of the Southwest Visitor Center and extensive road rehabilitation. Impacts from the above actions, together with the impacts of the no-action alternative, would result in minor adverse cumulative impacts to soils in the Park. The no-action alternative would contribute a negligible long-term adverse increment to total cumulative effects on soils in the Park.

Conclusion. Both the no-action alternative and the preferred alternative would have long-term, negligible to minor, adverse and beneficial effects, and would not impair soils in the Park.

5.3.2 Water Resources.

Alternative 1
The following are the potential impacts from the various proposed treatments:

1. Prevention, reseeding, and irrigation would have a beneficial effect of promoting the reestablishment of native vegetation, which could help reduce erosion and sedimentation in

surface waters. Changes in water quality could be beneficial, minor to moderate and long-term on a local level.
2. The potential impacts to water quantity from irrigation would likely be negligible since this treatment would be very rarely used.
3. Minor mechanical disturbance to native plants from tilling or other ground disturbing activity may result in indirect effects, such as increased sedimentation, to surface waters. Adverse impacts would be minor, short-term and localized.

Alternative 2
Alternative 2 would have all of the same potential impacts as alternative 1, plus the following:

There would be no use of herbicides that do not have an aquatic label in or adjacent to water. Herbicide labels will be strictly followed. Further, the RAVE (Relative Aquifer Vulnerability Evaluation) model to evaluate the risk of ground water contamination in areas where leaching is possible would be utilized. Therefore, while the potential for adverse effects to water resources is slightly higher under this alternative, the mitigations that would be put in place would keep the adverse effects at a negligible to minor, short-term level.

The adverse effects of using the wilting tool would be negligible .

Cumulative Impacts. The primary impacts to water resources as a result of other past and ongoing actions are a result of localized construction that resulted in negligible, short-term impacts. Extensive mitigations and Best Management Practices have been put in place for all major constructions projects so as to keep the impacts negligible. Such projects include the construction of the Southwest Entrance Station, construction of the Visitor Center and road rehabilitation. Major repairs to many of the Park's road culverts have also taken place in the last several years that resulted in negligible short-term impacts to both water quality and quantity. In several cases it has restored dynamic hydrologic processes previously altered by the road. Several projects have also taken place in the last several years to improve the Park's quality of drinking water. Improvements to several water intakes as well as several water treatment plants have had negligible short-term adverse impacts as well as minor long-term beneficial impacts to water quality. A new leach field is planned to be constructed for the Warner Valley in 2008. This project could result in minor short-term adverse impacts due to construction. However, the removal of the old leach field would lead to moderate long-term beneficial impacts to water quality because the current leach field is failing and thus creating adverse impacts to water quality. Impacts from the above actions, together with the impacts of the no-action alternative or the preferred alternative, would result in minor short-term adverse effects and minor long-term beneficial effects.

Conclusion. Both the no-action alternative and the preferred alternative would have long-term, minor, adverse effects, but would not impair water resources in the Park.

5.3.3 Wetlands

Alternative 1
The following are the potential impacts from the various proposed treatments:
1. Prevention, reseeding, and irrigation would have a beneficial effect of promoting the reestablishment of native vegetation, which could help reduce erosion and sedimentation in surface waters. Changes in water quality could be beneficial, minor to moderate and long-term on a local level.
2. The potential impacts to water quantity from irrigation would likely be negligible since this treatment would be very rarely used.
3. Minor mechanical disturbance to native plants from tilling or other ground disturbing activity may result in indirect effects, such as increased sedimentation, to surface waters. Adverse impacts would be minor, short-term and localized.

Alternative 2
Alternative 2 would have all of the same potential impacts as alternative 1, plus the following:

There would be no use of herbicides that do not have an aquatic label in or adjacent to water. Herbicide labels will be strictly followed. Further, the RAVE (Relative Aquifer Vulnerability Evaluation) model to evaluate the risk of ground water contamination in areas where leaching is possible would be utilized. Therefore, while the potential for adverse effects to water resources is slightly higher under this alternative, the mitigations that would be put in place would keep the adverse effects at a negligible to minor, short-term level.

The adverse effects of using the wilting tool would be negligible .

Cumulative Impacts. The primary impacts to water resources as a result of other past and ongoing actions are a result of localized construction that resulted in negligible, short-term impacts. Extensive mitigations and Best Management Practices have been put in place for all major constructions projects so as to keep the impacts negligible. Such projects include the construction of the Southwest Entrance Station, construction of the Visitor Center and road rehabilitation. Major repairs to many of the Park's road culverts have also taken place in the last several years that resulted in negligible short-term impacts to both water quality and quantity. In several cases it has restored dynamic hydrologic processes previously altered by the road. Several projects have also taken place in the last several years to improve the Park's quality of drinking water. Improvements to several water intakes as well as several water treatment plants have had negligible short-term adverse impacts as well as minor long-term beneficial impacts to water quality. A new leach field is planned to be constructed for the Warner Valley in 2008. This project could result in minor short-term adverse impacts due to construction. However, the removal of the old leach field would lead to moderate long-term beneficial impacts to water quality because the current leach field is failing and thus creating adverse impacts to water quality. Impacts from the above actions, together with the impacts of the no-action alternative or the preferred alternative, would result in minor short-term adverse effects and minor long-term beneficial effects.

Conclusion. Both the no-action alternative and the preferred alternative would have long-term, minor, adverse effects, but would not impair water resources in the Park.

5.3.4 Vegetation

Alternative 1
Potential impacts to vegetation resources include the following:
1. Intrusion by personnel conducting exotic plant management activities would cause negligible, short-term adverse effects from foot traffic en route to exotic plant populations. Individual plants would be trampled but would result in no long-term effects.
2. Cultural treatments, such as reseeding could have a long-term moderate beneficial effect of promoting the reestablishment of native vegetation in localized areas.
3. Ground disturbance, such as can occur when using hand tools, may cause a minor, short-term adverse effect to individual nearby native plants. However, infrequent impacts to individual plants generally have negligible to minor impacts on plant communities.
4. The level of exotic plant management in Alternative 1 would have a minor to moderate, long-term, beneficial effect on plant communities and habitat.

Alternative 2
Potential impacts to vegetation include all of those listed above for Alternative 1, plus the following:
1. Non-target native plants subjected to chemical (herbicide) drift could experience no effect, reduced vigor, or death depending on the sensitivity of the plant species to the specific herbicide and the dose the plant was subjected to. Overall, use of chemical controls would have infrequent

adverse, short-term minor impacts on individual plants. Infrequent impacts to individual plants generally have negligible to minor impacts on plant communities. The impacts of herbicide use on native (non-weed) species would therefore be directly adverse, site-specific, short-term, and negligible to minor. The effect on plant communities from the targeted removal of weed species through chemical use would have a localized beneficial, moderate effect in the long-term.
2. Inherent potential risks when fire as a management tools is negatively impacting non-target species. Proper training and monitoring will eliminate or reduce this risk. Potential adverse impacts of accidentally burning non-target species would be minor and short-term.
3. The level of exotic plant management in Alternative 2 would have a moderate, long-term, beneficial effect on plant communities and habitat. This alternative would likely achieve the desired condition for plant communities in a more timely fashion than would Alternative 1.

Cumulative Impacts. The primary impacts to vegetation within the Park have come from both natural and human-induced events. Volcanic eruptions of Lassen Peak in 1914 and 1915 destroyed over three square miles (1,920 acres) of forestland. The successional process of reforestation is now taking place, with herbs, shrubs, and finally, trees taking root in the coarse soils. Human activities, particularly fire suppression, have also altered the structure and composition of forest vegetation. In addition to broad scale changes in vegetation characteristics, relatively small patches and corridors of habitat have been lost in the park in areas that have been developed for facilities, trails, and roads. Impacts from the above actions, in combination with the impacts of either the No Action Alternative or the Preferred Alternative, would result in negligible adverse cumulative effects on vegetation over the long-term. Both alternatives would also result in minor localized beneficial effects.

Conclusion. Both the no-action alternative and the preferred alternative would have minor short-term adverse effects, but they would both also provide minor to moderate beneficial effects in the long-term and would not impair vegetation in the Park.

5.3.5 Wildlife

Alternative 1
Potential impacts of various treatments on wildlife are described below:
1. Intrusion into habitat by personnel conducting exotic plant management would cause short-term, negligible harassment to wildlife species. There may be some escape flight response from wildlife during these activities, but this would produce negligible, short-term, site-specific adverse impacts in the form of unnecessary energy expenditures.
2. Reseeding and irrigation could have a beneficial effect of promoting the reestablishment of wildlife habitat. The impacts would therefore be beneficial, site-specific, long-term, and minor to moderate.
3. Manual or mechanical treatments could have site-specific adverse impacts on ground nesting birds, burrowing animals, and amphibians or their food source. Best Management Practices would limit these adverse effects to being short-term and negligible.
4. Potential effects of irrigation treatments would likely be negligible on surface water flows since this tool is not often used. Adverse impacts to fisheries would therefore be negligible, site-specific and short-term.
5. Minor mechanical disturbance to native plants from ground disturbing activities may result in slightly increased sedimentation to surface waters which could indirectly result in minor, adverse, site-specific, short-term effects on fisheries.
6. Overall improvements to vegetation communities by removal of the targeted species directly relate to an improvement in wildlife habitat. Therefore, this alternative would have a minor, site-specific, long-term beneficial effect on wildlife.

Alternative 2
Alternative 2 would have all of the same potential impacts as alternative 1, plus the following:

It is unlikely that terrestrial wildlife species would receive direct exposure to herbicides during application. It is also unlikely that wildlife would be overexposed over time if the herbicides are used according to label specifications. Wildlife species would most likely flee the area or escape to an underground burrow/den upon the arrival of personnel conducting exotic plant management treatments. IPM practices ensure that herbicide accumulation on site would be minimal and persistence is contingent on the specific herbicide. Adverse impacts would be minor, short-term, and site-specific. The reduction in habitat by the removal of exotic species would be negligible and short-term as the native plant community replaces it. In addition, ground and noise disturbance to wildlife will be reduced by the decrease in staff and volunteers hours at the site.

Although aquatic herbicide application is not being considered at this time, it is also unlikely that aquatic wildlife species would receive direct exposure to herbicides during application, and it is unlikely that they would be overexposed if the herbicides are used according to label specifications. Impacts resulting from the use of herbicides would not be expected to have any long-term adverse impacts on native aquatic wildlife species, their habitats, or natural processes sustaining them. The impacts of chemical treatments on aquatic wildlife and fisheries would therefore be direct, site-specific, short-term and negligible.

Negligible impacts to wildlife species are predicted as a result of fire treatments.

Cumulative Impacts. The combined effects of development in the Park and in the surrounding area over time coupled with the purposeful eradication of many predator species during the 1800s and early 1900s have contributed to low level or extirpated wildlife populations of some key species in the Park. While there are no major development projects planned for the Park that would result in additional cumulative effects to wildlife, the cumulative effects of existing development continue to take a toll on wildlife from the effects of collisions on the road as well as from occasional wildlife-human interactions. The existence and maintenance of the park roads contribute to a long-term negligible minor adverse effect on wildlife increasing some species while decreasing the presence of others. Actions proposed under both alternatives would contribute a negligible long-term adverse effect, as well as negligible beneficial effects from habitat improvements resulting from weed management.

Conclusion. Both the no-action alternative and the preferred alternative would have negligible to minor, short-term, site-specific adverse effects and major long-term beneficial effects, and neither would impair wildlife in the Park.

5.3.6 Special Status Species

Alternative 1
There would be no additional impacts (no effect) to special status species under the implementation of the No Action Alternative. Occurrence and impact information is presented in the Affected Environment section of this EA.

Alternative 2
There would be no additional impacts (no effect) to special status species under the implementation of the Preferred Alternative. Occurrence and impact information is presented in the Affected Environment section of this EA.

Cumulative Impacts. Most of the special status species have not been verified to occur within the park and suitable habitat is limited or does not exist. Habitat modification within the park includes broad scale changes in vegetation characteristics due to fire suppression, grazing, water resources alteration, and the loss of comparatively small patches and corridors where park land has been

developed for facilities, trails, and roads. This has resulted in a reduction of habitat available for use by special status species that occur within the Park. Because neither alternative would affect special status species, there would be no contribution to cumulative effects on these species.

Conclusion. There would be no effect on any listed, candidate, rare or sensitive wildlife. There is no habitat for any listed, rare, or sensitive species would be affected by the proposed actions and because those species also do not occur within weed management areas. There would be no impairment of special status species under either alternative. Mitigation measures for species of concern to park management are outlined in section 5.4.

5.3.7 Prehistoric and Historical Archeology

Alternative 1
As discussed in the Affected Environment section of this document, many areas within the park have not have been surveyed for presence of archeological resources. The potential for disturbing previously unknown or undiscovered archeological resources exists. A mitigation measure has therefore been created to account for this possibility. Any new areas or areas not previously reviewed for vegetation removal or management shall be reviewed by the Cultural Resources Program Manager prior to any weed removal treatments being undertaken. The Plant Ecologist will contact the Cultural Resources Program Manager in advance of the weed management project to determine if the area is within a known archeological or culturally sensitive area. A strategy to preserve the integrity of the cultural site will be determined at that time. For areas that have been approved by the Cultural Resources Program Manager to have weed management projects undertaken, it is still required that all work stop immediately if any archeological resources are found or uncovered and the Cultural Resources Program Manager shall be contacted immediately.

Alternative 2
This alternative has the same potential for impacts and thus contains the same mitigation measures listed above under Alternative 1.

Cumulative Impacts. Archeological resources have been adversely impacted to varying degrees from past construction-related disturbances (prior to the advent of archeological resource protection laws); visitor impacts and vandalism; and erosion and other natural processes. Because of mitigation measures, neither alternative would be expected to contribute to cumulative effects on archeological resources.

Conclusion. Both the no-action alternative and the preferred alternative would have no adverse effect and would not impair archeological resources in the Park.

5.3.8 Visitor experiences

Alternative 1
Operation of tools and equipment could have a negligible, short-term adverse effect on visitor experience.

The Park has received some complaints in the past that the presence of exotic species reduces their enjoyment level in the park. The successful implementation of a weed management plan would result in a negligible to moderate beneficial impact on visitor experience, depending on the individual.

Alternative 2
Chemical treatments could, on rare occasions, require visitor use closures for visitor protection during herbicide application and while the herbicide dries. Visitor access would also be restricted during wilting treatments for safety purposes. This displacement of visitors would be rare, short-

term, and site-specific due to the wide distribution of exotic plants throughout the Park. The health and safety benefits to visitors, however, outweigh the short-term effects of restricting their access. The impacts to visitor use would be directly beneficial and adverse, site-specific, short-term, and minor.

Cumulative Impacts. The majority of park visitation occurs along the main park road, where most of the park's recreational facilities and interpretive displays are found. A newly constructed Visitor Center will soon be providing beneficial effects to visitor experience over the long-term. Over time, other new facilities (limited by the current developed footprint) could continue to be added or old facilities improved, resulting in negligible to minor adverse and beneficial cumulative impacts to visitor experience. Other past improvements to visitor experience have included repaving the main park road, campground improvements, increased vault toilets, new interpretive signs, and more. Both the No Action Alternative and the Preferred Alternative would contribute a negligible long-term beneficial effect to visitor experience.

Conclusion. Both the no-action alternative and the preferred alternative would have negligible to moderate beneficial effects as well as negligible to minor adverse effects on visitor experience in the Park.

5.3.9 Park Operations

Alternative 1
Implementation of a weed management plan could slightly affect park operations. Funding for its implementation would come from a continuation of existing funding used for weed management and construction contracts.

Alternative 2
There would likely be a decrease in administrative support for personnel and procurement because of the effectiveness and efficiency of these additional tools. The increase in storage space needs and fuel will be negligible. However, the park already provides these services and can absorb the small increases associated with continuing the existing weed management program. The adverse impacts on park operations would therefore be short-term and negligible. Implementation of additional Best Management Practices (Appendix 8.11) procedures would require park operations to adhere to more stringent practices than in Alternative 1. The additional time and cost in preventative practices will be offset by the reduction in personnel and equipment costs to treat the weeds.

Cumulative Impacts. Virtually every aspect of park management can and has affected Park Operations throughout the history of the park. Actions proposed under the no action alternative would contribute a negligible long-term adverse effect while actions proposed under the preferred alternative could contribute negligible long-term beneficial effects and negligible short-term adverse effects to park operations.

Conclusion. The no-action alternative would have negligible long-term adverse effects while the preferred alternative would have negligible short-term adverse effects as well as negligible long-term beneficial effects.

5.3.10 Wilderness values

Alternative 1
A Minimum Requirement Analysis would be completed prior to any treatments in wilderness areas to confirm that the minimum tool/treatment that poses the least possible risk to wilderness values is selected. Minimum Requirement Analysis would be used to select the "minimum tool," or treatment or combinations of treatments that pose the least risk to wilderness values, while still accomplishing weed management objectives.

A temporary change in wilderness character and associated values would occur during weed management activities. Some aspects of weed management may be intrusive on the wilderness experience. The presence of park personnel and equipment could impact visitor solitude and self-discovery. However, the removal of weed species could also improve the wilderness experience for those individuals who find that weed species detract from their overall experience. The adverse impacts of weed management on wilderness would be minor and short—term and the beneficial impacts would be moderate and long-term. The plan's objective to restore functioning native plant communities supports Wilderness Values and, in many cases, it is the health of these ecosystems that initially supported wilderness designation.

Alternative 2
Herbicide and wilting techniques would be primarily used in non-wilderness areas where previous disturbance is greatest. The infrequent use of herbicides and wilting in wilderness would have minor and short-term adverse effects. The increased effectiveness of the proposed alternative, however, would reduce the repeated, long-term disturbance to visitors, wildlife, and plants by reducing the number of staff and volunteer hours spent removing vegetation by hand.

Cumulative Impacts. The primary impacts to wilderness in the past have been from noise from aircraft and park fire operations and visitor use. Actions proposed under both alternatives are non-motorized and would contribute a negligible to minor adverse effect to wilderness values in localized areas. A Minimum Requirement Analysis Worksheet was completed (Appendix 8.13). It was determined the Weed Management Plan supports Visitor Enjoyment and Recreation and Resource Protection and Research.

Conclusion. Both the preferred alternative would have minor and short-term adverse effects as well as minor and long-term beneficial effects. Neither alternative would impair wilderness values in the Park. The plan's objective to restore functioning native plant communities supports Wilderness Values and, in many cases, it is the health of these ecosystems that initially supported wilderness designation. Both the no-action alternative and the preferred alternative would have minor and short-term adverse effects as well as moderate and long-term beneficial effects. Neither alternative would impair wilderness values in the Park.

5.4 MITIGATIONS

Impact Topic	Mitigation Measures	Responsibility
Soils	Follow park-specific protocol and, where applicable, herbicide labels.	Plant Ecologist
Water Resources	Follow herbicide label. Conduct Relative Aquifer Vulnerability Evaluation (RAVE) for herbicide to determine site suitability and potential buffer zones. Follow Weed Management and Herbicide Protocols	Plant Ecologist
Wetlands	Follow Weed Management and Herbicide Protocols. Follow herbicide label. Conduct Relative Aquifer Vulnerability Evaluation (RAVE) for herbicide to determine site suitability and potential buffer zones.	Plant Ecologist
Vegetation	Follow Weed Management Protocol for surveying, treatment, and monitoring to track native plant community cover and diversity.	Plant Ecologist
Wildlife	Bald Eagles, California Spotted Owl, American Peregrine Falcon Northern goshawk: Wildlife biologist will be contacted during breeding season before entering the site. Cascades frog: Wildlife biologist will be contacted before treatment in the vicinity of designated ponds. Sierra Nevada red fox, Little Willow Flycatcher, Greater Sandhill Crane, Prarie Falcon, Rufous Hummingbird, Vaux's Swift, American Dipper, Northwestern pond turtle: Wildlife biologist will be contacted immediately upon sighting.	Plant Ecologist Plant Ecologist Plant Ecologist

Archeology	Any new areas or areas not previously reviewed for vegetation removal or management shall be reviewed by the Cultural Resources Program Manager. The Plant Ecologist will contact the Cultural Resources Program Manager in advance of the management project to determine if the area is within a known archeological or culturally sensitive area. A strategy to preserve the integrity of the cultural site will be determined	Park Archeologist and Plant Ecologist
Visitor Experiences	Follow Weed Management and Herbicide protocols.	Plant Ecologist
Park Operations	Follow Best Management Practices.	Division Chiefs, Facility manager, Project managers
Wilderness Values	Conduct Minimum Requirement Analysis.	Plant Ecologist

6.0 CONSULTATION AND COORDINATION

6.1 PERSONS, ORGANIZATIONS, AND AGENCIES CONSULTED

The following persons, organizations, and agencies were contacted for information and/or assisted in identifying important issues, developing alternatives, or analyzing impacts of this environmental assessment.

Cheryl Bartlett, Wetland Ecologist, National Park Service Klamath Network
Michelle Cox, Plant Ecologist, Lassen Volcanic National Park
Amy Fesnock, Acting Branch Chief of Foothill and Valley Ecosystems, US Fish & Wildlife Service Sacramento Field Office
Debra Frein, NEPA Coordinator, Lassen Volcanic National Park
Louise Johnson, Chief of Natural Resources, Lassen Volcanic National Park
Cari Kreshak, Archeologist, Lassen Volcanic National Park
Michael Magnuson, Wildlife Biologist, Lassen Volcanic National Park
Nancy Nordensten, Biologist, Lassen Volcanic National Park
Judy Perkins, Assistant Forest Botanist, Lassen National Forest
Bobbi Simpson, Liason – CA Exotic Plant Management Team, National Park Service
Mandy Tu, Regional Invasive Species Ecologist, The Nature Conservancy

6.2 LIST OF PREPARERS

Michelle Cox, Plant Ecologist, Lassen Volcanic National Park
Debra Frein, NEPA Coordinator, Lassen Volcanic National Park

6.3 PERSONS, ORGANIZATIONS, AND AGENCIES WHO RECEIVED THIS ENVIRONMENTAL ASSESSMENT

Lassen Volcanic National Park conducted both internal scoping with appropriate NPS staff and external scoping with the public and interested and affected groups, agencies, and tribes to determine the range of issues to be discussed in this Environmental Assessment.

A press release initiating the public scoping process and comment period was issued on December 19, 2007 and was also posted on the park's website. Two local newspapers, the *Red Bluff Daily News* and the *Chester Progressive* printed the press release.

Native American Indian Tribes
Five tribes are routinely consulted with regarding park proposed actions. These tribes are Greenville Rancheria, Mooretown Rancheria, Redding Rancheria, Pit River Tribe and the Susanville Rancheria. These five tribes were sent letters on January 14, 2008 noting the likely undertaking. No comments were received.

California State Historic Preservation Office
Consultation, noting determination of effects on cultural resources will be sent to the State Historic Preservation Office pending the release of this Environmental Assessment to determine concurrence with the determinations of effect noted herein.

U.S. Fish and Wildlife Service
Because there would be no effect on listed or candidate species from the alternatives in this Environmental Assessment, no further Section 7 (Endangered Species Act) consultation with the USFWS is necessary. The Federal Endangered and Threatened Species list (Document # 080114103718) was queried on January 14, 2008 from the Sacramento Field Office website.

(http://www.fws.gov/sacramento/es/spp_lists/auto_list.cfm). A copy of the query can be found at R:\Natural Res Management\Vegetation\Rare Plants\Listed plant\USFWS_quad_list_1_2008.pdf. A memorandum dated January 15, 2008 documents the conversation with LVNP's contact person at USFWS Sacramento Field Office. Their decision to not require a concurrence letter and the justification is located in the compliance files for this EA.

This EA is available for a **thirty-day** public review period. At that time, a press release will be distributed to a list of persons, businesses and agencies that have expressed interest in Lassen Volcanic National Park proposed actions and events. The Environmental Assessment will also be mailed to local libraries, organizations and individuals that have requested to receive a copy of the EA as well as others who request copies during the review period. The EA will also be available on the park's website, located at http://www.nps.gov/lavo.

The following groups have either received a hard copy of the EA or have been notified of its availability:

ENVIRONMENTAL GROUPS

A.S. ENVIRONMENTAL AFFAIRS COUNCIL
ALTACAL AUDUBON SOCIETY
BARRY R. KIRSHNER WILDLIFE FOUNDATION
BATTLE CREEK WATERSHED CONSERVANCY
BIDWELL PARK ENDOWMENT FUND
BIDWELL WILDLIFE REHABILITATION CENTER
BUTTE CREEK WATERSHED CONSERVANCY
BUTTE ENVIRONMENTAL COUNCIL
CALIFORNIA CONSERVATION CORPS
CALIFORNIA NATIVE PLANT SOCIETY
CALIFORNIA TROUT INC
CALIFORNIA WILDERNESS COALITION
CHEROKEE PRESERVATION SOCIETY
CHEROKEE WATERSHED GROUP
CHICO CONSERVATION VOTERS
DEER CREEK WATERSHED CONSERVANCY
EARTHJUSTICE LEGAL DEFENSE FUND
ENVIRONMENTAL ADVOCATES
FRIENDS OF BUTTE CREEK
FRIENDS OF PLUMAS WILDERNESS
LASSEN FOREST PRESERVATION GROUP
LITTLE CHICO CREEK WATERSHED GROUP
MILL CREEK CONSERVANCY
NATIONAL AUDUBON SOCIETY
NATIONAL PARKS CONSERVATION ASSN.
NATURAL LANDS PROJECT
NATURAL RESOURCES DEFENSE COUNCIL
NATURE CONSERVANCY
NORTHERN CALIFORNIA REGIONAL LAND TRUST
PLUMAS FOREST PROJECT
SACRAMENTO RIVER PRESERVATION TRUST
SACRAMENTO RIVER WATERSHED PROGRAM-RESOURCE CENTER
SIERRA CLUB, SHASTA GROUP
SIERRA CLUB, YAHI GROUP
SIERRA NEVADA FOREST PROTECTION CAMPAIGN
THE NATURE CONSERVANCY, SACRAMENTO RIVER PROJECT
THE WILDERNESS SOCIETY
WILDERNESS WATCH
WINTU AUDUBON SOCIETY

GOVERNMENT AGENCIES

CDFG – NORTHERN CA NORTH COAST REGION
FEATHER RIVER RECREATION & PARKS
LASSEN COUNTY AIR QUALITY MGMT DIST
LASSEN COUNTY PLANNING DEPT.
LASSEN HISTORICAL SOCIETY
LASSEN NATIONAL FOREST
LASSEN/MODOC CDF
MCARTHUR BURNEY FALLS STATE PARK
MT LASSEN TROUT FARM
CALIFORNIA STATE OFFICE
NORTHERN SIERRA AIR QUALITY MGMT DIST
PARK RANGERS ASSN. OF CA
PLUMAS COUNTY
PLUMAS NATIONAL FOREST
SHASTA COUNTY
SHASTA COUNTY AIR QUALITY MGMT DIST
SHASTA COUNTY SHERIFF
SOIL CONSERVATION SERVICE
STATE BOARD OF FORESTRY
TEHAMA COUNTY AIR QUALITY MGMT DIST
U.S ENVIRONMENTAL PROTECTION AGENCY
U.S. ARMY CORPS OF ENGINEERS
U.S. FISH AND WILDLIFE SERVICE
U.S. GEOLOGICAL SURVEY
USDI – BUREAU OF RECLAMATION
USGS – VOLCANO HAZARDS TEAM
CA AIR RESOURCES BOARD
CA DEPARTMENT OF TRANSPORTATION
CA HISTORIC PRESERVATION OFFICE
CALIFORNIA CONSERVATION CORP
BUREAU OF INDIAN AFFAIRS
CA REGIONAL WATER QUALITY CONTROL BOARD
CALIFORNIA DEPARTMENT OF FISH & GAME
BUREAU OF LAND MANAGEMENT

NATIVE AMERICAN RANCHERIAS
GREENVILLE RANCHERIA
LASSEN NATIONAL FOREST – TRIBAL LIAISON
PIT RIVER TRIBE
REDDING RANCHERIA
BERRY CREEK RANCHERIA
ENTERPRISE RANCHERIA
GREENVILLE RANCHERIA
MOORETOWN RANCHERIA
SHINGLE SPRINGS RANCHERIA
SUSANVILLE RANCHERIA
UNITED AUBURN INDIAN COMMUNITY

LOCAL BUSINESSES
CALIFORNIA GUEST SERVICES
BATTLE CREEK MEADOWS RANCH, INC.
LASSEN PARK FOUNDATION
LASSEN ASSOCIATION
BURNEY CHAMBER OF COMMERCE
CHILD'S MEADOW RESORT
DYER MOUNTAIN ASSOCIATES
GLEN FERGERSON CONSTRUCTION
LASSEN COUNTY CHAMBER OF COMMERCE
LASSEN VIEW RESORT
MCGOVERN CABIN RENTALS
MILL CREEK RESORT
MINERAL GAS MART
MINERAL LODGE
MT LASSEN CAMP
MT. LASSEN/KOA SHINGLETOWN
OLD STATION CAFE & PUB
OLD STATION CHEVRON
PASSAGE EXCAVATING
PAUL BUNYAN CONSERVATION SOCIETY
PLUMAS CITY VISITORS BUREAU
RANCHERIA RV PARK
RED BLUFF-TEHAMA COUNTY
REDDING CHAMBER OF COMMERCE
REEDS SENTRY MARKET
RIM ROCK RANCH
RIPPLING WATERS RESORT
SHASTA CASCADES WONDERLANDS
SHINGLETOWN REALTY
SHINGLETOWN STORE
SIERRA PACIFIC INDUSTRIES
VOLCANO COUNTRY CAMPING
WESTON HOUSE

POLITICIANS
LASSEN COUNTY BOARD OF SUPERVISORS
PLUMAS COUNTY BOARD OF SUPERVISORS
SHASTA COUNTY BOARD OF SUPERVISORS
TEHAMA COUNTY BOARD OF SUPERVISORS
DAVE COX
BARBARA BOXER
DIANNE FEINSTEIN
SAM AANESTAD
RICK KEENE
DOUG LA MALFA

SPECIAL USE PERMITS
3HG ENTERPRISES, INC.
ADVENTURE TREKS, INC.
ALL WEST COACH LINES
ASA PEAK ADVENTURES
BAY AREA OUTDOOR ADVENTURE CLUB
CALIFORNIA ALPINE GUIDES
COPPER CREEK CAMP
GREEN TORTOSIE ADVENTURE TRAVEL
MOUNTAIN ADVENTURE SEMINARS, LLC
MOUNTAIN MEADOW RANCH
OUTBACK ADVENTURES
SIERRA WILDERNESS SEMINARS, INC.
STORER COACHWAYS
TAHOE TRIPS & TRAILS, LLC
TIMBERLINE ADVENTURES
WATERCOLOR ADVENTURE
JACK TROUT GUIDE SERVICES

LIBRARIES
PLUMAS COUNTY LIBRARY
SHASTA COUNTY LIBRARY
SUSANVILLE DISTRICT LIBRARY
TEHAMA COUNTY LIBRARY
CHESTER LIBRARY
SHINGLETOWN LIBRARY
SHASTA COUNTY LIBRARY
CHICO PUBLIC LIBRARY

7.0 LITERATURE CITED

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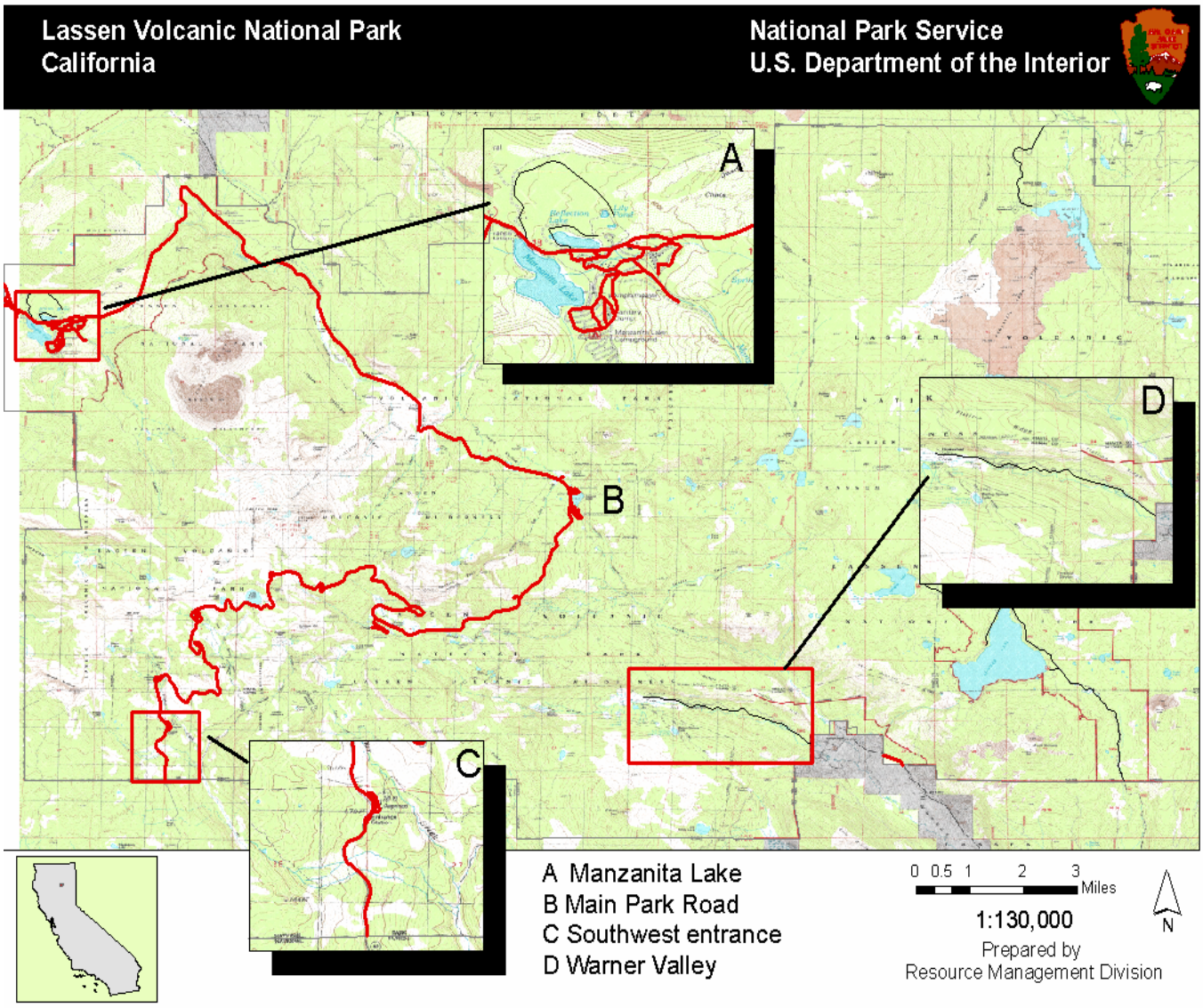
8.0 APPENDICES

8.1 MAP



Map 2. Location map of Lassen Volcanic National Park, California highlighting major developed areas.

8.2 PRIORITIZATION OF EXOTIC SPECIES

Excerpt from "An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1." (Morse and others 2004).

NatureServe, in cooperation with The Nature Conservancy and the U.S. National Park Service, developed this Invasive Species Assessment Protocol as a tool for assessing, categorizing, and listing non-native invasive vascular plants according to their impact on native species and natural biodiversity in a large geographical area such as a nation, state, province, or ecological region. This protocol is designed to make the process of assessing and listing invasive plants objective and systematic, and to incorporate scientific documentation of the information used to determine each species' rank. NatureServe's methodology has previously included assessments of the conservation significance of native species; this protocol extends that scope to non-native species as well. The protocol is used to assess species (or infraspecific taxa, as appropriate) individually for a specified "region of interest" and to assign each species an Invasive Species Impact Rank (I-Rank) of High, Medium, Low, or Insignificant to categorize its negative impact on natural biodiversity within that region. The protocol includes 20 questions, each with four scaled responses (A-D, plus U = unknown). The 20 questions are grouped into four sections: Ecological Impact, Current Distribution and Abundance, Trend in Distribution and Abundance, and Management Difficulty. Each species is assessed by considering these questions, with the answers used to calculate a subrank for each of the four sections. An overall I-Rank is then calculated from the subranks. Text comments and citations to information sources should be provided as documentation for each answer selected, along with a concise text summary of the major considerations leading to the overall rank. While designed for use in a specified large, contiguous, biogeographically diverse region, the protocol can be adapted to specified noncontiguous regions (such as the 50 states of the United States), and may also be applied to assess the impact in the non-native range of a species that is also present elsewhere in a region as a native. NatureServe is now using this protocol to assess the biodiversity impact of the approximately 3,500 non-native vascular plant species established outside cultivation in the United States. The protocol is offered here in generalized form for others who might wish to use it to conduct similar assessments and create lists of invasive plants for other nations, states, provinces, ecological regions, or comparable areas.

Results
In the Establishment Phase, management should place a high priority on cheatgrass (brotec), Himalaya blackberry, perennial pepperweed, and reed canarygrass (Figure 1).

In the Spread Phase, species management should place a high priority on bull thistle and mullein, with salsify a close third (Figure 2). The software determined salsify to be a high priority based on its wide distribution throughout the park but staff tacit knowledge of the invasiveness and density of LVNP populations determines it to be a low priority (Appendix 8.5). Tacit knowledge trumps software with this one species.

In the Colonization Phase (Figure 3) species were more evenly distributed. It is recommended (Klinger 2007) early detection protocol be applied to highest scoring species which would have the greatest impact if they do invade an area (medusahead, purple loosestrife, French broom, Scotch broom, and star thistle). The other species had high scores because of their distribution and abundance patterns, but tend to have less severe impacts than the first five.

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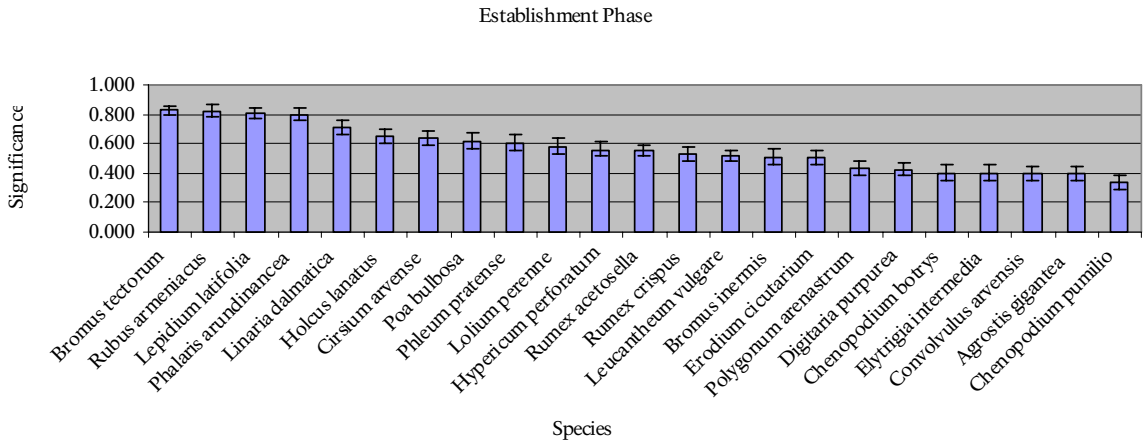

Figure 1. The significant (low to high) risk each species poses in Lassen Volcanic National Park, CA during the establishment phase using *An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1* (Morse and others 2004).

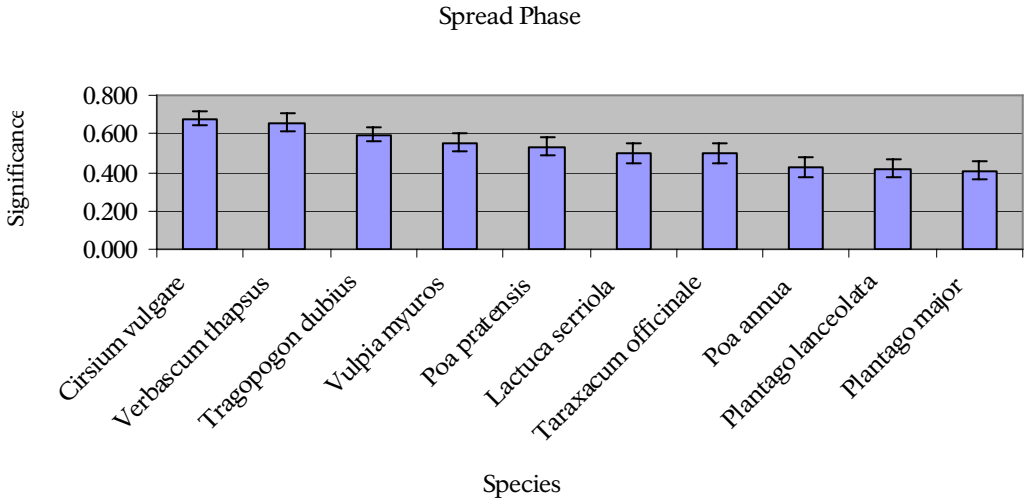

Figure 2. The significant (low to high) risk each species poses in Lassen Volcanic National Park, CA during the spread phase using *An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1* (Morse and others 2004).

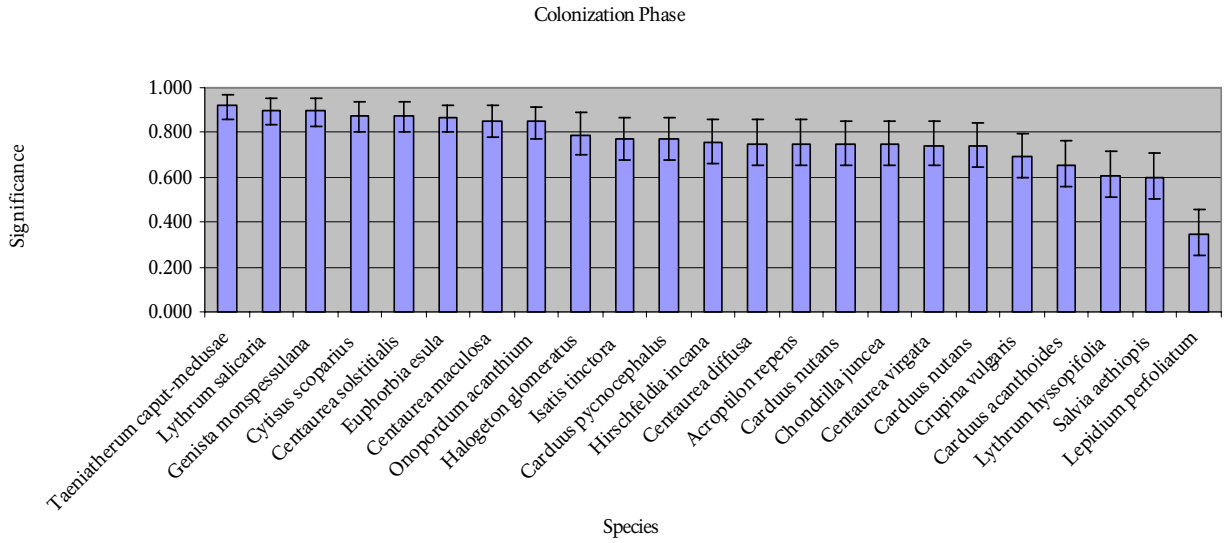

Figure 3. The significant (low to high) risk each species poses in Lassen Volcanic National Park, CA during the spread phase using *An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1* (Morse and others 2004).

8.3 NON-NATIVE PLANTS KNOWN TO OCCUR WITHIN OR IMMEDIATELY ADJACENT TO LASSEN VOLCANIC NATIONAL PARK.

Asteracea (family)
Carduus acanthoides plumeless thistle
Centaurea sostitalis..... yellow star-thistle
Cirsium vulgare..... bull thistle
Crepis capillaris..... smooth hawk's beard

Gnaphalium luteo album... weedy cudweed
Lactuca serriola..... prickly lettuce
Leucanthemum vulgare.... oxeye daisy
Taraxacum officinale..... common dandelion
Tragopogan dubius..... yellow salsify
Sonchus asper ..... prickly sow thistle
Centaurea squarose..... squarrose knapweed
Centaurea maculosa..... spotted knapweed

Brassicaceae
Alyssum minus..... small-flowered alyssum
Capsella bursapastoris..... shepherd's purse
Hirschfeldia incana..... Mediterranean hoary-mustard
Lepidium heterophyllum... variable-leafed pepperwort
Sisymbrium orientale..... oriental hedge-mustard

Caryophllaceae
Cersatium fontanum..... mouse-eared chickweed
Herniaria hirsuta..... herniaria
Spergularia rubra..... ruby sandspurry
Stellaria media..... common chickweed

Chenopodiaceae
Chenopodium album..... lamb's quarter
Chenopodium botrys..... Jerusalem oak
Chenopodium pumilo..... Tasmanian goosefoot

Convovulaceae
Convolvulus arvensis..... bindweed

Euphorbiaceae
Chamaesyce maculata..... spotted spurge

Fabaceae
Cytisus scoparius..... Scotch broom
Lotus corniculatus..... bird's foot trefoil
Melilotus alba..... white sweet-clover
Melilotus indica..... Indian sweet-clover
Trifolium hybridum..... alsike clover
Trifolium repens..... *w*hite clover

Geraniaceae

Erodium cicutarium..... red-stemmed filaree

Hyperiacaceae
Hypericum perforatum..... Klamathweed

Lythraceae
Lythrum hyssopifolium..... hyssop loosestrife

Malvaceae
Malva neglecta..... common mallow

Plantaginaceae
Plantago lanceolata..... English plantain
Plantago major..... common plantain

Polygonaceae
Polygonum arenastrum.... common knotweed
Rumex acetosella..... *c*ommon sheep sorrel
Rumex crispus ..... *c*urly dock

Scrophulariaceae
Verbascum thapsus..... woolly mullein

Poaceae
Agrostis gigantea..... giant bentgrass
Bromus inermis..... smooth brome
Bromus tectorum..... *c*heatgrass
Crypis schoenoides..... swamp pricklegrass
Dactylis glomerata..... orchardgrass
Elytrigia intermedia..... intermediatewheatgrass
Festuca pratensis..... meadow fescue
Holcus lanatus..... comon velvetgrass
Koeleria pheoides..... bristly koeler's grass
Lolium perenne..... perennial ryegrass
Phleum pratense..... common timothy
Poa annua..... annual bluegrass
Poa bulbosa..... bulbous bluegrass
Poa palustris..... fowl bluegrass
Poa pratensis..... Kentucky bluegrass
Vulpia myuros..... foxtail fescue

8.4 LASSEN VOLCANIC NATIONAL PARK WEED MANAGEMENT PROTOCOL

See the next page for this protocol.

Lassen Volcanic National Park

Protocol for Weed Surveying & Treatment

Resource Management Division
Updated July 2007

Protocol for Weed Surveying & Treatment in Lassen Volcanic National Park

What to Survey and Why

Successful exotic species have several characteristics in common: (1) its native habitat and the "reception" area are similar in climate, plant lifeforms, and soil; (2) it has a general seed dispersal mechanism (wind, water, or animal) allowing it to be carried to the "reception" area and spread; (3) it is successful in areas where few native species reproduce successfully by seed (Baker 1986); (4) it has rapid growth, flowers early, and produces a large number of seeds; (5) it has a wide range of phenotypic "plasticity" (6) its germination "polymorphism" allows some seeds to germinate immediately and others to germinate much later; and (7) its seeds have the ability to establish within a wide range of photoperiods and temperature conditions (Baker 1965; Mulligan 1965; Pimental 1986).

Communities with a high frequency of disturbance and/or are adjacent to disturbed land, such as grasslands, riparian, waterways, roadsides, sand dunes, and some forests, are highly susceptible to the establishment of exotic species. Resource extraction and housing developments are common disturbances (Baker 1986). Disturbance may alter the inter-species competition, predator-prey, and physical stresses by increasing levels of certain resources (Orians 1986). The "invader" has an advantage over more sensitive species when these factors are absent. The disturbance history of a community will often determine the distribution of a species (Brown and Brown 1996). For more detail on the Federal and State mandates, guidelines, and regulations see the LVNP Weed Management Plan (LVNP 2007).

Two of the most common types of disturbance in the park are facilities maintenance and fire. Maintenance activities include installing toilet facilities, culvert work, sewage treatment, roadwork, and tree salvage. The main vectors in spreading weeds are equipment (borrowed or equipment that has been used outside the park are "red flag" vehicles) and materials (fill, gravel, wood chips, etc.). The soil surface is often disturbed providing seeds and/or rhizomes an opportunity to establish.

Old burn units tend to have some of the most problematic weed populations in the park. Lost Creek, Butte Creek, Summertown and Watertank are all areas of particular concern. In addition, recent wildland fires have made new areas vulnerable to weeds. These fires open the forest canopy and expose preexisting weed seed banks to increased sun and moisture giving them the opportunity to grow. Fire can also spread seed that's already onsite via wind. The fire induced winds can move unwanted invasive species to new areas. Because burning can increase weed populations, areas scheduled to be burned should be surveyed *before* burning. During this time existing weed populations should be mapped and documented as well. This enables park personnel to accurately plan for work in the following seasons. Any burn unit or wildland fire that has known weed populations needs to be surveyed and treated for at least 3 years after the burn. It is important to try to incorporate fire effects monitoring plots by speaking with the park fire ecologist. Do not try to implement intensive monitoring without first formulating specific goals and objectives and identifying thresholds and adaptive plans for subsequent management of the site. Historically, monitoring plots have been established without prior planning and the results have been poor sampling design and poor data.

How to Survey Different Types of Land Use Areas

How to Survey: If possible, two or more people need to walk across the designated area in a line, approximately 50 to 100 feet apart and visually scan for invasive plants. This is similar to a grid search used in search and rescue. This needs to be repeated until the entire area has been scanned. The distance apart will vary depending on terrain. Particular attention should be paid in wet areas, areas where the canopy has opened up and in places where fire burned with high intensity.

Both Bull Thistle and Mullein are biannual. They appear only as rosettes the first year, which makes them difficult to spot, especially near a downed log or base of a tree. It's easy to miss them the first year and not catch them until they have already bolted.

Surveying Burn Sites: Areas that were disturbed by either prescribed burns or wildland fires are ideal habitats for invasive species. It is important that areas with known weed populations are surveyed before and after prescribed burns. Afterwards, the perimeter of the burn should be walked and visually scanned for weeds both within and on the edge of the burn. If spike camps or helispots were set up to fight wildland fires, these areas must be surveyed, even if they are outside the burn area. The bases of uprooted trees and snags are an additional disturbance and should be carefully checked for weeds as well. Invasive seeds can travel on clothing or in gear from other places and a disturbed area makes a perfect landing spot.

If the burn area has been surveyed before the prescribed burn and there are known weed populations, these locations need to be resurveyed and perhaps used as a starting point with surveyors moving out from that central weedy point. This increases the chance of picking up any satellite populations of weeds that may have sprouted in response to the fire.

Surveying Trails: Trails need to be routinely surveyed for weeds. First priority are trails in high use areas with known weed populations like Manzanita Lake. Surveys are accomplished by walking the trail and visually scanning for weeds on either side of the trail. Special attention should be paid to areas where trail or facilities maintenance has occurred, moist areas, uprooted trees, horse corrals/places where stock have been and along trails that travel through burned areas. If weed populations are small enough and do not prevent completing the survey in the targeted time period, treatment can be conducted concurrently.

Surveying Areas of Historic Use: These are defined as areas where there were historic ranches, farms, grazing, mining or anything else classified as a disturbance.

Drakesbad Ranch in Warner Valley is a good example of historic use. Weed seeds are often excreted in animal dung, and even though stock in the park should be fed weed-free hay before and during their stay, we can't assume that's always the case. It is required in the concessions contract but there is no compendium for visitor stock. Old and

undiscovered seed banks may still exist from previous years, or from ranchers or farmers growing feed for animals that are now considered invasive (especially in the case of grasses).
Priority Areas: Anywhere there is water and known weed populations in an area of historic use. In Warner Valley this is below the water tank, around Dream Lake, and in the flat areas where Hot Springs Creek floods and then subsides near the park boundary. Other areas of high use, campgrounds, picnic areas, stock trails, hitching areas, and corrals need to be checked annually as well.

Surveying Wetlands and Waterways: Seeds are very easily dispersed via streams and lakes and thus it is very important that all streams and waterways should be walked and checked for weeds. Because of the number of streams and lakes in the park, priorities need to be made. First, all water areas that have known weed populations as well as the waterways between them, need to be surveyed. For example, the inflow to Manzanita Lake, the area around the lake itself and the outflow should all be walked.

In addition, waterways in high use areas and areas of historic use are of particular concern. It's very easy for seeds from animal excrement to get into the waterways and create satellite populations downstream. The same goes for water around or near a burn unit or previous wildland fire. These sites need to be more closely monitored for similar reasons.

Surveying Construction Sites: If there is any kind of construction, especially involving fill dirt, those areas need to be checked and monitored. These sites are usually smaller with a discrete perimeter and if, early detection protocol is followed, more easily treated. However, the weeds are often more noxious. Ideally the area is surveyed and treated before the activity and the material and origin (in or out of park quarry) is inspected prior to disturbance. The site also needs to be inspected several years post-disturbance.

Mapping and Data Recording

Once located all weed populations need to be mapped with a GPS Unit, the coordinates and details recorded on the Weed Information Management System (WIMS) occurrence datasheet. The cover, density, and plant phenology also need to be noted, along with the date, and any other particulars i.e. if the site is difficult to access safely, or other particular hazards that might exist at the site. Remember that NPS depends on seasonal staff, some of whom may be unfamiliar with the park, so make notes as if the person reading them knows nothing about the area. It's much better to be too specific than too vague. An example of a specific location write up might be, "Behind the Loomis Museum, 100 feet from Manzanita Creek between the trail and the sewer line."

ALL LOCATIONS ARE COLLECTED IN WGS84 DECIMAL DEGREES.

In the office, all data collected on a Trimble unit must be downloaded immediately. Hand written data field form must be placed in the "WIMS to be entered" file folder for later entry into the system (see Appendix A for more details).

Phenology

It is important to record the life stage of the weeds that are you are removing in each location. This helps park personnel maximize strategies for weed eradication. For example, *Bromus tectorum* is a winter annual that matures much faster than other weeds so getting to those populations and pulling them is a high priority early in the season. Areas where the weeds mature later can be weeded later in the year.

Photo Documentation

Whenever possible take before and after photos of work sites, especially when working with volunteers. Also, photos of huge piles of weeds or bulging trash bags are always popular. It's important to record as much information as possible on the photo card that you should have with you. Date, location and work being done, as well as the work crew should all be recorded. Once back at the office it's important to download and label the photos. Photos must be saved in the Team Drive (R:Natural Resources/Vegetation/Weeds/Exotic Plant Photos). Within the Exotic Plant Photos folder choose the appropriate folder for the weed you were working with, i.e. cheatgrass, bull thistle etc. Within the specific plant folder either create a new folder if you have multiple photos from one site and label it with the location and date (ButteLakeAugust07), or simply place a labeled photo in the specific plant photo folder.

Databases

Lassen Volcanic National Park Natural Resources Division enters their data into the Nature Conservancy's Weed Information Management System (WIMS) database. WIMS is a Microsoft Access program. Ideally, field data needs to be entered on a daily basis so any discrepancies can be checked with people while it's still fresh in their minds. The key to WIMS is consistency in the way in which the data is recorded and entered. The areas that the species are categorized under must remain constant so that querying will not be difficult. Invasive species are always categorized under three areas: watershed, subwatershed and then a more specific region like Manzanita Lake. The tertiary area is the "primary area" that shows up in WIMS when searching. It is important to record enough data on either the Trimble or field form so that you can enter more specific data regarding location that can be typed into WIMS. See Appendix A for details.

Treatment Methods for Particular Species

Weeds in LVNP are either hand-pulled or clipped. The majority of weed populations within the park are small enough that with persistence these methods are effective. There are a few variations, though, depending on the species that is being treated and its phenology.

Bull Thistle (*Circium vulgare)* aka CIVU

Studies in Yosemite National Park have shown that pulling bolting thistles increases disturbance to the seed bank, and results in higher regeneration of thistles (Randall 1990). The disturbed area is smaller if the bolting plant is clipped at the base, preferably below the basal leaves. Sometimes this is not possible, but clipping at the soil surface or just below works fairly well. There is a 5% chance of the plant re-sprouting with this method, but so far this only seems to happen in particularly wet environments. Using the information from this study, the Park's protocol for removing bull thistle varies based on the size of the plant.

Rosettes: Because trying to clip rosettes often results in a fair amount of disturbance, all of them should be pulled and left to dry.

Bolted: If the bull thistle has bolted, the seed head (if there is one) must be clipped, bagged and disposed of. From there, the thistle itself should be clipped below the basal leaves and then left to dry in the sun. If the plant is budding or flowering it is very important to clip, bag and carry out the seed heads.

Disposal: The clipped and pulled plants need to be piled on top of a log, rock or bare area making sure that no roots are in contact with the soil and to increase desiccation. It also reduces missing rosettes because they are covered by clipped stalks (see photo in mullein section). Bull thistle flowers can potentially continue to bloom after they are clipped from the plant, so it is important to remove all flowers, even a tight bud. **Remember:** branches easily tear the larger plastic bags so it's best to double bag and be cognizant of it. Also, be aware of holes from the prickles on the flowers. Sometimes when working with thistles a large paper bag is best for head collection (that has not gone to seed). The bags will be disposed at HQ or taken to the commingle plant to be burned.

Mullein (*Verbascum thapsus*) aka VETH

Mullein is hand-pulled both in the rosette and mature stages. It is important that the plant be completely removed from the soil and left somewhere where it will desiccate – piled on top of a rock or log is best. If the plant is flowering the stem should be clipped, bagged and removed. Be careful as mullein flowers will hide at the base of the stem. If you're pulling a lot of mullein, long sleeves are recommended as sometimes a rash can develop from repeated exposure to the fuzzy leaves. Double bagging is only necessary if hiking out a long enough distance that the bag will be subject to additional stress (shifting during transport, tied to a pack etc.). Mullein is removed for herbal medicinal purposes by a private school under the research collection permit process.

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Salsify *(Tragopogon dubius)* aka TRDU

Salsify, or goatsbeard, is not as invasive as grasses and thistles. The policy is to treat it opportunistically. No species specific surveying is required with this plant. The flower and seed heads are large and need to be clipped, bagged and carried out. It is also fine to pull the entire plant and leave it to desiccate. Seed heads should be clipped and bagged before the plant, as they are delicate and fall apart easily.

Cheatgrass (*Bromus tectorum)* aka BRTE

This weedy grass is so prevalent that most land managers don't bother treating it. However, the populations within LVNP are small enough that hopefully through consistent hand-pulling they can eventually be reduced. Cheatgrass is a winter annual that blooms and sets seed early in the season. It is a small and delicate annual grass with a shallow root system and there are lots of them, so pulling is tedious but can be accomplished with persistence. The entire plant needs to be pulled and bagged. It spreads mainly by seed, which gets into everything. Care should be taken not to go into other parts of the park after treatment, and all clothes should be washed immediately following any weeding. It's especially important to check socks and shoes for seeds afterwards. Consider weeding BRTE last if you are doing other non-BRTE work that day/trip. Solarization using clear plastic is an alternative to manual removal. Herbicide is also being investigated.

Reed Canary Grass (*Phalaris arundinacea)* aka PHAR3

An infestation of reed canary grass beside the Drakesbad horse corral was treated in August of 2006 by volunteers from the Golden Gate Habitat Restoration Team. Treating reed canary grass in the park is a two part process. First all inflorescences must be removed with clippers and bagged for proper disposal. Secondly, it is important to grub out as much of the rootstock as possible using mattocks. The 2006 treatment was the first of what is expected to be a series of twice-yearly treatments. Other treatment options are being considered, including covering the site with black plastic sheeting for a year and suffocating the plants.

Intermediate Wheatgrass (*Elytrigia intermmedia)* aka ELIN

Several populations of this grass occur in the park, mainly on the old ski slope, the sewage mounds and just off the chicken shack pullout. This is a perennial grass that spreads via rhizomes, and takes years of grubbing to remove. Depending on the soil compaction everything from a large pick mattock to a Japanese farmer's knife is effective. This entire plant needs to be grubbed out, bagged, and removed. Care needs to be taken to get as much of the root system as possible.

Himalayan Blackberry (*Rubus armeniacus)* aka RUDI

The only known population of non-native blackberry in the park it is found at Terminal Geyser. RUAR can be eradicated by repeatedly grubbing out the root crown three years in succession. Pick mattocks and clippers are necessary for this as well as clippers to clear away the stems. Thick gloves, long sleeves and pants are also recommended when removing RUAR. All plant parts can be piled onsite and left to desiccate, as it does not resprout from cuttings or dry rootstock. DO NOT LET CANE TIPS TOUCH MOIST SOIL, THEY MAY TAKE ROOT.

Klamathweed / St. Johnswort (*Hypericum perforatum)* aka HYPE

There are two known populations of Klamathweed /St. Johnswort in the park. One is in Summertown, just NE of the fenced leach field. The other is just north of the A-frame at the Mineral HQs. HYPE is rhizomonous and because LVNP has small populations it can be eradicated with repeated grubbing. A small mattock or farmer's knife should do the job, with the entire plant being bagged and removed. Care should be taken to remove as much of the root system as possible, as even a small shoot can have a surprisingly large root system. The park hosts two native St. Johnsworts: *Hypericum anagalloides* and *Hypericum formosum*. Some of these occur in the drainage between Little Willow Lake and Willow Lake. If you find a new population of Klamathweed /St. Johnswort, make sure it's *perforatum* and not one of the others. Klamathweed /St. Johnswort is also being removed for herbal medicinal purposes by a private school under the research collection permit process.

FOR TREATMENT PROTOCOL OF ADDITIONAL SPECIES, SEE SPECIFIC MANAGEMENT PLANS FOR TARGETED WEEDS

Tools of the Trade

The park has a large number of tools available for weed removal. The most popular is the small, versatile pick mattock. In addition there are clippers, Japanese farmer's knives, Pulaski's, large pick mattocks, shovels and weed wrenches for more shrub-like weeds. Pick the tools you feel most comfortable using. There should be a variety of tools in the vehicle. Make sure you carry them in one of the large black Rubbermaid tubs to minimize damage to the car and for safety reasons. There are also small sharpeners for the clippers which will need to be sharpened at least twice during the season. Any tools that don't work properly should be set aside for repair. It is also a good idea to carry a full size shovel in each vehicle for general use.

Each vehicle should also be equipped with the following:

- ✓ 2 pairs of clippers
- ✓ 2 small pick mattocks
- ✓ 2 farmer's knives
- ✓ 1 clipper sharpener
- ✓ 2 pairs of gloves
- ✓ 1 roll of flagging
- ✓ 1 large jug of potable water
- ✓ 2 GPS units and extra batteries.
- ✓ Park radio
- ✓ Plastic file folder holder containing:
    - o WIMS field forms
    - o Printout of all park personnel radio call numbers
    - o Data sheets
    - o 1 trail map of the park
    - o Wildlife sighting data sheets
    - o Reporting party forms
    - o Digital camera and extra batts and film card
    - o Laminated photo cards to i.d. location and date in photos
    - o Pen for laminated photo cards
    - o Laminated plant reference cards
    - o Sharpies for labeling
    - o Extra pencils

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8.5 SPECIFIC MANAGEMENT PLANS FOR TARGETED WEEDS

Cirsium vulgare
Cirsium arvense
Rubus armeniacus
Bromus tectorum
Hypericum perforatum
Leucanthemum vulgare
Phalaris arundinacea
Tragopogon dubius

This document is updated periodically.

Scientific name: Cirsium vulgare

Common name: bull thistle

Updated 3/8/07

A. PRIORITY: High
Cal-IPC list B; CDFA list B

B. DESCRIPTION
From the Fire Effects Information System (FEIS 2004):
Bull thistle is a biennial, and sometimes annual or monocarpic perennial, forb. In the juvenile phase, individual bull thistle plants form a single rosette with a taproot up to 28 inches (70 cm) long. The taproot does not spread, but develops several smaller lateral roots. Stems have spiny wings and grow 1 to 6.6 feet (0.3 to 2 m) tall, with many spreading branches, and sometimes a single stem. Bull thistle stem leaves are more or less lance-shaped and 3 to 12 inches (7.6-30 cm) long, prickly hairy on the top and very hairy underneath. Lobes on leaves are tipped with stout spines. Bull thistle flowerheads are 1.5 to 2 inches (3.8 to 5 cm) in diameter, 1 to 2 inches (2.5-5 cm) long, usually solitary, and more or less clustered at the ends of shoots and branches. Flowers are subtended by narrow, spine-tipped bracts. Bull thistle fruits are achenes, 1/16th-inch (0.15 cm) long, with a long, hairy plume that is easily detached.

Breeding System: Bull thistle reproduces and spreads entirely from seeds. Bull thistle flowers are bisexual (Klinkhamer and de Jong 1993; Randall 2000). While there is some evidence of self-pollination, selfing may result only in hollow seeds; therefore, bull thistle may require cross-pollination to set fertile seed. Only those plants that flower during the main flowering period, or where plants are growing in sufficient density, will contribute substantially to the following generation (Michaux 1989). A review by Forcella and Randall (1994) indicates that heavy seeds may be produced through self-pollination, and that these seeds can establish at high rates and enable isolated plants to begin new populations.

Pollination: Bull thistle flowers produce abundant nectar (Randall 2000) and require pollinators for effective pollination.

Seed production: Bull thistle plants produce about 100 to 300 or more seeds per flowerhead under favorable conditions, and anywhere from 1 to over 400 flowerheads per plant (Forecella and Randall 1994; Klinkamer and others 1988; Klinkamer and others 1993; Michaux 1989; Randall 2000). Variability in production of seeds per flowerhead and flowerheads per plant yields a wide range in number of seeds produced per plant. Bull thistle seed production can also vary considerably among years and within populations (Klinkamer and others 1993). Size of mature bull thistle plants, timing of flowering and environmental conditions can influence seed production.

Seed Dispersal: Bull thistle seeds are equipped with a feathery pappus that is suited to wind dispersal, although it is unclear how effective this dispersal mechanism is. Michaux (1989) notes that the pappus readily detaches from bull thistle seed at maturity, so a majority of seeds (91%) fall within a distance of 1.5 times the height of the parent plant…

Seed banking: Evidence for seed banking in bull thistle varies. Numerous examples of bull thistle establishment following disturbance suggest either long-distance seed dispersal or seed stored in the soil. Reviews by Doucet and Cavers (1996), Michaux (1989), and Forcella and Randall (1994) indicate that bull thistle is characterized as having either a transient or a very small persistent seed bank. Studies concluding that bull thistle has a short-lived seed bank (Klinkamer and others 1988) only consider seeds located on or near the soil surface, and that seeds buried at least 6 inches (15 cm) may have over 50% viability 3 years after burial; seeds at or near the soil surface either germinate or are destroyed by rodents, insects, or microbes (Klinkamer and others 1988).Those buried at greater

depths appear to experience an induced dormancy, and decay more slowly with increasing depth (Dickie and other 1988; Klinkamer and others 1988; Michaux 1989). A seed bank at 6 inches (15 cm) or deeper will not maintain a bull thistle population from year to year, but it could provide seeds that would re-establish the population after major physical disturbance of the soil (Doucet and Cavers 1996). In noncultivated areas, however, bull thistle seeds are not usually buried to great depths.

Germination: Germination rate of bull thistle seeds tends to decrease as light decreases (Klinkamer and de Jong 1993; Michaux 1989; Pratt and other 1984).

Seedling establishment/growth: Bull thistle seedling establishment is favored by soil disturbance and seedling growth is favored by vegetation disturbance. The absolute growth of bull thistle seedlings is very low for 2 months after sowing, even under ideal conditions (Forcella and Randall 1994). Transition from seedlings to rosettes is when the greatest attrition in bull thistle populations typically occurs (Focella and Wood 1986; Klinkhamer and others 1993; Randall 1991).

An annual census of 2 bull thistle-infested meadows in Yosemite National Park found that seedlings accounted for about 85% of deaths observed, 13% of mortality was rosettes, and less than 2% of mortality was due to individuals that died after flowering (Forcella and Randall 1994).

Site Characterisitcs: Bull thistle is widespread and can grow in a wide range of environments but is most troublesome in recently or repeatedly disturbed areas such as pastures, overgrazed rangelands, recently burned forests and forest clearcuts, and along roads, ditches, and fences. Even small-scale disturbances such as gopher mounds promote bull thistle establishment and survival (Randall 2000), and density tends to increase as grazing intensity increases. In Yosemite National Park, bull thistle germination was promoted by removal of vegetation and further promoted by soil disturbance (Randall 1990). Bull thistle can also colonize areas in relatively undisturbed grasslands, meadows and forest openings (Randall 2000).

Successional Status: Populations of bull thistle tend to be short lived, establishing after disturbance, dominating for a few years, and then declining as other vegetation recovers (Cox 1970; de Jong and Klinkhamer 1988; Doucet and Cavers 1996; McDonald 1999; McDonald and Fiddler 1995; Young and others 1967). Bull thistle was the most frequent species observed 6 to 9 years after clearcutting in Sierra Nevada mixed conifer (Allen and Bartolome 1989).

True biennials are uncommon or absent in late successional plant communities because they often need abundant light for establishment (Forcella and Randall 1994). Doucet and Cavers (1996) note that bull thistle is absent from densely shaded areas. A review by Klinkhamer and de Jong (1993) indicates that bull thistle is almost absent if light is reduced to less than 40% of full sunlight. Bull thistle invasion is enhanced in pastures with decreased vegetative cover (Forcella and Randall 1994). In a greenhouse experiment, bull thistle germination was not suppressed by sedge (Carex spp.) cover, but subsequent survival of seedlings was reduced and the percentage of seeds that germinated and survived decreased exponentially with increasing cover (Forcella and Randall 1994).

Seasonal development: Bull thistle plants usually release seed in late summer and early autumn. Germination may occur shortly after the onset of autumn rains or in spring when soil temperatures rise. An individual bull thistle plant produces a small rosette of spiny leaves and a fleshy taproot by the end of its 1st year, and generally overwinters in this form. In its 2nd growing season the rosette typically enlarges rapidly, bolts, and produces a flowering stalk. Flowering occurs from mid to late summer, but inflorescences can be seen until the 1st frost or snowfall in autumn (Beck 1999; Forcella and Randall 1994). The time interval between bolting and seed maturation decreases as temperature increases (Forcella and Randall 1994).

Bull thistle requires a vernalization period before bolting. There is no size requirement for vernalization; however, plants need to attain a certain size after vernalization to bolt and flower. Some plants (about 1%) may flower without vernalization, and this may vary with location (Klinkhamer and de Jong 1993).

C. CURRENT DISTRIBUTION ON THE SITE

Bull thistle is located throughout the park. It is almost exclusively found on sites disturbed by fire and maintenance activities. (Refer to map)

D. DAMAGE & THREATS

Bull thistle is most prolific after fire and mechanical disturbance. Within the Snag Fire, the "Bowl" area has a density of 20 bull thistle/$m^{2.}$ In the Lost Creek Burn Unit it dominates the understory and accounts for 60% of the cover. Native species, such as, rock spirea (Holodiscus (Outline damage caused and threats posed by the species. Refer to Section 1B)

E. GOALS

The goal is to prevent further spread and introduction of bull thistle by containing populations until native vegetation comprises 60% of the cover and direct sunlight has been reduced by 40%.

F. OBJECTIVES (Measurable)

(Establish measurable objectives for the planned control activities. Include:

1. At each site treated, our objective is to see a 50% -75% reduction in cover;
2. Approximately 15 infested acres will be impacted using a variety of treatments;
3. Each site differs but we hope to see results within the next 2-5 years.

G. MANAGEMENT OPTIONS

Viable control options are:

(1) No treatment

Bull thistle remains within forested areas for an average of 6-9 years (Allen and Bartolome 1989) as the community reaches a later seral stage. No treatment is an option in areas where spreading is unlikely and the overstory canopy will return within 6 years. For instance, Fire Mangement Handbook Fire Effects plots may indicate that removal in shrub fields is unnecessary.

(2) Manual/mechanical

Manual/mechanical treatment is preferred near riparian and wetland communities, sensitive plant and animals species or communities, and human residences. Protocol for removal for each species is detailed in the Weed Removal Protocol (LVNP 2006). Removing the root crown of thistle and only packing out the inflorescence is based on studies conducted in Yosemite National Park and is a more effective use of resources. At Yosemite National Park, less than 5% of the adults cut at the soil surface resprouted; of those resprouts, the mean height and number of inflorescences were lower (Randall 1990 and 1991). Removal of adult bull thistle must be repeated annually for 4 or more years. Some plants may remain as rosettes for up to 5 years (Randall 1991).

(3) Herbicide

Herbicides are not a long-term solution to weed management but will be effective in gaining control of new or severe infestations (Bussan and Dyer 1999). In concert with early detection, manual removal, revegetation, and education and modifying land management practices (fire and development) to prevent new infestations, herbicides will be a short-term tool integrated into an adaptive management plan.

Herbicides may be most appropriate for use on large infestations after a fire or near structures where constant disturbance will occur or the likelihood of spread is high. In areas where revegetation with nursery stock will occur, removal of bull thistle is very important (Randall and Rejmanek 1993).

Chemical control of bull thistle is reviewed by Forcella and Randall (1994), and Randall (2000). Clopyralid, dicamba, MCPA, picloram, 2,4-D, metsulfuron, and chlorsulfuron will all kill bull and musk thistles. Timing of application is important. Autumn is a good time to control biennial thistles with herbicides because all live plants will be seedlings or rosettes, and plants are easiest to control in the seedling and rosette stages. Bull thistle is less aggressive and easier to control than other biennial thistles (Beck 1999).

Milestone was chosen because of its low toxicity and application rate. It will be applied with a hand spray bottle or backpack sprayer at a large droplet, low spray setting. Rosettes and young shoots will be targeted. Application rate will be from 3-5 oz per acre per annual season. Each individual rosette will be sprayed; therefore, it is estimated we will treat less than one canopy infested acre annually (visually, take all the thistle and push them into one corner of the unit). This is in compliance with California state law. Milestone will be mixed with water.

(4) Revegetation

Revegetation with aggressive desirable species has been shown to inhibit reinvasion of bull thistle, especially with the help of effective biological control agents and carefully prescribed grazing practices. Promoting desirable competitors is important both after weed control and before weed establishment.

H. ACTIONS PLANNED (Treatments and monitoring)

It is difficult to describe treatments at each site because bull thistle is so widely distributed. Manual and revegetation treatments will be applied at most current and new sites. Chemical treatment is targeted for the Stonehenge and Butte Burn Unit. Monitoring (Weed Information Management System surveys) will occur every other year at manually treated sites and annually at chemically treated sites.

I. HOW ACTIONS WILL BE EVALUATED (Criteria for success)

Monitoring (Weed Information Management System surveys) will occur every other year at manually treated sites and annually at chemically treated sites. Actions will be based on percent cover of bull thistle versus native vegetation as outlined the objectives.

Each site will be revisited at annual or biennial periods. At designated areas of high or unique infestation, monitoring plots will be installed to gauge treatment success. Effectiveness will be determined by the size and density of the infestation at each visit. For example, a polygon may decrease from .1 hectare to .01 hectare or remain at .1 hectare but decrease from 90% foliar cover to 50% foliar cover.

J. RESOURCE NEEDS

Bull thistle is the most widespread and time-consuming weed at LVNP due to fire activity. Treatment and surveys consume approximately 800 staff hours and 360 volunteer hours. Annual equipment replacement and repair is estimated at $500. Vehicles and fuel is estimated at $1100.

K. RESULTS OF EVALUATION

(This section is to be filled in later, preferably within 1 year, when monitoring data has been taken and evaluated, at least preliminarily. The evaluation should be used to determine whether any of the sections B-K above should be modified.)

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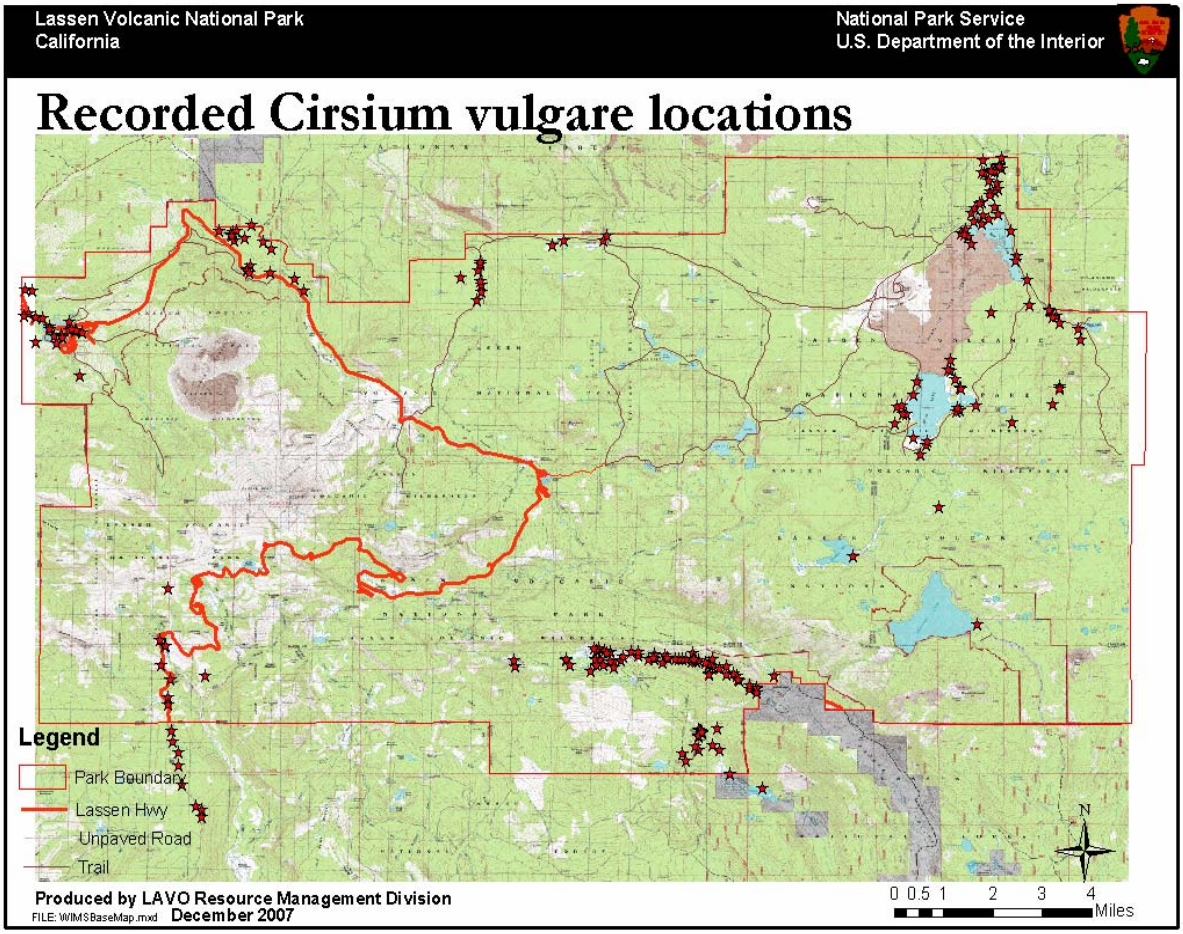
Lassen Volcanic National Park
California
National Park Service
U.S. Department of the Interior
Recorded Cirsium vulgare locations
Legend
Park Boundary
Lassen Hwy
Unpaved Road
Trail
N
0 0.5 1 2 3 4
Miles
Produced by LAVO Resource Management Division
FILE: WIMSBaseMap.mxd December 2007

Scientific name: Cirsium arvense
Common name: **Canada/yellow thistle**
Updated 6/07
A. PRIORITY high

B. DESCRIPTION
Excerpts from Fire Effects Information System (FEIS 2004)

Canada thistle leaf morphology (texture, hairiness, lobing and spininess) can vary considerably, even within a geographical region (Hadderlie and others 1987; Moore 1975). It produces numerous small flowers clustered in heads that are typically 1-1.5 cm in diameter and 1.3-1.5 cm tall. Flower color ranges from lavender to pink or white. Flowering is triggered by long days with light requirements varying among ecotypes (Nuzzo 2000). Plants are usually dioecious, with male and female flowers produced on separate plants. Female (pistillate) flowers can be readily distinguished from male (staminate) flowers by the absence of pollen (abundant in male flowers) and presence of a distinct vanilla-like fragrance (Rogers 1928).

Dispersal: Canada thistle reproduces both sexually by seed and vegetatively by creeping roots. Generally, vegetative reproduction contributes to local spread and seeding to long distance dispersal. Canada thistle allocates most of its reproductive energy to vegetative propagation, and a patch can spread rapidly by vegetative means under favorable conditions.Canada thistle has a deep and wide-spreading root system with a slender taproot and far-creeping lateral roots. Despite multiple literature assertions, Canada thistle has adventitious root buds not rhizomes. (Donald 1994; Haderlie and others 1991; Kiltz 1930). Under favorable growing conditions, new adventitious shoots can develop along the root at any location and any time of the year. Most Canada thistle roots are in the top 0.7 to 2 feet (0.2-0.6 m) of soil, but roots can extend as deep as 6.5 to 22 feet (2-6.75 m) (Morishita 1999). New plants can also form from root fragments as short as 0.2 inch (6 mm) (Nadeau and Vanden 1989). Large patches often form; individual clonal patches may reach 115 feet (35 m) in diameter (Donald 1994). Soil type, structure and horizonation may impact the anatomy, morphology and distribution of Canada thistle roots as well. This suggests that root morphology and distribution are site specific and greenhouse studies of root morphology may not apply (Donald 1994).

Canada thistle is insect pollinated, primarily by honeybees (Hutchison 1992; Moore 1975; Donald 1994). Canada thistle seeds are released about 2-3 weeks after pollination (LaLonde and Roitberg 1989). They are equipped with a pappus, loosely attached to the seed tip, that enables wind dispersal, and have good aerodynamic efficiency (Sheldon and Burrows 1973). However, wind dispersal has not been considered a major factor in its spread, since the pappus readily breaks off, leaving the achenes within the seedheads (Bostock and Benton 1979). Observations in Rocky Mountain National Park indicate that trails, especially those used by horses, are major invasion pathways for Canada thistle (McLenden 1992).

Germination:

Canada thistle seeds mature quickly and most are capable of germinating 8 to 11 days after the flowers open, even if the plants are cut when flowering. Moore (1975) summarized research indicating that almost all Canada thistle seed can germinate upon dispersal, although germination is extremely variable (0-95%). The soil seed bank does not usually contain large numbers of Canada thistle seeds (Champness and Morris 1948; Roberts 1981). Canada thistle seeds are short lived (<5 years) if there is periodic soil disturbance and are buried less than 8 cm because most seed being lost from the soil seed bank by germination during the 1st year (Donald 1994). Seeds that have been in water for several months can still be viable (Haderlie and others 1987). Canada thistle seedlings usually start growing slowly and are sensitive to competition and shading (Donald 1994; Heimann and Cussans 1996; Leininger 1988). Seedlings grow poorly in very moist, poorly aerated soils and do not tolerate drought stress (Wilson 1979). Before seedlings become perennial, they are also highly susceptible to tillage (Morishita 1999).

Within a few weeks of germination, a Canada thistle seedling with at least 4 true leaves can begin producing root buds that can eventually produce new shoots (Morishita 1999). A single Canada thistle plant can potentially produce 26 adventitious shoots, 154 adventitious root buds, and 364 feet (111 m) of roots after 18 weeks of growth (Morishita 1999; Nadeau and Vanden 1989). Root buds are inhibited by the presence of the main shoot, primarily due to a competition for water (Hunter and others 1995), and new root bud growth is highest during late fall and winter months following death of aerial shoots (McAllister and Haderlie 1985). When the main shoot is removed (e.g. as by mowing) the root buds are released, and new shoots emerge rapidly, especially when humidity is high (Hunter and others 1985), Nadeau and Vanden 1989). Root fragments as short as 0.2 inch (6 mm) and more than 6 weeks but less than 2 years old can regenerate entire plants, regardless of whether they have identifiable root buds at the time (Nadeau and Vanden 1989).

Canada thistle phenology varies with ecotype, but follows a general pattern. Plants develop new roots and underground shoots in January and begin to elongate in February (Nuzzo 2000). New shoots from established Canada thistle plants begin to emerge when average weekly temperature reaches 41 degrees Fahrenheit (5 °C), with optimum emergence after temperatures are at least 46 degrees Fahrenheit (8 °C) (Hoefer 1981; Morishita 1999; Nuzzo 2000). Plants remain short until long days trigger flowering and stem elongation, normally in May and June, or about 3 weeks after emergence (Haderlie and others 1987; Hoefer 1981). When soil is warm and temperatures are moderate (as in fall) Canada thistle grows vigorously (Haderlie and others 1987; Nuzzo 2000).

C. CURRENT DISTRIBUTION ON THE SITE

One population of 10 stems was recorded in 1998 on the eastern edge of Snag Lake. Despite no treatment, the plants are gone and have not returned in 2005 and 2006 revisits of the site. It is hypothesized that a wildfire followed by flooding has eliminated the population.

D. DAMAGE & THREATS

It is probably the most widespread of all thistle species (Morishita 1999). Canada thistle is adaptable to a wide range of habitats. It occurs in nearly every upland herbaceous community within its range, particularly prairie communities and riparian habitats(Nuzzo 2000). It is most commonly found in disturbed areas as part of the initial postdisturbance community along roadsides, railroads, streambanks, ditches, lakeshores, seashores, sand dunes and other open sandy areas (Morishita 1999), in clearcuts and forest openings, and in wet and wet-mesic grasslands and prairie potholes.

Canada thistle grows best in open sunny sites (Moore 1975). Canada thistle seedlings are much less competitive than established plants, and will survive only if competition is limited and the daytime light intensity remains above 20% of full sunlight (Morishita 1999). In Rocky Mountain National Park, total canopy cover of vegetation within Canada thistle patches is less than outside the patches (McLendon 1992). At Yellowstone National Park, Canada thistle was found in 6 out of 10 campgrounds, with occurrences most frequent under a canopy cover of less than 20%, although it was occasionally present under more closed canopy covers (up to 95%) suggesting that it is somewhat tolerant of shade. Twenty percent of the quadrats in which Canada thistle was present had no evidence of disturbance (Allen and Hansen 1999).

Canada thistle can be a minor component in the winter and spring diet of mule deer (Bailey and other 1998; Kufeld and others 1973). There are more than 130 species, including pathogens, birds, and over 80 insects, known to feed on Canada thistle (Maw 1976; Nuzzo 2000). Larvae of the painted lady butterfly feed on Canada thistle, but only on an intermittent basis (Reese 1991; Story and others 1985). Canada thistle seeds are eaten by goldfinches, whose diet consists largely of thistle seeds. Many of the seeds are destroyed this way, but some may pass through the birds unharmed (Rogers 1928).

Roads, streams and ditches provide areas of disturbance and corridors for invasion. At Yellowstone National Park, Canada thistle was found in all levels of disturbance (along horse and foot trails, roadways, and campgrounds) and its abundance increased as disturbance cover increased (Allen and Hansen 1999; Turner and others 1997).

E. GOALS
Maintain Canada thistle population at zero plants.

F. OBJECTIVES (Measurable)

1.Continue monitoring and surveying to keep numbers at zero;
2.Continue monitoring the .01 acre area of the known location and continue surveying for it throughout the park;
3. Continue objectives throughout the life of the plan.

G. MANAGEMENT OPTIONS

Canada thistle should be removed from lightly infested natural areas when first observed, since it is very tenacious and difficult to control once well established (Nuzzo 2000). Priorities for controlling infestations must be developed when planning a Canada thistle management program, with actions ranging from prevention, to reduction and containment, to eradication. Some state noxious weed laws require the implementation of control measures (Morishita 1999).

Effective long-term control of Canada thistle includes killing the roots and root buds, and preventing seed production and reinfestation by seedlings (Donald 1990;Haderlie and others 1991). Because Canada thistle has root nutrient stores, it recovers readily from most types of stress, including control attempts. Therefore, control is optimized by stressing the plant enough to force it to use all of its root-stored nutrients. New seedlings must be killed within 2.5 weeks of emergence so they will not become perennial (Haderlie and others 1991). A buffer zone between uninfested areas and external sources of thistle can help prevent vegetative invasion, and Canada thistle plants within wind-dispersal range must be controlled or kept from seeding. Treatment to control the perennial plants must be thought out in advance and followed until control is complete (Donald 1994; Haderlie and others 1991).

Viable control options are:
(1) No treatment;
(2) Manual treatment:
In natural areas with limited infestations, Canada thistle can be pulled and/ or cut several times during the growing season to weaken roots, and carefully treated with spot application of herbicide in the fall. Combinations of mechanical (hand pulling and mowing) and chemical methods improved control of Canada thistle in non-crop situations in Colorado (Sebastian and other 1998).
(3) Chemical treatment:
In natural areas with limited infestations, Canada thistle can be pulled and/ or cut several times during the growing season to weaken roots, and carefully treated with spot application of herbicide in the fall. Combinations of mechanical (hand pulling and mowing) and chemical methods improved control of Canada thistle in non-crop situations in Colorado (Sebastian and other 1998).

(4) Seeding treatment: Maintaining a healthy native community is the best defense against Canada thistle invasion, and can help to shade and weaken Canada thistle plants on sites already infested (Doyle and others 1998; Hutchison 1992). Canada thistle growth may be discouraged in disturbed natural areas if suitable native species are seeded densely enough to provide sufficient competition (Haderlie and others 1991). To be effective against Canada thistle the seeded species must come up before Canada thistle, grow rapidly during the early summer in order to shade out the thistle, and retain vigor until frost (Nuzzo 2000).

H. ACTIONS PLANNED (Treatments and monitoring)
The Snag Lake site will be visited every year the bull thistle from the Bowl area is treated and/or surveyed because it can be monitored on the same visit.

I. HOW ACTIONS WILL BE EVALUATED (Criteria for success)
If the Canada thistle has not reemerged during the monitoring period then the goal will have been achieved. If the population does return, treatment will be initiated.

J. RESOURCE NEEDS

It will require 2 staff members 2 hours (if conducted in conjunction with other monitoring) 1 hour to survey the area.

K. RESULTS OF EVALUATION

(This section is to be filled in later, preferably within 1 year, when monitoring data has been taken and evaluated, at least preliminarily. The evaluation should be used to determine whether any of the sections B-K above should be modified.)

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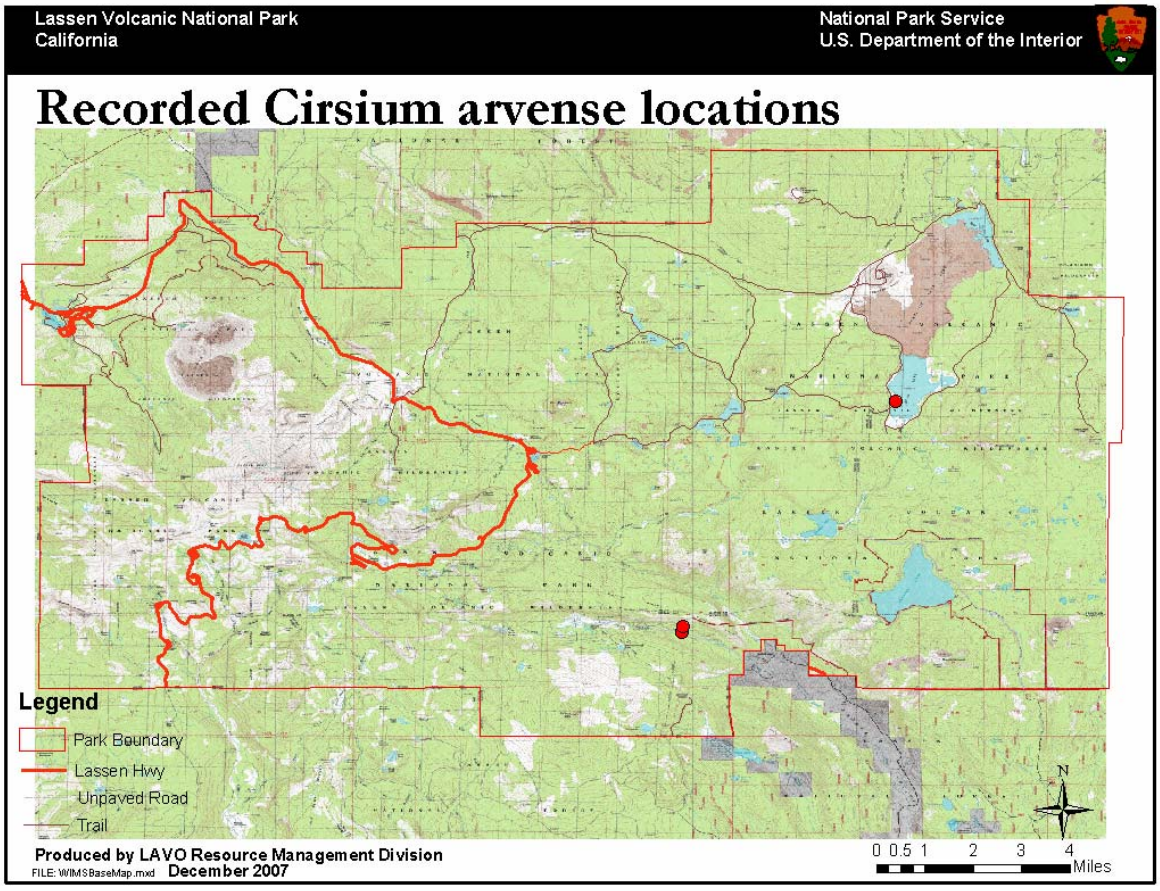

Rubus armeniacus (Himalayan blackberry)

Scientific name: Rubus armeniacus aka Rubus discolor
Common name: Himalayan blackberry
Updated Aug. 21, 2006

A. PRIORITY High

B. DESCRIPTION
Originally from Western Europe, and brought to the U. S. as a cultivar, Himalayan blackberry is a robust shrub with leaves in clusters of 3 or 5, with a white back, and somewhat ribbed, thick thorny stems. In the Rosaceae family, Himalayan blackberry blooms are small & white, while fruit is a red to dark oblong deep purple berry, depending on ripeness.

The Jepson Manual (Hickman 1993): HIMALAYAN BLACKBERRY Arched bramble. ST 5-15 mm diam, 5-angled; prickles many, + wide-based, gen + curved. LF compound; stipules linear; petiole + 3-9 cm, lflets 3-5, gen widest above middle, sharply toothed, white below, longest lflet stalk + 10-40 mm; longest lflet blade + 5-11 cm. INFL: panicle, many-fld, nonglandular. FL: sepel tips gen + 1 mm; petals 10-15mm, obvate, white to pinkish; pistils > 15. FR: blackberry like, + oblong, black + glaborous. Common. Disturbed moist areas, roadsides, fencerows. < 1600 m.

C. CURRENT DISTRIBUTION ON THE SITE
Next to the trail just NW of Willow creek as it flows beside Terminal Geyser. East of the trail that circumnavigates Manzanita Lake between the Loomis Museum and the Entrance Station. Between house 264 and the 294 (A-Frame) in the Ceonothus bush.

D. DAMAGE & THREATS
Himalayan blackberry forms dense thickets of close to impenetrable foliage, which shades out native plants, and if left unchecked, causes significant ecological change to area.

E. GOALS
Complete eradication of known Himalayan blackberry populations from the park within three years.

F. OBJECTIVES (Measurable)

1. 100% removal of the foliage, roots & root crowns of all plants at each location.
2. Approx. 125 sq. feet.
3. Elimination of Himalayan blackberry in threeyears, with bi-annual checks for re-sprouting.

G. MANAGEMENT OPTIONS
Viable control options are:
(1) No treatment: Not an option. The population is small (<3 plants) and must be treated.
(2) Manual/Mechanical: Cutting of foliage and manual grubbing out of root crowns. When Himalayan blackberry populations are small enough, cutting the foliage and manual removal of the root crowns is very successful. This needs to be done every year for at least two years, followed with checks of the area every other year or so. Evidently a claw mattock works well on the root crowns, removing them in a similar fashion to removing a nail with the claw end of a hammer.
(3) Chemical: Not necessary at this time.

H. ACTIONS PLANNED (Treatments and monitoring)
The foliage of the Himalayan blackberry cut back to the ground, and piled onsite in a dry sunny spot where there is no danger of re-sprouting, the roots & root crowns removed manually before fruiting

for at least two year in succession, with monitoring every two years thereafter.

I. HOW ACTIONS WILL BE EVALUATED (Criteria for success)
Site will be checked at least every two years after the first two years of treatment. If Himalayan blackberry reappears, it should be manually removed again, for three years, and then back to monitoring. The key to controlling this plant is repeated treatments for as long as it takes. Most literature agrees that within 3 to 5 years it will be gone.

J. RESOURCE NEEDS

Himalayan blackberry can be treated in conjunction with treatment of the bull thistle around Terminal Geyser, thus reducing travel time expenses. It should take 2 people 5 hours to remove RUAR around Terminal Geyser; this includes the 2-hour round trip from the Willow Lake Trailhead and 3 hours of survey and removal. The Manzanita site should take one person 15 minutes. The Mineral HQ site should take one person 30 minutes.

A polaski, or ax needs to be taken to grub out the root crowns, thick gloves and long-sleeved shirts should be worn.

K. RESULTS OF EVALUATION
(This section is to be filled in later, preferably within 1 year, when monitoring data has been taken and evaluated, at least preliminarily. The evaluation should be used to determine whether any of the sections B-K above should be modified.)

L. LITERATURE CITED

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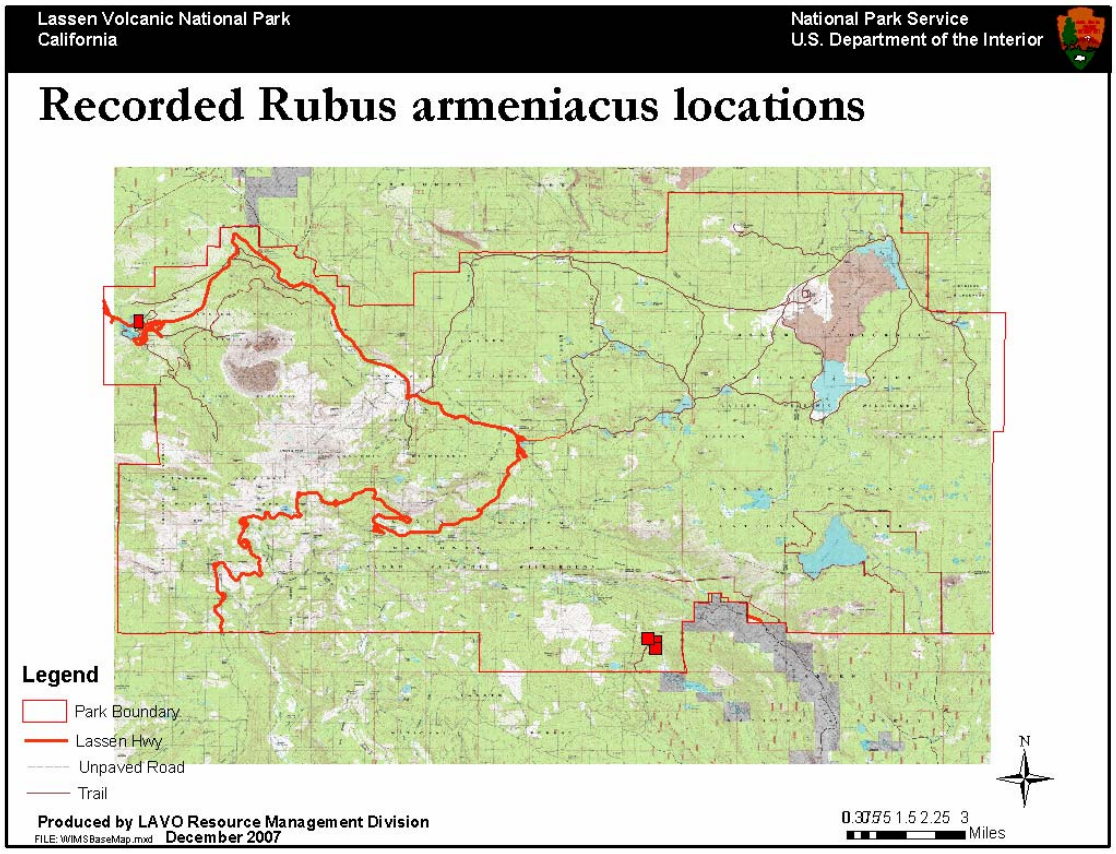
Lassen Volcanic National Park
California
National Park Service
U.S. Department of the Interior
Recorded Rubus armeniacus locations
Legend
Park Boundary
Lassen Hwy
Unpaved Road
Trail
Produced by LAVO Resource Management Division
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Scientific name: *Bromus tectorum*
Common name: Cheat-grass, downy brome
Updated 6/19/07

A. PRIORITY High

B. DESCRIPTION
Cheatgrass is a highly invasive annual grass from Eurasia that has naturalized into large portions of the west. It can alter both soil composition and fire cycles in a short period of time. A relatively short delicate grass with drooping spikelets, cheatgrass matures much faster than native grasses.

C. CURRENT DISTRIBUTION ON THE SITE
Lassen Volcanic National Park currently has three occurrences of cheatgrass with a total infested area of ½ acre. Two are located at Butte Lake, and the other is at Manzanita Lake. At Butte Lake, there is cheatgrass at the helipad, as well as a new population along the trail that runs east along the lake towards Butte creek, Widow and Snag lakes. There is a new population at Manzanita Lake, presumably brought in with fill dirt used in a water project. The cheatgrass is clustered behind the ranger station, the public bathroom, the Loomis museum, and along both sides of Manzanita Creek, where a pipe crosses the creek.

D. DAMAGE & THREATS
Because cheatgrass is a winter grass, able to sprout after the first rains in fall, and begin to establish a root system; therefore, it is able to come up, fruit and set seed far faster than the native annuals in the spring. It also dries out about a month sooner, making the area more susceptible to fire, and vastly shortening the time between natural fire cycles, especially in sagebrush scrub. It reproduces entirely by seed, which it produces an incredible amount of. It is capable of explosive growth, and in many areas, land managers don't even try to eradicate it.

E. GOALS
1. Containment of cheatgrass at all sites.
2. Prevent new populations from establishing.
3. Continue surveying to detect other populations.
4. Reach a 75% reduction in the current population.

F. OBJECTIVES (Measurable)
1. A 55% reduction of BRTE, with a 30% increase of native grasses in the same area by 2010.
2. A 75% reduction of BRTE in all areas by 2014 with a 100% increase of native grasses and forbs.

G. MANAGEMENT OPTIONS
Viable control options are:
(1) No treatment: Not an option. The population is still manageable and should be treated.
(2) Manual treatment:
As with most invasive species, you must have an integrated management approach to removing cheatgrass. Hand-pulling cheatgrass is an option for manageable populations with a robust native vegetation component. Based on LVNP resources, this is defined as an area less than 400 ft^2 with a 1:1 ratio of cheatgrass to native plant cover.
We recommend hand-pulling in the fall and spring, and the fall seeding of native grasses. Because it occurs at both Manzanita and Butte Lakes, and it usually emerges before the native grasses, pulling should occur as early as possible in the spring, and continue as needed throughout the season. Even if the cheatgrass has already seeded, it does not seed well on bare ground, so the pulling and clearing of old plants and leaf litter can help to deter sprouting. Cheatgrass does not respond well to competition, so reseeding of native perennial grasses in conjunction with removal is critical to keeping cheatgrass in check.
(3) Chemical treatment:

If BRTE cannot be hand-pulled, or if the populations expand to the point where hand-pulling is not an option; it is recommended an application after the plant has leafed but before it has gone to seed (purple stage) is the most effective. Perennial grasses should continue to be reseeded for a number of years to increase competition for BRTE. Some occurrences of BRTE are near water, care should be taken to use an herbicide that will degrade fairly quickly. One population is a good candidate for herbicide use: Manzanita Lake population near the park structures. It is a population that can easily be transported to other sites, it is greater than 400 ft^2 with a low ratio of cheatgrass to native plant cover. Landmark, glyphosate, and Milestone have been proven to be effective.

(4) Cultural treatment:
Fire applied with a propane torch (flame torch) is an experimental option. Large-scale (burn unit) application of fire has been shown to increase the density and extent of cheatgrass populations. At sites too large to manually treat and at sites that exclude the selected herbicide, the flame torch may be a viable option. See Appendix 8.10).

H. ACTIONS PLANNED (Treatments and monitoring)
All cheatgrass populations need to be treated by either seasonal staff or volunteers. This should happen as early as possible in the summer, as it comes up before native grasses. If staff cannot reach the site early enough, it needs to be pulled before it goes to seed. It is critical to keep on this for at least 3 years to both contain and begin to eradicate these populations
When crews are hand-pulling, the entire BRTE plant needs to be bagged, removed and destroyed. Crews need to wear gloves and clothes that are only used for BRTE removal, and care should be taken that the seeds are not transferred away from the site.
Seed from perennial grasses in the area need to be collected in the late summer/fall and broadcasted in the fall before the first snows. The areas will be resurveyed each year to check for any further spread of cheatgrass.

Butte Lake: There are two occurrences of cheatgrass at Butte Lake.
(1) The Helipad BRTE seems to be confined to two small hillocks. It has been surveyed but not mapped, and does not seem to be increasing in size, perhaps because of the highly alkaline soil around it. This site will be manually treated unless this is ineffective. Chemical treatment is an option because it is >100 ft from water.
(2) The Trail BRTE is on the north side of the lake, along the trail that leads to Butte Creek, Snag Lake, and Widow Lake was discovered in 2005. It consists of several patches that spread from the just off the trail to the north, then straight down the hill to the south, almost to the lake edge, and several patches off to the sides; it was not complete treated or mapped. In early summer of 2006, this occurrence was partially surveyed and treated. This population would require a 4-person crew 8 hours to manually remove the plants. This area is both <100 ft from water and has one patch with > 1:1 ratio of native plants (*Acnatherum* ssp. and *Elymus Elymoides*), therefore, excluded from chemical treatment.
During the early spring of 2007, 2 plastic treatment plots were placed on the cheatgrass population next to Butte Lake. The clear plastic allows the sun's ultraviolet light to heat up and kill the cheatgrass. It will take 3 years to kill the current cheatgrass and any remaining viable seeds in the soil. The current percent cover of cheatgrass under the plastic is 50%. Each year the percent cover will be recorded in order to establish effectiveness. The plastic plots are the most effective method for the denser patches in the population. The thinner areas, will still be manually hand pulling as outlined in section 2, above.

Manzanita Lake: There are two occurrences at Manzanita Lake.
(1) The Pipeline BRTE is on both sides of Manzanita Creek and was supposedly brought in by contractors via fill or equipment. This area was thoroughly surveyed and treated in 2006. Manual treatment is required because of its proximity to the creek. It will require annual treatment early summer and reseeding with native grasses for a minimum of 5 years.
(2) The Loomis BRTE has been thoroughly surveyed, but incompletely mapped. It was treated mechanically by hand-pulling by volunteers as it was setting seed in 2006, and just after. It will require annual treatment early summer and reseeding with native grasses for a minimum of 3 years.

I. HOW ACTIONS WILL BE EVALUATED

Occurrences of BRTE will be mapped with GPS each year and entered into the Weed Information Management System. Covers will be compared annually to determine if the goals and objectives have been met.

J. RESOURCE NEEDS

Hours do not include travel time (estimated 4 hours round trip from Mineral).

Butte Lake (twice per season):

Helipad BRTE would take 2 people 4 hours to manually remove.

Trail BRTE would take 4 people 8 hours to manually remove.

Hours do not include travel time (estimated 2 hours round trip from Mineral).

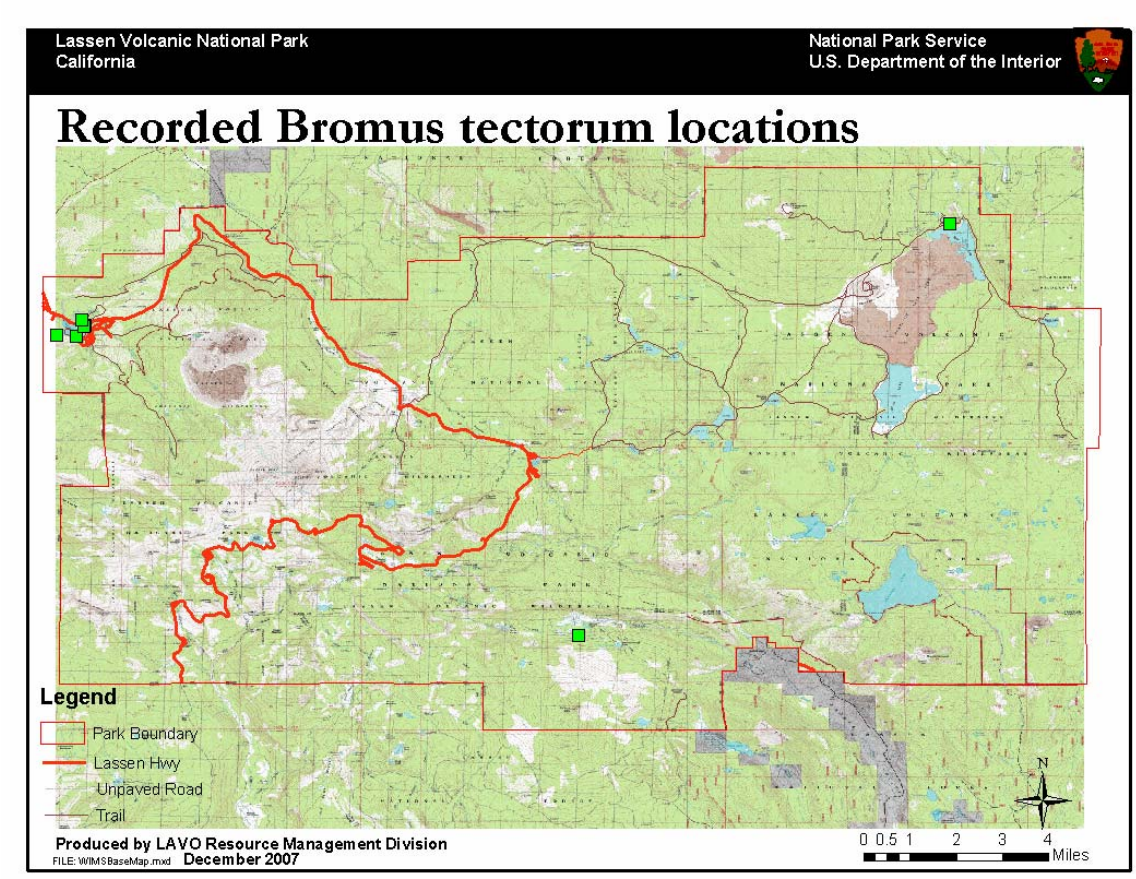
Manzanita Lake (twice per season):

(1) Pipeline BRTE would take 2 people 6 hours to manually remove.

(2) Loomis BRTE would take 2 people 4 hours to manually remove.

K. RESULTS OF EVALUATION

(This section is to be filled in later, preferably within 1 year, when monitoring data has been taken and evaluated, at least preliminarily. The evaluation should be used to determine whether any of the sections B-K above should be modified.)



Scientific name: *Hypericum perforatum*
Common name:_St. Johnswort/Klamathweed
Updated July 26, 2006

A. PRIORITY: High (park-wide)

B. DESCRIPTION
St. Johnswort is a perennial plant that grows 1 to 5 feet high. It has distinct yellow inflorences with stamens that burst from the middle of each flower. If the smooth ovate leaves are held to the light, small pinpricks show through, hence the species name: Perforatum. Originally from Europe & Asia, St. Johnswort was brought to this country as an ornamental.

The Jepson Manual (Hickman 1993): Hypericum perforatum. KLAMATH WEED Per from taproot. STS erect, many from base, 3-12 dm; sterile axillary branches gen 2-10 cm. LF 1.5-2.5 cm linear to oblong; margins rolled under, black-dotted; lower surface conspicuously clear-dotted. INFL: fls gen 25-100 per st. FL: sepals 4-5 mm, lancelate, acuminate, with black and clear dots, margin glabrous; petal 8-12 mm, + oblong, copiously lack gland-dotted, twisting after fl, bright yellow; stamens many, in 3 clusters, anthers black-dotted; styles 4-6 mm. FR 7-8 mm, unlobed. SEED + 1 mm, brown. Pastures, abandoned fields, disturbed places; < 1500 m. (In 2-3 lines list habit, life history, native range, and other outstanding characteristics)

C. CURRENT DISTRIBUTION ON THE SITE
Known coverage of St. Johnswort is approximately 75 ft^2. Summertown Burn Unit: NE of SE corner of leechfield fence.
Mineral Housing area: North of A-frame. West of Admin building at the tree/grass interface.
Reflection Lake: A historic location that the 2006 crew was not able to relocate.
(Refer to map)

D. DAMAGE & THREATS
St. Johnswort looks somewhat shrub-like, with reddish woody base and a spreading root system. It spreads via both root and seed. It grows well in rocky &/or sandy soils, so it can colonize areas and out-compete native plants. It is extremely toxic to livestock.

E. GOALS
Lassen has very small populations of St. Johnswort found in weedy & disturbed areas. Prevention is the key to keeping this weed in check.
1. The complete eradication at known locations.
2. Continue surveying for populations.

F. OBJECTIVES (Measurable)

1. Complete eradication of known St. Johnswort populations within the park boundaries by 1012.
2. Reseed treatment sites to increase native plant cover by 25% by 1012.

G. MANAGEMENT OPTIONS

(1) No treatment: Not an option. The populations are small.
(2) Manual/mechanical: Manually remove plants before they set seed. For an infestation as small as those in Lassen, repeated hand-pulling and grubbing should eradicate the plants over time (Rice and Randall 2004). It's important to get all root fragments and to minimize disturbance when pulling. Plants that are pulled should be bagged and removed, either to a landfill, or burned, to prevent seed spread &/or root fragments. St. Johnswort is not a terribly competitive plant, so seeding of native grasses should help restore the area (Piper 1999).

(3)Chemical: Not necessary at this time. It is difficult to control with herbicides but it does respond to some herbicides - Glyphosate, 2-4,D, triclopyr (Campbell and Nicols 1997; William and others 2001).
(4) Cultural: Under no circumstances should St. Johnswort be burned, as this increases its spread.

H. ACTIONS PLANNED (Treatments and monitoring)
Populations in Mineral and Summertown should be treated as soon as possible in June/July before blooming & setting seed. Re-treat as necessary throughout the season. If possible, native grass seeds should be broadcast seeded in Sept/Oct to provide competition.

I. HOW ACTIONS WILL BE EVALUATED (Criteria for success)
Populations will be monitored every year until 1012. Data will be entered into the Weed Information Management System and population size tracked.

J. RESOURCE NEEDS

Summertown Burn Unit:
The leechfield population could easily be treated by one person in one hour, or anyone going out to pull weeds in Summertown. This area also needs to be seeded.

Mineral Headquarters:
The population by the A-frame in mineral is by far the largest population, and would take 2 people approx. 4 hrs to treat. The administrative building population would take one person one hour treat. Both areas need to be seeded with native grass seed .

Main Park Road:
The two seedlings discovered at Dersch Meadow September 2007 are probably from the culvert replacement work. It should take one person 15 minutes to survey and remove seedlings from that area.

K. RESULTS OF EVALUATION
(This section is to be filled in later, preferably within 1 year, when monitoring data has been taken and evaluated, at least preliminarily. The evaluation should be used to determine whether any of the sections B-K above should be modified.)

L. LITERATURE CITED
Campbell MH and HI Nicol. 1997. Improving herbicide effectiveness on Hypericum perforatum L. (St. John's wort) and replacing it with pastures sown on non-arable land. In: Jupp, Paul W.; Briese, David T.; Groves, Richard H., eds. St. John's wort: Hypericum perforatum L.--Integrated control and management: Proceedings of a workshop; 1996 November 13-14; Canberra, Australia. In: Plant Protection Quarterly. 12(2): 93-96.
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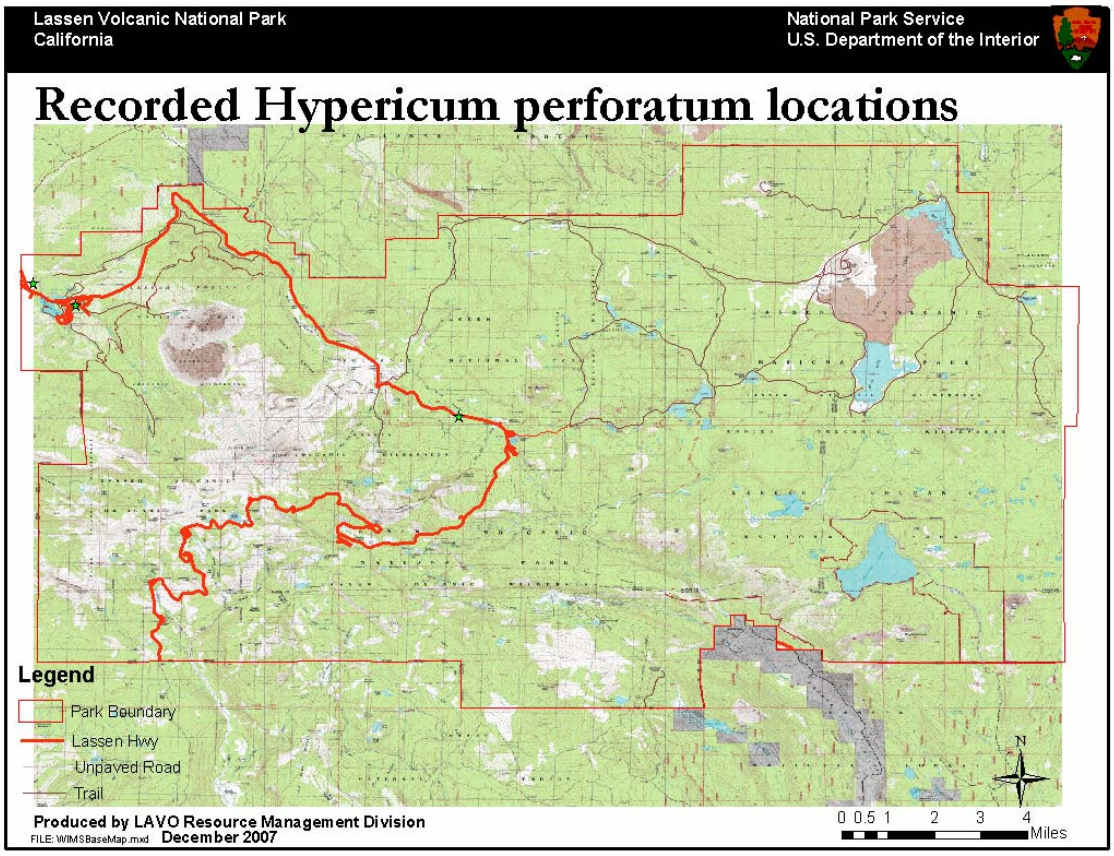
William RD, D Ball, and TL Miller, compilers. 2001. Pacific Northwest weed management handbook. Corvallis, OR: Oregon State University. 408 p.


Lassen Volcanic National Park
California
National Park Service
U.S. Department of the Interior
Recorded Hypericum perforatum locations
Legend
Park Boundary
Lassen Hwy
Unpaved Road
Trail
N
Produced by LAVO Resource Management Division
FILE: WIMSBaseMap.mxd December 2007
0 0.5 1 2 3 4
Miles

Leucanthemum vulgare (Oxeye Daisy)

Scientific name:_Leucanthemum vulgare
Common name:_Oxeye Daisy
Updated 9/30/06

A. PRIORITY: High
CAL_IPC: moderate rating, impact, invasiveness, and distribution.
Expanding range, invasiveness varies locally

B. DESCRIPTION
Erect, rhizomatous perennial, 10-24 in tall, glabrous to sparsely hairy. Leaves progressively reduce in size upward on stem. Basal and lower stem leaves are oblanceolate to narrowly obovate, 2-5 in long incl. petiole, margin crenate to lobed. Upper leaves sessile and toothed. Flowering heads solitary at the end of branches, about 1 in long.
Fruits have about 10 ribs. Meadows roadsides, waste places. Flowers June through August.

From The Jepson Manual (Hickman 1993): leaves irregularly pinnately lobed. Ray flowers white, disk flowers yellow, heads solitary, phyllaries in 2-3 series. Fruits pappus 0 or a narrow crown. Less than 2000m. Common. Escape from cultivation in pastures, disturbed mtn meadows, roadsides

C. CURRENT DISTRIBUTION ON THE SITE
Oxeye daisy is currently not known within the boundaries of LVNP, but there is a serious infestation at the administrative headquarters in Mineral, making it only a matter of time before it establishes in the park. The occurrences at Mineral are along small streams and seeps, in the open meadow areas, and roadsides. It has not been surveyed or GPSed so exact coverage is not known (see map).

D. DAMAGE & THREATS
Oxeye daisy out competes native forbs & grasses in a wide variety of growing conditions, changing the kinds of native plants available to wildlife, and eventually changing the entire ecology of an area.

E. GOALS
Oxeye daisy must be reduced to levels where the chances of accidental seed spread into the park proper are diminished.

F. OBJECTIVES (Measurable)
Include:
A 50% to 80% reduction of cover within the Mineral compound 5 years
after beginning a management program for Oxeye daisy. The Mineral compound
itself is about 10 acres square, and actual coverage of oxeye daisy has not yet been determined.

G. MANAGEMENT OPTIONS

(1) No treatment: not an option. This species is very invasive and we are fortunate it has not spread into the park. It must be made a high priority.
(2) Manual: A combination of manual removal and mulching.
(3) Chemical: Historically, oxeye daisy does not respond well to herbicides. Milestone has recently been discovered to reduce populations with 3-5 fluid oz. per acre. Since it does not compete well, fertilizer applied at 80 lbs/acre (with no herbicide) to a mountain meadow in Eastern Washington was found to be the most cost-effective method (MSU Extension Service 2003). It increased desirable forage cover by 500%. The use of the Waipuna system is still under investigation.
(4)Cultural: The plant can also be grazed, with the best results from sheep & goats. If it seems feasible, the grazing option could be explored. An accurate cover is required to accurately evaluate this management

strategy.

H. ACTIONS PLANNED (Treatments and monitoring)
Treatment: Prevention is key to the management of this plant; educating each division is critical. Also, populations closest to the busiest areas of the compound need to be treated first, perhaps with signs posted to explain the treatment.
Treatment will consist of manual removal and bagging of plants and then covering with mulch. The Mineral headquarters will be treated by non-resource management staff on a volunteer basis. The area will also be treated by visiting volunteers and staff.

Monitoring: Populations will be monitored every year until 1012. Data will be entered into the Weed Information Management System and population size tracked. After the first season of removal and mulching, the mulched areas will be mapped and monitored for oxeye daisy growth up through the mulch before flowering in the May/June following the initial treatment. Any re-sprouts should be pulled, counted, and more mulch applied.

I. HOW ACTIONS WILL BE EVALUATED (Criteria for success)
Treatments will be divided into zones within the Headquarters area. Each zone percent cover will be tracked in WIMS. Success will be a 50% decrease in cover by 1010 and a 75% decrease by 1012.

J. RESOURCE NEEDS
Estimate 8 people about 40 hours to pull all plants and apply mulch.

Equipment:
straw bales or other weed-free mulch
gloves
tools
bags

K. RESULTS OF EVALUATION
(This section is to be filled in later, preferably within 1 year, when monitoring data has been taken and evaluated, at least preliminarily. The evaluation should be used to determine whether any of the sections B-K above should be modified.)

L. LITERATURE CITED
Hickman JC ed. 1993. The Jepson manual: higher plants of California. University of California Press: Berkeley, CA. 1400 p.
[MSU Extension Service]Montana State University Extension Service. *Oxeye Daisy*. MontGuide fact sheet #200002. 03/16/2006. www.montana.edu/wwwpb/pubs/mt200002.html.

Phalaris arundinacea (Reed Canary Grass)

Scientific name: Phalaris arundinacea
Common name: Reed Canary Grass
Updated: 9/30/06

A. PRIORITY: Medium

B. DESCRIPTION
From The Jepson Manual (Hickman 1993): Perennial from distinct rhizomes. 5-15 dm tall. Inflorescence 7-40 cm, 2-11 cm wide, cylindric, interrupted near base; branches spreading in flower, appressed in fruit; Spikelet glumes 3.5-7.5 mm, midvein scabrous, wing 0, tip acute, lower florets 2, 1-2.5 mm, awl-like, hairy; upper lemma 3-4.5 mm, +- 1.5mm wide, narrowly lanceolate, glabrous to sparsely hairy. Fruit 1.5-2mm, <1mm wide. Wet streambanks, moist areas, grassland, woodland. <1600m. CA_FR, temp N Am, Eurasia. Cultivated for forage.

Stout perennial that regenerates from large rootstocks, with stems 2 to 7 feet tall that are covered with a waxy coating that gives it a blue-green color. Leaf blades are flat, ¼ to ¾ inch wide. The panicle is more or less compact at first, then the branches spread. Aggressive species- wet ground along streams and in marshes in all the western region. Especially a problem in canals and irrigation ditches.

Excerpts from: *Best Management Practices for the Invasive Phalaris arundinacea L. (Reed canary grass) in Wetland Restorations* (Reinhardt and Galatowitsch 2004).

Studies have highlighted characteristics that contribute to *P. arundinacea*'s dominance in wetland restorations. In addition to drought-tolerance and flood tolerance, *P. arundinace*a is winter hardy (26). This species has shown impressive environmental plasticity (18, 25), e.g. allocating more resources to seed production in unflooded conditions, and allocating more resources to below-ground vegetative production in flooded conditions (35). *P. arundinacea* and is strongly clonal and sod-forming (30). *P. arundinacea* forms dense seed banks that are believed to be persistent for at least one year and most likely more (36, 37). Even after *P. arundinacea* standing vegetation and vegetative propagules have been eliminated from the site, *P. arundinacea* may continue to dominate the site vegetation through recruitment from the seed bank (16).

C. CURRENT DISTRIBUTION ON THE SITE
Drakesbad Meadow, 1-9x4 ft section next to concessionaire horse corral.

D. DAMAGE & THREATS
Reed canary grass (RCG) is a major concern for wetland restorations in the northern US because its establishment often precludes colonization by sedge meadow vegetation in restored prairie pothole wetlands. It invades natural wetlands, forming monotypic stands and displacing native vegetation (Reinhardt and Galatowitsch 2004).

E. GOALS
Goals for this species are to prevent the expansion of the current infestation into the meadow and fen system.

F. OBJECTIVES (Measurable)
1. Reduce the size of the infestation by 50 % by 1010.

G. MANAGEMENT OPTIONS
According to a document prepared by the Nature Conservancy in conjunction with various local, state & federal agencies (Tu 2004), "There is no immediate one-year "fix" to convert a RCG infestation into a native community, but much can be accomplished within 2 to 3 years. Continued monitoring and follow-

up treatments will be required for up to 5 to 10 years to prevent reinvasion…. The successful restoration of your wetland system from RCG will likely involve five steps:
1. The control/removal/kill/local eradication of the existing RCG plants and rhizome system.
2. Exhausting the RCG seed bank.
3. Depending on how long the RCG infestation has been in your site, active restoration (replanting or reseeding of desirable vegetation) may be required. If your RCG infestation has not been at that site for over 5 to 10 years, there may be enough of a remnant native seedbank to allow passive restoration.
4. Prevention of new seeds or stem fragments from entering your managed area, and/or changing those conditions that facilitated RCG invasion in the first place.
5. Finally, continued monitoring and follow-up treatments are necessary for lasting results.

There are a variety of methods available for the control of RCG. Which method or combination of methods you choose will depend ultimately on your management goals and objectives…Also, how many resources you are willing to invest and for how long, what resources do you already have available, and the size, distribution, and location of your RCG infestation will all determine which option you should choose to manage RCG. Unless you only have a few small isolated patches, the long-term successful management and control of RCG will require a multi-year commitment."

(1) No treatment: Due to the highly invasive nature of this species, this is not an alternative.
(2) Manual treatment:
In the case of the LVNP population, because it is near the horse corral in Warner Valley, and in a wetland, herbicides are not an option. It is a fairly small infestation, and due to the LVNP ability to get volunteers, manual removal is one of our options.
Digging isolated plants or small patches of RCG can successfully be removed by digging out and removing the entire root mass. Removal is easiest when the soil is moist. Be sure to remove all rhizomes and roots, as small rhizome fragments can resprout. Properly dispose of plant material, since rhizomes and stems can develop new roots if inundated, or if kept in contact with moist ground. Be sure to follow-up to catch any resprouted stems (Tu 2004).

Solarization, Shade Cloth, & Mulching Solarization (essentially baking under clear or black plastic) or the use of a thick woven geotextile shade cloth can be used to eliminate RCG. In dense areas of patchy RCG growth this method can provide specific, targeted control. In areas where RCG is mixed-in with desirable species, the kill of those desirable species may or may not be an option. Also, the use of certain materials for this method depends on your overall management goals. There are reports from the Puget Sound region of good RCG control by using several layers of cardboard covered by 4 to 6 inches of wood mulch. The addition of these materials into your site may or may not be acceptable. Excellent control of RCG can also be accomplished by using a thick woven plastic fabric (Mirafi(r) or Amoco(r) brands), held in place by 7-inch gutter spikes and washers and duck-bill tree anchors. The fabric is kept in place for over one year (over an entire growing season), even under inundation. This method will kill all plants under the cloth. Revegetation or reseeding is generally necessary with this method. Shade cloth is initially expensive (approximately $400 per 12 ft x 350 ft roll), but can be reused several times, and this method does not require follow-up visits during treatment. Shade cloth provides specific, targeted control. The installation of shade cloths greatly facilitates installation. Small patches can likely be treated using black plastic bags, if they are kept in place for the entire duration, the edges are tacked-down firmly, and the bags do not shred.

(3) Chemical treatment:
A large-scale field experiment demonstrated that the most effective way to control RCG is a combination of later season herbicide applications to maximize rhizome mortality, and burning to reduce the RCG seed bank density. In a mesocosm experiment, RCG growth, but not recruitment from seed, was suppressed by the presence of native species seed, suggesting that RCG control will likely be necessary during native species establishment .

Results from this research determined the most effective methods for controlling existing stands of RCG

(burning to reduce the seed bank, and later season herbicide applications to maximize rhizome mortality). However, even 2 years of the most effective use of herbicide and burning are not sufficient to reduce RCG dominance to the point where native species can establish. Recolonization from seed (either on-site in the seed bank or off-site from dispersal) will complicate control techniques. RCG can establish from very low propagule densities (even when native species propagule densities are high), and once established, grows rapidly and in a way that facilitates preemption over other simultaneously establishing species. Long-term management of re-invading RCG, and limiting availability of RCG propagules in the landscape, will therefore be key to successful reed canary grass control.

(4) Restoration/Competition:

Planting fast-growing shrubs or trees may eventually eliminate RCG since it is intolerant of year round shade, but depending on your management goals and objectives, this may not be a viable option. In the Puget Sound region where forested wetlands are common, planting native evergreen trees (*Pseudotsuga menziesii, Picea sitchensis*) may be desirable and can successfully shade-out and eliminate RCG. One way to add conifers into a RCG dominated system is to cut holes into large downed woody debris, and plant the conifer seedling into that hole. If planting trees directly into the RCG wetland, the trees will do better if the RCG is kept mowed, or if the trees are planted on top of soil mounds. In the Willamette Valley however, native wet prairies did not have a large conifer component, and the addition of coniferous trees into this system may be undesirable. Because RCG can survive under the deciduous canopy of cottonwoods (*Populus trichocarpa*) and Oregon ash (*Fraxinus latifolia*), the planting of these trees and other native shrubs alone (*Spiraea douglasii, Sambucus racemosa)* are not be likely to be successful at fully eliminating RCG. However, the City of Portland Bureau of Environmental Services reports success with planting high-density cottonwood or alder. Where they have reached a closed canopy by year five, they report almost near eradication of RCG. While this is not true eradication, it is enough to allow success in moving the site into an artificial conifer succession stage and to try to establish some native forbs. Creating a dense herb layer may be able to exclude RCG, once it is firmly established. Native grasses, sedges and rushes such as *Beckmannia syzigachne, Eleocharis palustris, Carex densa, C. feta, C. unilateris, Juncus oxymeris, Deschampsia caespitosa, and Agrostis exarata*, along with a native forb component (*Myosotis laxa, Plagiobothrys figuratus, Veronica scutellata*) may work to exclude RCG in some situations in the Willamette Valley. Further, a complex herbaceous canopy can work to prevent RCG seed germination. The likeliest scenario for successful exclusion of RCG using native species is habitats that are marginal for RCG in the first place, i.e. those that are submerged for much of the year. In the transitional zone between the emergent plant community and the upland, where we find the most difficulty with RCG in the Portland Metro region, native sedges, grasses and other emergent species have difficulty in holding their own against RCG. The City of Portland Bureau of Environmental Services suggests those areas are most easily managed by planting either one of the two following strategies: 1) live stakes- living branch sections from adapted trees/shrubs like willow, dogwood 2) shrub clusters- first scalp the sod off the top of an area about 5' by 3', then plant a cluster of shrubs- we generally use 10 for each cluster, then mulch well with a coarse grained mulch which will keep RCG from coming up from the bottom but also prevent broadleaf weed invasion from the top (Tu 2004).

H. ACTIONS PLANNED (Treatments and monitoring)

This occurrence of RCG was evaluated and treated in the summer of 2006. Treatment consisted of hand-pulling and digging by volunteers from the GGNRA. There is the possibility of solarization over the fall, winter and spring.

I. HOW ACTIONS WILL BE EVALUATED (Criteria for success)

Monitoring: Populations will be monitored every year until 1012. Data will be entered into the Weed Information Management System and population size tracked. Any re-sprouts should be pulled, counted, and more mulch/tarp applied. When cover has been reduced by 80%, the area will be reseeded annually for 3 years.

A 4’ by 9’ area of RCG was removed from this site in 2006. In 2007, a count should be kept to compare

numbers returning/with numbers removed. In addition, it is suggested that competing forbs and shrubs, (willows or alder) be planted to compete with the RCG. Retreatment by manual removal and possible wilting may be necessary

J. RESOURCE NEEDS

A total of 5 volunteers spent 6 hours manually removed this population in 2006. The 4'x9' area was covered by black weed cloth in 2006. The ripped cloth was covered with another layer of weed cloth in 2007. The total expense for weed cloth was $60.00 . The cloth was secured with rocks. Grass and forbs to revegetate the area will take staff about 16 hours to collect and 1 hour to spread annually. Shrubs will take 1 hours to collect and 2 hours to plant.

K. RESULTS OF EVALUATION

(This section is to be filled in later, preferably within 1 year, when monitoring data has been taken and evaluated, at least preliminarily. The evaluation should be used to determine whether any of the sections B-K above should be modified.)

L. LITERATURE CITED

Hickman JC ed. 1993. The Jepson manual: higher plants of California. University of California Press: Berkeley, CA. 1400 p.

Reinhardt CH and SM Galatowitsch. 2004. Best Management Practices for the Invasive *Phalarisarundinacea* L. (Reed canary grass) in Wetland Restorations. University of Minnesota, Department of Horticultural Science, St. Paul, MN. Technical Report.

Tu, M. 2004. Reed Canary Grass (*Phalaris arundinacea* L.) Control and Management in the Pacific Northwest. The Nature Conservancy Inivasive Species Initiative.

Tragopogon dubius (Western Salsify, Yellow Salsify, Goatsbeard)

Scientific name: Tragopogon dubius Common name: Western Salsify, Yellow Salsify, Goatsbeard
Updated 9/06

A. PRIORITY low
CAL-IPC: No impact, limited invasiveness, moderate distribution, Minor component of disturbed areas

B. DESCRIPTION
Biennial, 1 to 3 feet tall, more or less branched, arising from a long taproot. Milky sap. Glabrous at maturity. Narrow leaves, up to 12 inches long, gradually tapering from the base to the apex. Flower heads at the end of long, hollow peduncles, involucral bracts, 8 or 13, 1-2 in long. Bracts distinctly longer than petals. Yellow ray flowers.
Achenes have a 1 in slender beak at the apex. Native to Eurasia. Found in roadsides and waste sites. Other species in the genus are common in the West, and species sometimes hybridize. Stalk is swollen below the flower head.

From The Jepson Manual (Hickman 1993): length of phyllaries and width of peduncles. 3-10 dm, phyllaries 2.5-4 cm long. Pale lemon yellow ligules, ligulate head, solitary, few branches, strongly ascending, phyllaries 1 series, pappus of stout plumose bristles, fruits spreading, forming a spheric head 4-5 cm diameter. Eurasia. Uncommon. 0-2700 m.

C. CURRENT DISTRIBUTION ON THE SITE
Scattered throughout the park, mainly in disturbed areas. A fair number are at the base of willow creek on the west side where the landscape opens up from trees to grassy meadow. They are also present at the Butte Creek Burn Unit, throughout Warner Valley and (Refer to map).

D. DAMAGE & THREATS
Salsify meets the criteria of a weedy species, but it is not explosive in its growth, so while it can contribute to stresses on the native plant community, it is not a major player.

E. GOALS
Maintenance of the current number or decrease of salsify within the park. Due to the combination of sparse numbers and wide distribution within the park, it is not practical to try to eradicate this species completely.

F. OBJECTIVES (Measurable)
A general decrease in the overall numbers of salsify throughout the entire park, this decreasing trend shown over a period of 7 years.

G. MANAGEMENT OPTIONS
Viable control options are:
(1) No treatment;
(2) TRDU can be controlled opportunistically by hand-pulling when it is encountered in the course of surveying for or weeding other invasive species. Seed heads should be carefully clipped, bagged and removed to prevent re-seeding.

H. ACTIONS PLANNED (Treatments and monitoring)
TRDU is one of the weeds pulled along with VETH & CIVU within burn
units and other disturbed areas. In addition it should also be opportunistically removed whenever it is seen in the course of other park duties, such as surveying or seed collection. Once hand-pulled, the

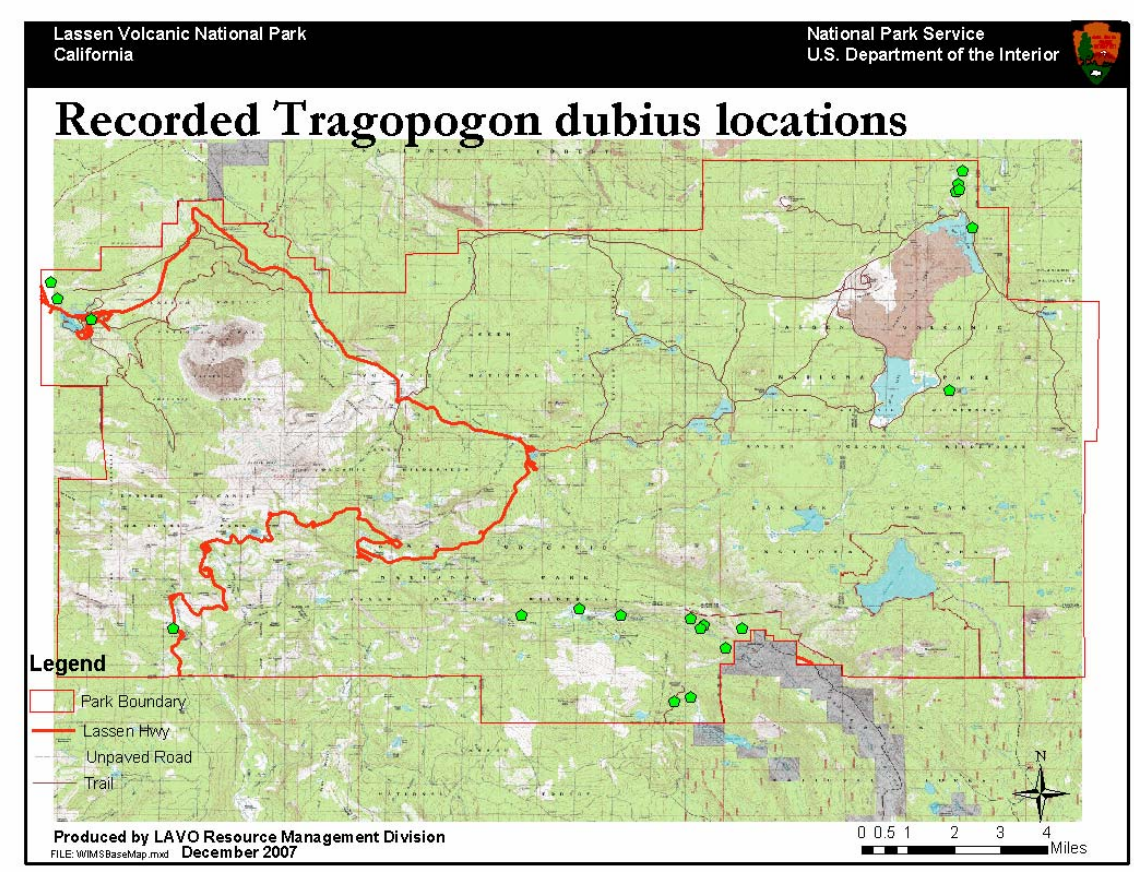
plant may be left onsite, but any flowering heads need to be carefully clipped, bagged & removed. A count of individuals should be kept, and compared year to year to monitor trends of this species.

I. HOW ACTIONS WILL BE EVALUATED (Criteria for success)
A record of it will be tracked in WIMS to detect trends annually.

J. RESOURCE NEEDS
As this weed is so sparse and widespread, and can be pulled quickly and easily in the course of other work, its removal during the season may add up to, at the most, 4 hours per season.

K. RESULTS OF EVALUATION
(This section is to be filled in later, preferably within 1 year, when monitoring data has been taken and evaluated, at least preliminarily. The evaluation should be used to determine whether any of the sections B-K above should be modified.)

L. LITERATURE CITED
Hickman JC ed. 1993. The Jepson manual: higher plants of California. University of California Press: Berkeley, CA. 1400 p.



8.6 FORMS USED IN COLLECTING MONITORING DATA

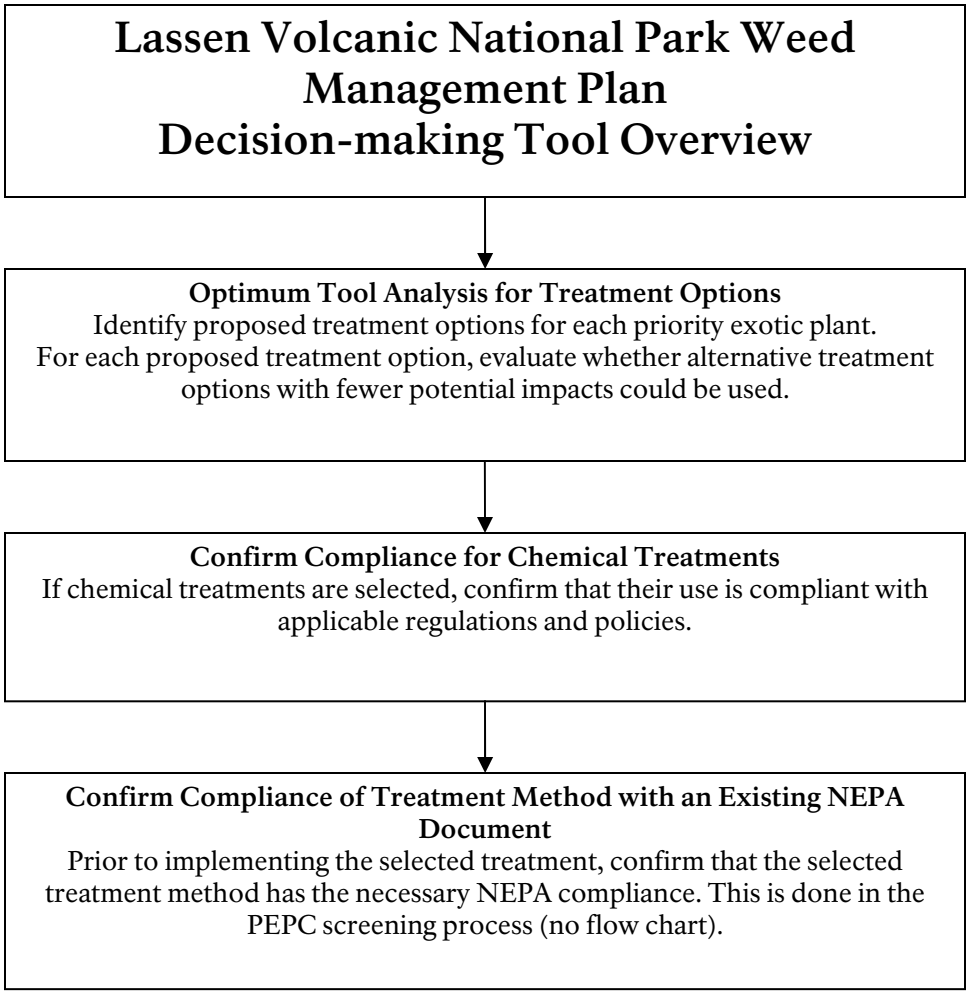
Basic Information		Notes
Date:		Enter date
Weed Name:		Common or scientific name
Location description:		Directions to Occurrence, Landmarks, etc.
Data Recorder:		Your Name
Northing:		Preferred: NAD 83 UTMs
Easting:		
Accuracy:	___GPS1 (within 3 feet) ___GPS2 (within 30 feet) ___GPS3 (within 300 feet) ___Man1 (within 150 feet) ___Man2 (within 300 feet) ___Man3 (within 660 feet)	
Comments:		

Location Information		Notes
Primary Area:		Watershed (best guess)
2nd Area:		e.g. Butte Lake, Drakesbad corral, burn unit
3rd Area:		optional
State/County:		

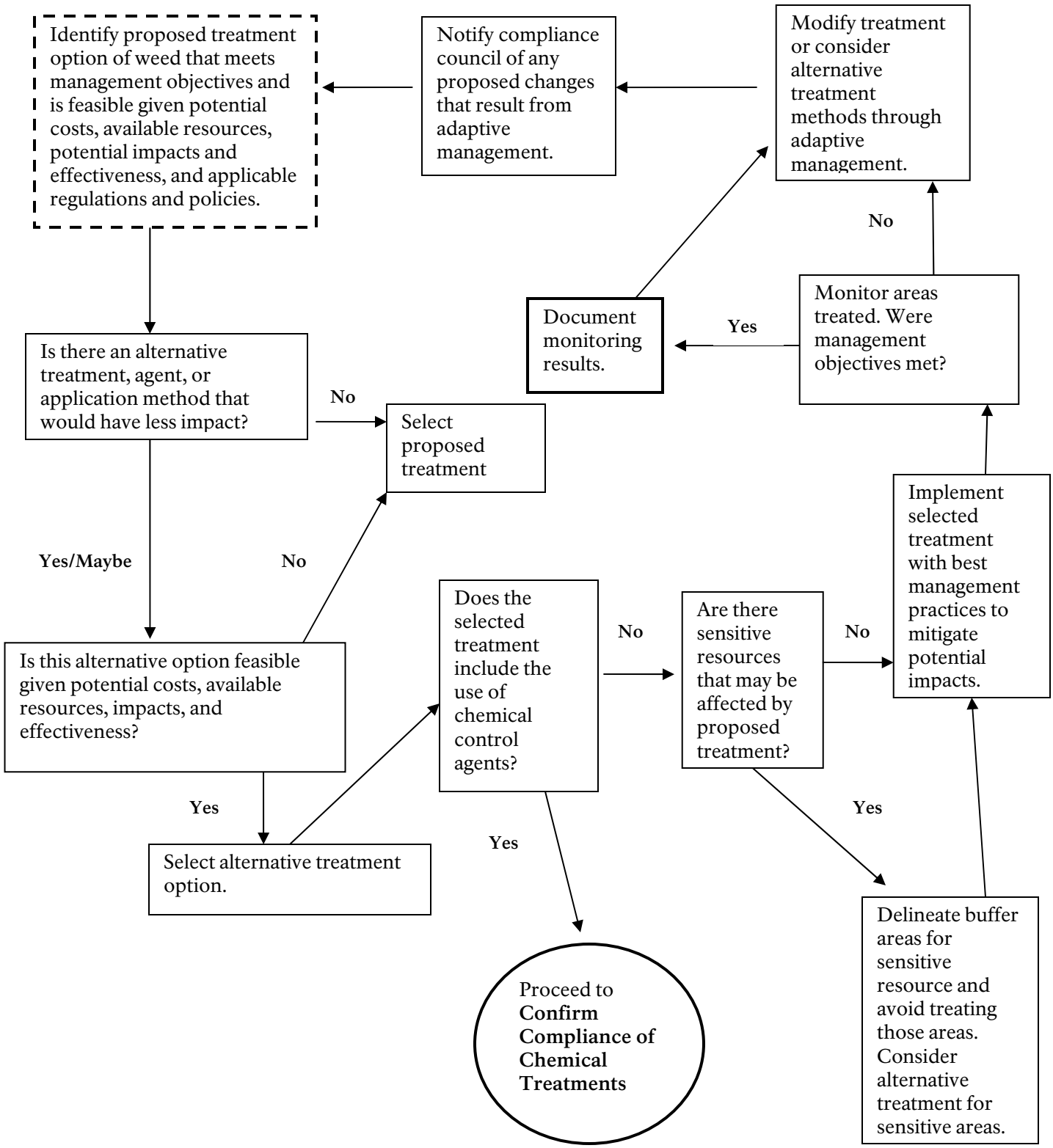
Features/Descriptions		
Number of adults:		Treated? Yes No
Number of rosettes:		Treated? Yes No
Disturbances:	___Construction ___Trail ___Fire ___Riparian ___Grazing ___Developed Area ___Roads ___Other (describe)	
Vegetation: Overstory and major understory		
Extent of infestation (acres or ft^2):		

8.7 PLANNING PROCESS

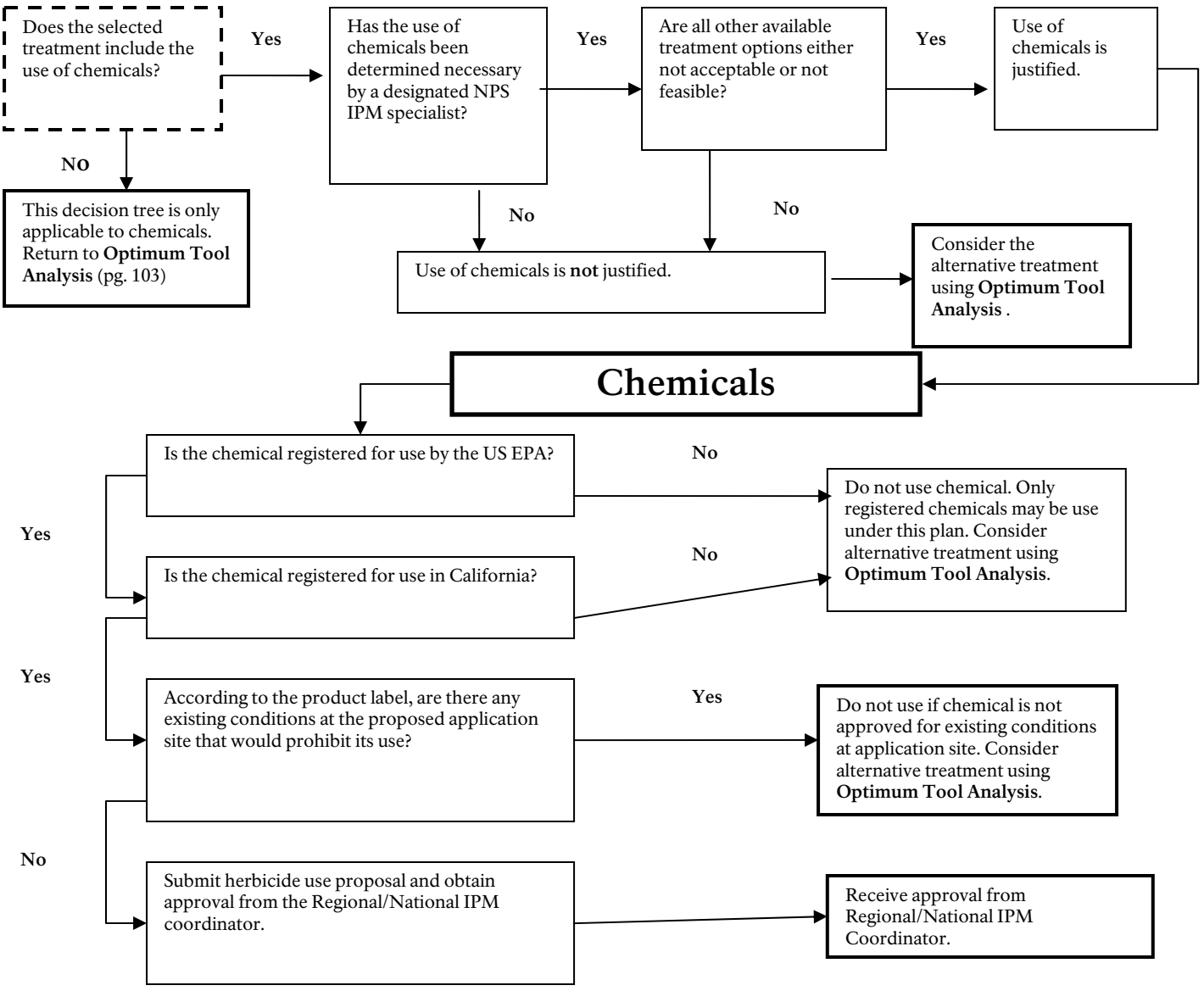
Adapted from Northern Great Plains Exotic Management Plan and Environmental Assessment, National Park Service, March 2005 (http://www.northerngreatplains-nps.com)



Optimum Tool Analysis for Treatment Options



Confirm Compliance for Chemical Treatments



8.8 HERBICIDE USE PROTOCOLS AND BEST MANAGEMENT PRACTICES

8.8.1. Herbicide Handling

Herbicide Purchase
NPS 77 allows NPS personnel to purchase the amount of herbicide authorized for use during the year of approval. Larger amounts can be purchased only when the smallest amount available for purchase is larger than the amount necessary for the project. If an approved herbicide is unavailable, any substitutions with different active ingredients will require approval through the same herbicide use request and approval process.

Herbicide Storage
Herbicide storage facilities must be locked, fireproof, and ventilated; proper warning signs must be posted. Herbicides must be stored separately from all other substances, and the directions provided on the labeling must be followed. In addition, each type of herbicide must be stored on separate shelves. Any structure used for storage of herbicides should be posted, and copies of labels, material safety data sheets (MSDS), and inventories should be kept in a locked container outside the storage facility.

Disposal of Herbicides
Only the amount of herbicide required for the treatment area should be mixed to limit the amount of excess herbicide generated during treatment. However, small remaining quantities of mixed herbicides and any rinsate from the container or spray equipment may be applied to the treatment area. If herbicides cannot be disposed of in this manner, they may be given to another agency or disposed of according to state laws and regulations. Donation of surplus chemicals should be documented and records kept for 3 years.

Herbicide Safety
Procedures for handling herbicides are provided on the herbicide label. These directions must be followed. The following precautions should also be followed. Unless the label specifies otherwise, applicators should wear protective goggles or face shields, rubber or neoprene gloves, an impervious cap with a brim and drip guard, long pants, a long-sleeved shirt, and rubber boots during mixing, loading, application, and cleanup. Depending on the formulation of the herbicide, the applicator should use a respirator approved for the type of herbicide being applied. Mixers and loaders should take the additional precaution of wearing an impervious apron.

When spraying liquids overhead, sleeves should be tucked inside the gloves. However, pants should never be tucked inside of rubber boots.

Herbicide application equipment should never be worn home or washed in home laundry facilities.

Herbicides should never be transported inside the cab or passenger compartment of a vehicle. Instead, they should be removed or placed in containers. They should never be stored in containers used for food preparation or other food service purposes.

Copies of the label and MSDSs should be at the site where herbicides are being applied.
In addition to the safety of the applier, the safety of park visitors and others not involved with the application of herbicides must be considered. Many herbicide labels specify the minimum periods before unprotected individuals may enter treated areas, or they specify that treated areas must be posted. If the label specifies a reentry period, treated areas must be posted with signs warning visitors and others not to enter the treated area. The signs should indicate that the area has been treated with an herbicide, what materials were used, and the name and telephone number of a contact person.

Contracted Pest Management Services
Some practices may require the services of an exotic plant management firm or pest control operator. Contract specifications should describe what is permitted and what is not permitted on the NPS property. Specification should include exotic plant identification, monitoring on a regular basis, and no herbicide application unless action thresholds have been met.
Sample contract language may include the following points:
1. Contractor to arrive at the job site with factory sealed containers.
2. Contractor to mix and apply the herbicide under the observation of a NPS representative.
3. No surplus herbicide(s) will be disposed of on NPS owned or managed lands.
4. If the applicator has arrived at the job site, but is unaware of these contract criteria and has not read them, no work will be permitted until all contractual language has been read and understood and contractual compliance is in order.

8.8.2. Respirator Use

The program will follow the LVNP Respirator Plan guidelines when JSAs determine if respiratory protection is needed and, if so, the appropriate cartridges and filters..
Airpurifying respirators, for remove harmful substances from the air, will be the only type needed for park weed treatments. Respirators must meet the standards set by NIOSH and MSHA. Respirators will be purchased for and assigned to individual workers for their exclusive use. Benefiting accounts will be responsible for covering costs associated with participation in the respiratory protection program.

8.8.3. Work Area Surveillance
Maintain surveillance of different conditions in the work area. Look for the degree of employee exposure and stress; and the combination of work rates, environmental conditions, and physiological burdens of wearing respirators.
Changes in operating procedures, temperature, air movement, humidity, and work practices may influence the concentration of a substance in the work area atmosphere. These factors require monitoring of the contaminant concentration. Testing should continue to assure that contaminant exposure has not risen above the maximum protective capability of the respirators. These tests should include personal or area air sampling. The Program Manager, in concert with the Park Safety Officer, supervisors, and affected employees, will develop JHAs that describe these activities and procedures.

Purpose: To ensure the safety of all individuals participating in or affected by herbicide use, to minimize the park's exposure to liability, to ensure the appropriate and effective application of herbicides as a management tool, and to minimize detrimental effects to the environment.

LVNP uses herbicides only when and where they contribute to the perpetuation of species, communities, and ecosystems targeted for preservation or when they provide the most efficient and/or environmentally compatible method for control of plants that 1) could be hazardous to staff and visitors or 2) are legally designated as "noxious" species requiring control.

1) Herbicides shall be used only in situations where benefits of controlling targeted "pests" outweigh overall risks of using herbicides and other methods are prohibitively expensive, not effective, or more likely to cause unintended damage than the herbicide.
2) An herbicide may be used only in a manner consistent with its labeling.
3) An herbicide may be used only in compliance with all federal, state and local regulations, including those related to licensing and/or certification of applicators, use of protective and safety gear, and posting requirements.

Required practices, described below, are designed to ensure that the LVNP's standards for use of herbicides meet or exceed the U.S. EPA's Worker Protection Standard for Agricultural Pesticides.

1) Prior to implementing use of any herbicide, the need for its use relative to management goals shall be described in the Site Management Plan, and/or in a Weed Plan specific to the site.
2) Only employees or volunteers who are certified/licensed by state and/or local regulations, are authorized to apply herbicides.
3) Application techniques, monitoring strategies, and impacts/progress toward goals and required reporting information shall be documented.
4) Standard safety practices for storage, mixing, transportation, disposal of containers and unused herbicide, and spill management will be followed.
5) Herbicide containers and related equipment will be stored in a secure containment area away from people, animals and food. Herbicide containers will be stored closed and inspected periodically. Hazardous waste will be labeled appropriately and include accumulation start dates.
6) Additional training required for the proper use and maintenance of personal protective equipment (PPE) and other equipment or required by the Occupational Safety and Health Administration (OSHA) shall be coordinated.
7) The point(s) of contact and threshold size for spills that must be reported shall be verified in advance with the appropriate local agency. This information and other emergency related information shall be provided to all applicators and initial responders through a written contingency plan.
8) Directions and contact numbers of the nearest emergency medical treatment facility will be provided to all applicators.
9) Investigations of herbicide related accidents and receipt of employee suggestions or complaints relating to safety and health issues involving herbicides will be used as a feedback mechanism that can be used to improve the program.
10) Even if not required on product labels, employees and volunteers shall wear the following protective gear when mixing or applying herbicides:
    - rubber boots or other protective footgear used exclusively for this purpose
    - protective clothing (long-sleeve shirts and long pants not used for other activities are sufficient, but disposable Tyvek suits should be provided if employees request them)
    - rubber gloves (Tyvek or nitrile gloves are preferred over neoprene)
    - safety glasses or goggles
    - a properly fitted respirator is recommended and shall be provided if requested.
11) In addition to being certified/licensed as required by state and/or local regulations, volunteers are required to sign consent and release forms.
12) Decontamination kits must be readily available, and must include two one-gallon (or more) containers filled with potable water, eyewash kits or eyewash bottles with buffered isotonic eyewash, hand or body soap, paper or other disposable towels, a full Tyvek coverall with foot covers, and a map and directions to the nearest medical facility. Whenever possible, those who apply herbicides shall have access (within 15 minutes travel time or at the nearest vehicle access point, whichever is closest) to an eyewash kit and either a 1) shower or large sink, or 2) emergency decontamination and first aid kits.
13) Treated areas should be closed to public access until they are judged safe for re-entry (or until the herbicide dries or for the minimum period required by the product label, whichever is longer). Posting is not required in most places, but where it is required (usually by local statute), place notices at points of entry or the perimeter of treated areas. Posting notices should include a statement that the area has been or will be treated, name of the herbicide, date of treatment, appropriate precautions to be taken or the date when re-entry is judged to be safe, and a phone number for additional information. Notices should be removed after it is judged safe to re-enter the area.
14) LVNP is required to report all herbicide application activities. These reports shall include information on site(s), purpose(s), name(s) and amount(s) of product(s) used, name(s) of applicator(s), and licensing requirements for all herbicide applications in the previous 12 months. In addition, the report shall include the same information, with estimates for the upcoming 12 months.

8.8.4. Lassen Volcanic National Park Herbicide Related Spill or Injury Contingency Plan

Material Safety Data Sheets for all herbicides used at LVNP are attached and are also located in the herbicide storage area and in the field hazardous material duffels along with a copy of this plan.

Emergency Response Numbers

Medical: 911
Hospital:
Chester **- Seneca District Hospital, 130 Brentwood Drive, 258-2151**
Susanville – Lassen Community Hospital , 560 Hospital Lane, 257-5325
Redding - **Redding Medical Center, 1100 Butte Street, 244-5400**
Red Bluff **- St. Elizabeth Hospital, 2550 Sister Mary Columbia Drive, 529-8000**
CA Poison Action Line (24-hour number) 1-800-222-1222
National Response Center (24-hour number) 1-800-424-8802 (spills)
CHEMTREC (chemical information, 24-hour number) 1-800-262-8200
National Pesticide Telecommunications Network (NPTN) 1-800-858-7378
Department of Environmental Protection (emergency response) 1-800-852-7550
California Environmental Protection Agency www.calepa.ca.gov

LVNP Incident Crew members are authorized, as initial responders, to commit the necessary resources during an emergency. The crew members are trained to initiate an emergency response sequence by notifying the proper authorities of the emergency and are usually on-site or on call (and can reach the facility on short notice during an emergency). If an accidental spill reaches the reportable threshold, the site will be secured and appropriate authorities will be contacted. Reportable threshold quantities are listed in the information kept in the herbicide storage area. Otherwise, the spill will be cleaned up according to label directives utilizing the spill kits located in the field with the applicator and/or at the herbicide storage area. Immediately after a spill or other herbicide related emergency, the appropriate DWP personnel will provide for proper management of recovered waste, contaminated soil or other debris, clothing, equipment and any contaminated surface or groundwater. All herbicide related accidents will be investigated to provide information on how such occurrences can be avoided in the future.

List of emergency equipment with locations and capability.

Portable eyewash units	initial treatment	field haz mat duffels
Pure Flow 1000 eyesaline flushing station	15 minute flush	RM basement
Chemical decontamination kits	initial treatment	herbicide locker
Spill response kits	for 5-6 gallon spills	herbicide locker
Shower	initial treatment	RM downstairs bathroom
First-aid kits	initial treatment–burn	herbicide locker/field/haz-mat duffles/trucks

All emergency equipment will be cleaned, replaced or otherwise made fit for its intended use before operations resume after an incident.

MEDICAL FACILITIES

Chester - Seneca District Hospital, 130 Brentwood Drive, 258-2151
Red Bluff - St. Elizabeth Hospital, 2550 Sister Mary Columbia Drive, 529-8000

Redding - Redding Medical Center, 1100 Butte Street, 244-5400
Urgent Medical Clinic, 2170 Esplanade Chico 343-5222

8 .8.5. Herbicide User's Generalized Check Sheet

Realizing that you are working with chemicals of varying levels of toxicity which can be harmful to you and the surrounding environment, please observe the following guidelines when mixing, transporting or applying herbicides at the Disney Wilderness Preserve. Remember…**Herbicide users are required by law to review and comply with all the conditions set forth in the herbicide label.**

1. Coordinate any herbicide activity with the Invasives Program Coordinator (IPC) first.
2. Take a radio, first aid, spill response and decontamination kit in the haz mat duffel.
3. Make sure that the laminated information sheet and clipboard containing emergency contact numbers and directions to the nearest hospital is in the haz mat duffel.
4. Use the proper safety equipment. The label states what safety clothing and equipment are required. Pant legs should be left outside of boots. Remove clothing that is contaminated after a spill. (Protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.) Inform the IPC of any problems however, minor.
5. A respirator will be provided for voluntary use or you may provide your own. In either case, you should consult with the IPC to ensure that the respirator itself does not present a hazard.
6. If your clothing becomes wetted with hazardous substances, remove it immediately and proceed to the shower or a decontamination kit whichever is closest.
7. Drink liquids to prevent dehydration during hot weather. Halt all activity if you experience respiratory difficulties and/or fatigue.
8. Extreme caution should be taken when handling herbicides. Never open a container at eye level. Never eat, drink, smoke, or use smokeless tobacco when handling herbicides, and wash immediately if contact with a herbicide is made because some formulations can cause irritation, blisters, blindness and death.
9. Choosing the correct herbicide and formulation is the first preventative measure to avoid misapplication, leaching, off-site drift, and carry over. The label should be read to ensure correct mixing. All mixing should take place at the herbicide storage area.
10. Prior to moving or transporting any container, inspect it for leaks. Transport herbicide containers in an upright and secured position to prevent spillage. Transport in the bed of a truck or other off road vehicle (MULE or swamp buggy) not in the cab. Unless you can completely secure the containers (including backpack sprayers containing mixtures) do not use ATVs to transport chemicals.
11. Read the Label for correct application instructions. The application unit should be properly calibrated to deliver the correct amount of product per unit of area. All precautions should be taken to deliver herbicide to only the target species. In order to prevent or reduce drift, the spray boom should be at the lowest setting that will still produce a good pattern. A drift control agent may be added to the herbicide mix. Do not apply herbicides when the wind is blowing >3 mph.
12. Keep current on weather conditions and forecasted conditions. Do not apply herbicides in the rain or if rain is forecasted before the herbicide has time to be absorbed.
13. Keep all pets, people, and livestock away from the area being treated. Do not allow anyone to enter the treated area during the restricted entry interval (REI) which varies based on the herbicide.
14. Equipment should be rinsed thoroughly following use. Spray tips and strainers should be rinsed and residue removed. Always triple rinse all glass, plastic, and metal herbicide containers. Each time a container is rinsed, it should be one-third full of water before shaking. Report any equipment problems or needed repairs to the IPC immediately.
15. Always store herbicides in the original container in the locked herbicide area. Store any unused portions of herbicides mixtures in a clearly marked and closed container. Include the accumulation start date on the label. Refer to the product label for the shelf life.
16. Read the label for disposal instructions. Improper disposal of excess herbicide, spray mixture, or rinsate is a violation of the Federal law. There are no especially designated landfills or incinerators in Florida for disposing of herbicide containers or unwanted herbicides. Some drums can be re-used and may be returned to the dealer. Smaller empty containers and unused mixtures will be stockpiled and surrendered to the appropriate collection locations during local hazardous waste collection dates.

17. Thoroughly wash any vehicles used in the transportation or application process.
18. Report the type, amount, location, weather conditions, etc. on the form provided and submit to the IPC upon completing the application.

8 .8.6. Herbicide User's Best Management Practicet

Adapted from *Northern Great Plains Exotic Plant Management Plan and Environmental Assessment*

BMPs would be followed to ensure that the overall effectiveness of pesticides is maximized and the potential for impacts is minimized. These general BMPs include the following:

- Pesticides would be selected and BMPs would be implemented to maximize the effectiveness of the treatment on the target exotic plant and to minimize the potential effects on non-target plants.
- Reduced application rates of pesticides would be used wherever possible. Reduced application rates are often more effective than higher application rates because translocation is enhanced prior to loss of physiologic function. Higher rates may burn off leaves and reduce translocation.
- Pesticides would be applied as near to the target plant as possible.
- Pesticide application would account for meteorological factors such as wind speed, wind direction, inversions, humidity, and precipitation in relation to the presence of sensitive resources near the treatment area and direction provided on labels. Pesticides would only be applied when meteorological conditions at the treatment site allow for complete and even coverage and would prevent drifting of spray onto non-target sensitive resources or areas used by humans.
- Pesticides would be applied only during periods of suitable meteorological conditions. Loss of spray from a treated area increases during high winds or low humidity. Pesticides should also not be applied during periods of dead calm (this could indicate an inversion) or when wind velocity and direction pose a risk of spray drift.
- Pesticides would be applied using coarse sprays to minimize the potential for drift. Avoid combinations of pressure and nozzle type that would result in fine particles (mist). Add thickeners if the product label permits.
- Pesticides would be applied at the appropriate time based on the pesticide's mode of action. Poor timing of application can reduce the effectiveness of pesticides and can increase the impact on non-target plants.
- Pesticides would be applied according to application rates specified on the product label.
- In areas where there is the potential to affect surface water or ground water resources, pesticide pH and soil pH would be considered to select the pesticide with the lowest leaching potential.
- Highly water-soluble pesticides would not be used in areas where there is potential to affect surface water or ground water resources.
- Pesticides with high volatility would not be used to treat areas located adjacent to sensitive areas because of the potential for unwanted movement of pesticides to these areas.
- Pesticides with high soil retention would be used in areas where there is potential to affect surface water or ground water resources.
- Pesticides with longer persistence would be applied at lower concentrations and with less frequency to limit the potential for accumulation of pesticides in soils.
- As needed to protect the efficacy of the pesticide, water would be buffered, depending on hardness, pH, and other factors.
- Safety protocols for storing, mixing, transporting, handling spills, and disposing of unused pesticides and containers are included in **Appendix E** and would be followed at all times. Plans for emergency spills are included in **Appendix E**.

- All federal, state, and local regulations regarding pesticide use would be followed at all times.
- All product labels would be read and followed by pesticide applicators. It is a violation of federal law to use a pesticide in a manner that is inconsistent with its label.
- Pesticide applicators would obtain any certifications or licenses required by the state and/or county.
- NPS policy requires that only pesticides that are expected to be used in a 1-year period can be purchased at one time. Therefore, pesticides would not be stored for periods greater than on year. Pesticide efficacy is lost over time. This practice of purchasing no more than a one-year supply would maintain pesticide efficacy that would otherwise be reduced by longer storage.
- Equipment would be maintained and calibrated prior to each application of pesticides. During all applications, droplet size would be controlled to decrease the risk of pesticide drift to non-target species outside the immediate treatment area. Droplet size is controlled by nozzle settings.
- Areas that may contain cultural or historic resources and that have not been previously studied would be surveyed. If cultural or historic resources are identified or are known to occur, all surface disturbing activities would be avoided in these areas. Use of pesticides within the boundaries of the cultural resource or historic resource sites would be restricted. Because of unknown effects, pesticides would not be directly applied to historic structures with limestone grout, hearth features, or cultural resources comprised of organic material, bone, pollen, seeds, and materials made from plant fiber. However, pesticides may be used in lands surrounding cultural or historic sites in accordance with BMPs.

To minimize the potential impact of pesticides on surface water and ground water resources, the following BMPs would be implemented:

- Only pesticides that are registered for use in or near water would be used in those areas.
- Only those pesticides that have a low potential toxicity, such as glyphosate (Roundup Pro and Rodeo) would be used within areas near surface waters or in areas with a high leaching potential. Glyphosate is strongly adsorbed into soil, with little potential for leaching to ground water. Microbes in the soil readily and completely degrade it even in low temperatures. It tends to adhere to sediments when released to water and does not accumulate in aquatic life (See Appendix 8.9).
- Applications of pesticides would be avoided during periods and in areas where seasonal precipitation or excess irrigation water is likely to wash residual pesticides into waterways.
- Applications of pesticides within 50 feet of surface water bodies (including streams, rivers, lakes, and waterways) would be done by hand equipment to minimize the potential impacts to surface waters.
- Each park currently monitors potable drinking water quality. This monitoring would continue to confirm that potable water meets drinking water standards as outlined by the Safe Drinking Water Act (SDWA).
- Parks would implement surface water and ground water monitoring programs as appropriate to protect natural resources. Rigorous testing of pesticides is required prior to release as a registered product.
- The RAVE system would be used by parks, as necessary and appropriate, to evaluate potential risks to ground water from chemical treatments.
- When available from the Regional IPM Coordinator, vertical buffer zones to ground water would be used.

Literature Cited

Standard Operating Procedure – Herbicide Use. TNC Policy and Procedures Manual. July 1997.
Contingency Plan Guidance. Department of Environmental Resources. August 1991.
Summary of Hazardous Waste Regulations. Department of Environmental Resources. February 1995.
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Control of Non-native Plants in Natural Areas of Florida. University of Florida. Cooperative Extension Service. 1997.
OSHA Standards 1910.120, .132, .133 and .134. Occupational Safety & Health Administration, U.S. Department of Labor.
Pers. comm. Lassen Volcanic National Park Safety Committee Chair, David Harry. 2006.

8.8.7. Herbicide use record forms

Employees are required to keep an annual herbicide use log and submit it to the park IPM coordinator at the end of the calendar year. This herbicide use log should include all herbicides, both approved and unauthorized use, applied by staff, private or commercial pest management companies. The herbicide use log should be maintained on a project-by-project basis. (For example, if project number "PARK-01-2003" for boric acid is approved for use in calendar year 2003 for crack and crevice treatment of cockroaches in the dining area, all use for this specific project should be tallied under this same project number.)

In addition, site conditions, types of species present, and percent cover of invasive and native species will be recorded in WIMS prior to application. This information will be valuable in evaluating the effectiveness of the herbicide, determining project success, improving methodology, and identifying mistakes.

The park IPM coordinator will include the crew's herbicide use in the park-wide herbicide use log and submit it to the PUPS database. This information is maintained for legal purposes and in accordance with NPS Management Policies.

PESTICIDE REQUEST FORM
TO BE SUBMITTED TO THE PARK IPM COORDINATOR
FOR THE CALENDAR YEAR OF 20____

Pesticide Name	Amount Used	Date Used	Location Used	Pest Targeted	**Applied By** (company or employee name)	Notes

PESTICIDE USE LOG
FOR THE CALENDAR YEAR OF 20____

Pesticide Name	Amount Used	Date Used	Location Used	Pest Targeted	Applied By (company or employee name)	Notes

8.9 RELATIVE AQUIFER VULNERABILITY EVALUATION (RAVE) MODEL

Rating Groundwater Vulnerability to Herbicide Contamination, based on the RAVE: Relative Aquifer Vulnerability Evaluation (Montana State University Extension Service 1990). Modifications from *User's Guide for the Vegetation Management Risk Assessment* (Baxter 1992) and a supplemental table from the *Northern Great Plains Exotic Plant Management Plan and Environmental Assessment*(NPS 2005).

Introduction
The behavior of an herbicide in water is dictated by its solubility in water. Water bodies can be contaminated when directly sprayed upon, or when herbicides drift, volatilize (vaporize), leach into to groundwater, or are carried in surface or subsurface runoff. Amounts of leaching and runoff largely depend on total rainfall the first few days after an application (Ohio State University Extension 1992). To prevent water contamination, carefully consider the hydrology of the system that is being treated. Hypothesize potential runoff scenarios and take appropriate measures to prevent environmental damage. Some herbicides will volatilize in hot weather and drift even on windless days. Improper spray pressures or techniques can cause droplets or clouds of herbicide to drift and land on non-target vegetation. The herbicide label will usually provide information about potential off-target risks (Tu and others 2001, Ohio State University Extension 1992).

To help farmers and pesticide applicators reduce the potential for contaminating ground water with pesticides, an aquifer vulnerability scoring system; RAVE: Relative Aquifer Vulnerability Evaluation has been developed. This numeric scoring system helps individuals evaluate pesticide selection for on-site ground water contamination potential. RAVE is designed only as a guidance system and does not replace the need for safe and judicious pesticide application required in all situations.

In most cases pesticide contamination of ground water can be avoided by using common sense and following label instructions. However, some areas are particularly vulnerable to pesticide contamination and thus require special consideration prior to making an application. The use of this score card may indicate whether an alternative pesticide should be used within a given area or if the area is not suited to pesticide applications. Several major factors in a particular area determine the relative vulnerability of ground water to pesticide contamination. Nine of these factors have been incorporated into the RAVE score card and are defined below. A value for most of these factors can be determined by a simple on-site inspection. If a value for a particular factor is not known, contact the appropriate agency for assistance. A listing of agency contacts is provided below. Pesticide leaching potential is based on the soil persistence and mobility of a pesticide. A list of leaching potentials for some commonly used pesticides is given below.

Factor Definitions
Annual Precipitation: Over 60 inches, between 30 and 60 inches and less than 30 inches on the site annually (Baxter 1992).
Depth to Ground Water: The distance, in vertical feet, below the soil surface to the water table.
Distance to Surface Water: The distance, in feet, from the field boundary to the nearest flowing or stationary surface water.
Percent Organic Matter: The relative amount of decayed plant residue in the soil (see soil test results, county soil survey or consult the SCS). This may be estimated by soil color; darker soil generally indicates higher organic matter (most Montana soils are < 3 %).
Pesticide Application Frequency: The number of times the particular pesticide is applied during one growing season.
Pesticide Application Method: A rating based on whether the pesticide is applied above or below ground.
Pesticide Leachability: A relative ranking of the potential for a pesticide to move downward in soil and ultimately contaminate ground water based upon the persistence, sorptive potential and solubility of the pesticide.

Topographic Position: Physical surroundings of the field to which the pesticide application is to be made.
Flood plain = within a river or lake valley, Alluvial Bench = lands immediately above a river or lake valley, Foot Hills = rolling up-lands near mountains, Upland Plains = high plains not immediately affected by open water or mountains.

Resources
Soils Information: (1) USDA-NRCS soil survey, district offices in most county seats; (2) University of California Cooperative Extension Service in most county seats.
Ground Water Information: (1) Department of Water Resources, Groundwater Information Center http://www.groundwater.water.ca.gov/; (2) United States Geological Survey Groundwater Information http://water.usgs.gov/ogw/; (3) California Environmental Protection Agency http://www.calepa.ca.gov/; (4) US Environmental Protection Agency Water Website http://www.epa.gov/ow/states/CA/.
Pesticide Information: (1) California Department of Pesticide Regulations http://www.cdpr.ca.gov/; (2) California Environmental Protection Agency http://www.calepa.ca.gov/; (3) California Department of Toxic Substances Control http://www.dtsc.ca.gov/ ; (4) US Environmental Protection Agency Pesticide Website http://www.epa.gov/pesticides/

Directions for Use of the RAVE Score Card
The RAVE score card can be completed in a matter of minutes. On a separate sheet of paper write down the appropriate value for each of the nine factors listed on the score card. For example; at a sprinkler irrigated site the "Irrigation Practice Factor" would be assigned a value of 7. Once all of the factors have been assigned a value, total all values. This total should then be compared to the Score Card Interpretation Scale to determine the relative vulnerability of ground water to contamination by an individual pesticide. Higher scores indicate higher vulnerability of ground water to pesticide contamination. If a high score is received, select an alternative pesticide and compare the results.

THE RAVE SCORE CARD

DEPTH TO GROUND WATER:
*2-10 ft 20
10-25 ft 12
25-50 ft 5
> 50 ft 0

_____

DISTANCE TO SURFACE WATER:
1-100 ft 5
100-500 ft 3
> 500 ft 2

_____

TOPOGRAPHIC POSITION:
Floodplain 15
Alluvial bench 10
Rolling foothill 5
Upland plain 2

_____

SOIL TEXTURE:
Gravelly 15
Sandy 15
Loamy 10
Clayey 5

_____

PERCENT SOIL ORGANIC MATTER:
0-1% 5
**1-3% 3
> 3% 2

_____

ANNUAL PRECIPITATION:
> 60" 5
30-60" 2
< 30" 1

_____

HERBICIDE APPLICATION FREQUENCY:
> 1/year 5
1/year 2

_____

HERBICIDE APPLICATION METHOD:
Soil applied 5
Foliar applied 2

_____

HERBICIDE LEACHING INDEX:
***High 20
Moderate 10

Total ALL Rankings for the field and pesticide in question here:
* If water table < 2 feet deep, applications should probably not be made
** If unknown, use this value
*** See Table 1A or 1B for pesticide leaching index

Interpretation of RAVE Scores
The RAVE score card rates aquifer vulnerability on a scale of 30 to 100 for individual application sites and pesticides. Higher values indicate high vulnerability of ground water to contamination by the pesticide used in the evaluation. Those values greater than or equal to 65 indicate a potential for ground water contamination. In such instances alternative pesticides should be sought which have a lower leaching potential. Scores of 80 or greater indicate that pesticide applications should not be made at this location unless an alternative product greatly reduces the score. Scores between 45 and 64 indicate a moderate to low potential for ground water contamination and scores less than 45 indicate a low potential for ground water contamination by the pesticide in question. Even in such cases, careful use of pesticides and following label instructions is imperative to protect ground water.

Score Card Interpretation Scale		
30	60	100
Low Concern		High Concern

Table 1a. Commonly used pesticides, an example trade name, and relative pesticide leaching potentials. Chemicals bolded have been found in ground water in Montana[1].

Herbicides / Pesticide Leachability	
acrolein (Magnacide H) high	acifluorin (Blazer) low
ametryn med	alachlor (Lasso EC) med
atrazine (AAtrex) high	Aminopyralid (Milestone) low[2]
clopyralid (Stinger, Transline) high	butylate (Sutan+) low
cycloate (Ro- Neet) med	chlorsulfuron (Telar) high
desmedipham (Betanex) low	cyanazine (Bladex) med
diclofop (Hoelon) low	dalapon high
diuron (Karmex) med	**dicamba (Banvel)** high
EPTC (Eptam, Eradicane) med	difenzoquat (Avenge) low
glyphosate (Roundup) low	fluazifop- P- butyl (Fusilade 2000) low
imazamethabenz-methyl (Assert) high	Glufosinate ammonium (Finale) low
imazapyr (Arsenal) high	hexazinone (Velpar) high
MCPA amine (Weedar) high	imazapic (Plateau) high
MCPA ester (Curtail M) high	MCPA high
paraquat (Gramoxone Extra, Cyclone) low	MSMA (Daconate) low
propachlor (Ramrod) low	**picloram** (Tordon) high
pyrazon (Pyramin) low	pronamide (Kerb) low
simazine (Princep) high	propanil (Stampede) low
tebuthiuron (Spike) high	sethoxydim (Poast) low
thifensulfuron (Harmony) high	sulfometuron methyl (Oust) med
triasulfuron (Amber) low	terbacil (Sinbar) high
vernolate (Vernam, Surpass) med	triclopyr (Garlon) med
2,4- D amine (Curtail) high	triflusulfuron methyl (Upbeet) med
2,4-DB (Butyrac) high	**2,4-D** high
2,4-DP (Weedone) high	**2,4- D ester (Curtail M)** high

Ratings Determination
Montana Department of Agriculture: George Algard
Montana State University, Extension Service: Jeff Jacobsen, Greg Hester
Prepared by: Tom DeLuca and Phil Johnson
Updated by: Donna Rise and David Rise
MT Department of Agriculture, Agricultural Sciences Division, Helena, MT 59620 MDA Technical Bulletin 90- 01A

[1] *adapted from* National Park Service. 2005. Northern Great Plains Exotic Plant Management Plan and Environmental Assessment. Available online: http://www.northerngreatplains-nps.com

[2] U.S. Environmental Protection Agency (US EPA)
2005a Pesticide Fact Sheet: Aminopyralid. United States Environmental Protection Agency, US Office of Prevention, Pesticides, Environmental Protection, and Toxic Substances Agency.
2005b Environmental Fate and Ecological Risk Assessment for the Registration of Aminopyralid, US Office of Prevention, Pesticides, Environmental Protection, and Toxic Substances Agency.

Table 1b. Supplemental Table: Herbicides and their Properties for use with Rave Scorecard[1].

Common name	Trade name	Solubility in water (ppm)	Soil sorption index (K_{oc})	Half life in soil (days)	Surface runoff (loss) potential	Leaching potential
Aminopyralid[2]	Milestone	2480	1.05-24.3 mL/g	26 (average)	Small	Small
Chlorsulfuron	Telar	300 (pH 5) 28,000 (pH 7)	40@pH 7 (average)	30 for acid soil 30+ alkaline soil	Small	Large
Clopyralid	Curtail, Transline, Stinger, Reclaim	1,000 (acid) 300,000 (salt)	1.4	20	Small	Large
Glyphosate	Roundup Pro & Ultra, Rodeo, Glypro, Accord	12,000	24,000	30	Large	Small

[1] McCrea J. 2001. Supplemental Table for RAVE *in* **Northern Great Plains Exotic Plant Management Plan and Environmental Assessment. National Park Service:** Available online: http://www.northerngreatplains-nps.com.

[2] U.S. Environmental Protection Agency (US EPA)
2005a Pesticide Fact Sheet: Aminopyralid. United States Environmental Protection Agency, US Office of Prevention, Pesticides, Environmental Protection, and Toxic Substances Agency.
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8.10 WILTING TREATMENT

This document provides an outline of what is needed to prepare for and implement wilting (flaming or spot-burning) in Lassen Volcanic National Park. It was adapted from protocol established at Golden Gate National Recreation Area.

Where wilting is used, the risk of causing a fire or damaging plastic fittings, such as sprinkler heads, must be taken into account. When using the burner, direct the hottest part of the flame (this is the cone-shaped area around the flame) at the weeds. Hold the nozzle above the plants and slowly pass it once over the plant.

Plants in dry conditions appear to be more susceptible to heat treatments than in cool and moist conditions. Weeds are most susceptible to heat when less than a few centimeters tall (the 4-5 leaf stage). This stage is when the roots are also killed by the heat treatment. In the cool, moist conditions of the coast, several treatments may be needed annually: one in spring to kill the majority of seedlings, followed by a treatment after fall rains cause another flush of germination. Regular treatment prevents establishment of perennials.

A. Training

All persons using the burner must first receive 1) Fire extinguisher and 2) Field Wilting Training given by designated staff. The training will be conducted in the field, and will cover all items outlined in this Standard Operating Procedure.

Fire Extinguisher Training
This required annual training will be provided by Fire Management and will provide information about fire suppression, and give individuals hands-on experience using a fire extinguisher to put out a live fire. In addition, this training will provide individuals with information on how to safely use propane and the hazards related to this material.

Certified Wilting Trainers
A small group of staff will be selected by the Plant Ecologist to receive the Certified Wilting Trainers Training from Fire Management. This training will cover: proper personal protective equipment, safe handling of equipment, evaluation of weather and fuel conditions, and emergency procedures. In order for a trainer to be eligible to train other staff, he/she will have to attend this one time training. Fire Management will offer this training once a year for new trainers.

Field Wilting Training
All individuals using the spot-burners are annually required to receive this field training from a Certified Wilting Trainer (CFT). This training will cover personal protective equipment, safe handling of equipment, evaluation of weather and fuel conditions, and emergency procedures. In addition, the training will provide information to users about effective use of the spot-burn on specific weeds and when to flame during a plants' life cycle. **Two** separate Field Wilting Training sessions are required before individuals are then able to operate the spot-burn in the field in accordance with the procedures described in this document. CWT's will document the people who receive the Field Wilting Training sessions, and dates on which they receive them.

B. Requirements for use

- **Burning duff and mulch is prohibited.** Do Not Use Spot-burn if a flame persists for more than a couple of seconds after burner passes over the treatment area.
- The Wilting team will contact Park Dispatch (209)379-1992) on the day that wilting will occur.

- A member of the Natural Resources staff will be designated to check with the NPS Wildland Fire Management Office on a regular basis during burning season to see if weather restrictions apply. The designate will then update all Spot-burn users by e-mail about moratoriums on use.
- A team of two people will operate the Wilting equipment: an operator and a support person.
- The support person will have a fire extinguisher, water pack and a shovel, for emergencies.
- All treated areas will be closely observed for ten (10) minutes following Wilting and will be "cold-trailed" (feeling the ground temperature around the perimeter) before leaving the site.
- The Wilting team will carry a radio to contact Park Dispatch in the case of an emergency.
- This method will only be used during the spring/early summer months when the target vegetation is green and wet.
- No treatment will occur during dry, windy periods or drought periods.
- Informational articles and signs will be posted in the project area(s) to educate visitors.
- See section C for required Personal Protection Equipment.

Using the Spot-burn

C. <u>Required Equipment</u>

Wilting unit consists of:
- Propane tank
- Hose
- Spot burning torch

Wilting Tool List:
- Propane Tank & Spot-burn Torch
- Spot-burn Tool Kit with:
    - Spark starter
    - Crescent wrench
    - Safety glasses
    - Ear plugs
    - Squirt bottle with soapy water
    - Important phone numbers
        - Eric Hensel (530)595-4444x5168
        - Dispatch (non-emergency and emergency) (209)379-1992
        - Michelle Cox (530)595-4444x5201
- Backpack Water Pump (filled with water)
- Fire Extinguisher
- Shovel & McLeod
- Radio
- Bungee chords to secure propane tank in truck

Personal Protection Equipment:
- Nomex pants and shirt
- 100% Cotton shirt, short or long sleeve (worn under Nomex shirt)
- Leather boots & gloves
- Goggles or safety glasses

- Hard hat
- Ear plugs

D. Inspection test

Prior to Each Use:

- Visually inspect all Spot-burn components (hose, torch and tank) for damage and/or wear. Replace the hose if it shows excessive abrasion, wear or has been cut.
- Visually inspect the propane tank for dents and damage to the collar, shut-off valve, or corroded foot ring.
- Remove and safely store propane tank protective plastic cap.
- Attach hose to propane tank.
- Perform a leak test - see instructions below.
- Ignite torch to check operation of the adjusting valve and other components.

NOTE: Always lift the propane tank by the handle, never by the valve.

Leak Test:

- Always test for leaks before using the torch.
- Close adjustment valve.
- Slowly open the propane tank shut-off valve.
- Test all connections for possible gas leaks using spray bottle with soapy water. If the applied soapy water bubbles, the hose or connector valve has a leak. Allow one minute for bubbles to appear.
- If a leak occurs, tighten connections and repeat leak test.
- DO NOT operate torch if any leaks are present, or you can smell gas.
    - If problems are detected, tag the parts to ensure they are not used by others. Replace or repair parts as necessary.

E. Instructions for Use

Lighting Instructions:

- Make sure adjustment valve on spot-burn torch is closed.
- Open the propane tank shut-off valve.
- With the spot-burn torch pointed away from propane tank and any flammable material, open adjustment valve $1/8^{th}$ of a turn or until you can hear gas escaping.
- Ignite the torch using the sparker. (Support person)
- Use the adjustment valve to control the size & intensity of the torch output.
  Note: In daylight, the Spot-burn output is barely visible.

When using the torch:

- Be VERY aware of where the torch is pointed. Do not aim it at people or non-target vegetation/materials.
- The wand should be held far enough away from the target weed to provide maximum heat. The hottest part of the flame appears as a blue color at the end of the flame (6”-12” away from the end of the torch).
- Flame from the torch should be slowly passed over target weeds to destroy plant cells.
- When the torch is lit or hot after use, keep it away from the propane tank and hose.

- Keep the torch away from your feet and the feet of others when lit.
- When moving the Spot-burn unit to a new location, turn off torch and tank.
- Watch for condensation build up on the propane tank. As the torch expends heat the propane tank gets cold and forms condensation. If the torch fuel flow becomes erratic, shut down the unit and allow the propane tank to warm up.

Shut-Off Instructions:

- Close the propane tank shut-off valve.
- Close the torch-adjusting valve.
- Briefly re-open the torch-adjusting valve to release any residual gas left in the hose.
- Disconnect hose from the propane tank after all gas has left the hose

Before leaving the site:

- Observe the site for 10 minutes after Wilting activities have stopped.
- Check the site for smoldering debris.
- Use your hand to feel the ground around the perimeter of the site. If necessary, wet down any hot spots with water.

F. Propane transport and storage

- When not in use, propane tanks and or canisters must be stored in an upright position and locked in an OSHA approved propane storage cabinet.
- Propane tanks and or canisters must be secured and transported in the bed of a truck and not inside the cab. Propane tanks must be secured in an upright position to the truck bed by bungee cords or other fasteners to prevent tank movement.

G. Potential Hazards

Potential Hazards to watch for:

- Steep, uneven terrain– DO NOT USE WILTING METHOD
- Dry mulch conditions – fire danger
- Dry grass – fire danger – DO NOT USE WILTING METHOD
- Propane tank freeze up
- Improper lifting of propane tank – back injury
- Storage and transportation of propane tanks
- Poison oak- Do flame as smoke will cause injury
- Skin rashes, burns, respiratory issues

Do Not Use wilting method if a flame persists for more than a couple of seconds after torch passes over the area.

8.11 BEST MANAGEMENT PRACTICES

Interim BMPs until Pacific West Region BMPs are finalized.
Adapted from:
Midwest Natural Resources Group
www.mnrg.gov

Document Purpose: The purpose of this document is to provide a list of potential Best Management Practices (BMP) for non-native invasive species (NNIS) management activities that will reduce the burden of impact to federal agencies. The Midwest Natural Resources Group (MNRG) Great Lakes Terrestrial Invasive Species (TISC) Committee encourages you to consider these BMPs to help reduce the spread of invasive species within your program. Every federal employee has a role to play in this important effort. If you have additional comments or suggestions to this document please submit them to the document contact below.

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Recommended Best Management Practices for Non-native Invasive Species

Eastern Region USFS and Midwest Region NPS

January 09, 2008

These best management practices (BMPs) are designed to incorporate modified practices or patterns in our day-to-day activity to reduce the threat of non-native invasive species (NNIS) to our managed lands. For BMPs to be the most effective it is important for all aspects of management activity to utilize the following guidelines. Although the outline of these BMPs follows a somewhat sequential order of events, it is important for each individual to be aware of the joint role that we share in BMP activity. Special cases and considerations follow this generalized guidance.

This document was designed to encompass management guidelines from both USFS and NPS. As this is a jointly produced document, the term 'forest' is used to represent any federal land management area regardless of use or dominant vegetation type.

Activities from USFS National Strategy and Implementation Plan for NNIS Management and NPS Invasive Species Action Plan:

1. Prevention, including leadership coordination, education and outreach
2. Early Detection Rapid Response
3. Control and Management, including research and information management
4. Rehabilitation and Restoration

Federal Laws, Regulations, Policy

- Executive Order 13112 - Invasive Species (February 1999)
- Noxious Weed Control and Eradication Act (2004)
- Federal Noxious Weed Act (1974)

USDA/USFS Regulations and Policy

http://www.fs.fed.us/r9/wildlife/nnis/r9-nnis-laws-regs-policy.shtml

- Departmental Regulations 9500-010 - Policy on Noxious Weed Management
- Forest Service National Strategy for Invasive Species Management (2004)
- Forest Service Noxious Weed Strategy - Stemming the Tide (1996)
- Forest Service Manual 2080 - Noxious Weed Management
- Forest Service Manual 2150 - Pesticide Use Management and Coordination
- Non-native Invasive Species Framework for Plants and Animals in the U.S. Forest Service, Eastern Region

DOI/NPS Regulations and Policy

http://www1.nrintra.nps.gov/BRMD/publications/Invasive_Species_Action_Plan.pdf

- DOI Department Manual 517- Integrated Pest Management Policy
- National Park Service Management Policies 2006
- National Park Service Invasive Species Action Plan 2006
- NPS-77 Natural Resources Management Guidelines
- NPS-75 Natural Resources Inventory and Guidelines
- NPS Integrated Pest Management Manual

SITE MANAGEMENT

- Compile a list of known and potential NNIS, locations and sources of NNIS introduction and/or dispersal within the forest. This information will reside within the USFS TERRA/NNIS and NNIS FACTS or NPS GIS databases and should be made available to individuals working, volunteering or recreating within managed lands.
- Conduct NNIS inventories of all lands considered for acquisition.
- Consider NNIS status of lands when making land adjustment decisions.
- Incorporate NNIS prevention provisions in all special use permits, road use permits, and easements.
- Retain bonds until reclamation and restoration is complete for mineral permitting.
- Train personnel (including volunteers and contactors) to watch, identify and treat NNIS.
- Practice Early Detection Rapid Response (EDRR):
    1. Monitor disturbed habitats or pathways of introduction for newly established NNIS.
    2. Map and treat any new and pioneering infestations.
    3. Maintain a record of treatment of NNIS to assist in future management efforts.
    4. Map known infestations and flag NNIS in the field for easy relocation. Search the area for any satellite infestations and mark them.

PRE-PROJECT ASSESSMENTS AND ACTIVITY

- Environmental analysis for road construction and reconstruction will include a NNIS risk assessment and a strategy for NNIS management in construction layout, design, and project alternatives evaluation.
- Consider NNIS risk and spread factors in travel plan (road closure) decisions
- Ensure that NNIS prevention and related resource protection are considered in travel management.
- Check NNIS databases, pre project and enter NNIS information.
- Inventory NNIS infestations both on site and in the adjacent area before initiating ground disturbing activities.
- Remove or treat NNIS seed sources and other viable reproducing plant parts that could be spread by construction disturbance, passing vehicles, or foot traffic.
- Identify (flag) existing NNIS populations to be avoided
- Set up equipment cleaning stations for vehicles and other equipment in project activity.

PROJECT SITE ACTIVITY

- Do not allow the introduction of new NNIS species into project areas (pits, construction etc)
- All individuals working, volunteering or recreating should clean mud, dirt, and plant parts off vehicles, pets, equipment and boots before going onto public lands.
- Use uninfested areas for staging, parking, and cleaning equipment.
- Keep active road construction sites that are in relatively NNIS free areas closed to vehicles that are not involved with construction.
- If possible, begin activities in uninfested areas before operating in infested areas. Clean equipment via equipment cleaning stations before moving to an NNIS free area.

- Minimize contact with roadside sources of NNIS seed and propagules that could be transported to other areas or restrict to those periods when spread of seed or propagules are least likely.
- Minimize soil disturbance and retain desirable vegetation in and around area to the maximum extent possible.
- Minimize the creation of sites suitable for NNIS establishment
- Minimize removal of roadside vegetation during construction, maintenance, and other ground disturbing activities.
- Protect the native seedbank in uninvaded areas.
  -Minimally disturb soil, duff, and litter to keep seed bank intact.
  -Separate top soil for reapplication.
  -Salvage and reapply seedbank (within litter, duff, and topsoil).
  -Do not cover top soil with plastic or other materials that could destroy seeds by heating.

RESTORATION AND FOLLOW-UP

- Check NNIS databases post project completion and enter NNIS information.
- Quickly treat individual NNIS plants or small infestations before they become established, produce seeds, and are able to spread.
- Suppress the growth and/or reduce the reproductive capabilities of NNIS to slow or prevent their establishment.
- When revegetating areas that were previously dominated by invasive plants, attempt to achieve at least 90% control of the invasion before attempting restoration.
- Use certified weed free mulch and hay.
- Use only NNIS free sand, gravel, topsoil, etc.
- Consider the use of NNIS free fiber roll barriers or sediment logs.
- Consider whether a site requires seeding to insure that disturbed soil does not optimize NNIS plant establishment.
- Revegetate using plant materials that have a high likelihood of survival.
- Use locally native material including seed mixes, plugs, and sods where appropriate and available. Use certified NNIS free products.
- Use appropriate seeding guidelines and mixes and realize that many species previously recommended for this purpose now present invasive problems. Cross reference seeding list with list of known or potential NNIS.
- Consider the appropriate seed transfer zones for the native plants used in various restoration projects within – wildlife, fisheries, etc. and follow guidance regarding use of locally native plants in restoration.
- Consider carefully if fertilization is warranted, because addition of fertilizer will increase risk and degree of NNIS invasion.

MONITORING

- Include monitoring and treatment for NNIS in project maintenance programs.
- After a ground disturbing activity, monitor infested areas annually for at least three growing seasons following completion of activities and provide for follow up treatments based on inspection results.
- Monitor and evaluate the success of revegetation in relation to project plan

ROADS, SOIL, AND VEGETATION DISTURBANCE

- Develop training, MOU's etc. by which other local entities who may maintain FS/NPS roads (county, state, etc.) employ the same NNIS protocol as the USFS/NPS.
- Do not blade roads or pull ditches where new invaders are found, if possible.

- When it is necessary to conduct soil work in infested roadsides or ditches, schedule activity when seeds or propagates are least likely to be viable and to be spread.
- Move sediment to upland or quarantined areas when cleaning around culverts, canals, or irrigation ditches.
- Avoid moving NNIS infested gravel, rock, sand, topsoil and other fill materials to NNIS free locations including soil and gravel pits.
- Eliminate and monitor NNIS within gravel pits and soil piles.
- Do not establish new soil pits in areas where new NNIS are present on NF lands.
- Check the area where pit material is used to ensure that no NNIS are transported and introduced to a new site.
- Where NNIS occur within soil pits, strip at least 8 inches and stockpile the contaminated material.
- Maintain desirable roadside vegetation. If desirable vegetation is removed during blading or other ground disturbing activities, the area should be revegetated with desirable vegetation.
- Reduce NNIS establishment in road obliteration and reclamation projects. Consider treating NNIS in road obliteration and reclamation projects before roads are made undrivable.

RECREATION- General

- Maintain trailheads, boat launches, outfitter and public camps, airstrips, roads and leading trailheads, and other areas of concentrated public use in a NNIS free condition.
- Time mowing of recreational areas and roads to minimize movement of NNIS propagules and to maximize control of NNIS (e.g., time mowing to prevent NNIS from producing seed)
- Reduce NNIS establishment and spread from activities covered by Recreation Special Use Permits.
- Include NNIS educational materials on identification and reporting of NNIS with all Recreation Special Use Permits issued.
- Ensure that rental equipment is free of NNIS seed and propagules before the contracting officer representative accepts it.
- All individuals working, volunteering or recreating should clean mud, dirt, and plant parts off vehicles, pets, equipment and boots before going onto public lands.
- Provide cleaning stations for ATVs, water craft, mountain bikes, animals and footwear.
- Discourage camping and traveling through areas infested with NNIS if they can be avoided.

Horses/Equestrian

- Before entering public lands, horses should be brushed to remove NNIS.
- Purge horses for 12 hours by feeding certified weed free feed before entering public lands.
- Use only certified NNIS weed free forage products.
- Stock should be tied and/or held in such a way as to minimize soil disturbance and avoid loss of native/ desirable vegetation.

Hunting

- Do not plant NNIS for wildlife. Plant native species if planting is deemed essential.
- Disallow access to infested areas.
- Waterfowl hunters should use elliptical, bulb shaped or strap anchors on decoys to avoid collecting submersed and floating aquatic NNIS.
- Monitor food plots for accidental NNIS introduction.
- Use NNIS free materials at game baiting stations.
- Do not allow blinds to be constructed from NNIS.

Fishing and Boating

- Construct new boat launches and ramps at deep water sites.
- Maintain a 100 foot buffer of aquatic NNIS free clearance around boat launches.
- Sign NNIS infested areas, access sites, etc.
- Disallow access to infested areas
- Establish and monitor boat cleaning stations.
- Drain water from boat, motor, bilge, live well, and bait containers before leaving a water access site.
- Remove visible plants, animals and mud from boat before leaving a waterbody.
- Clean and dry boats and equipment before entering another waterbody.
- Dispose of unwanted bait in trash. Do not dump earthworms in the woods even if earth worms are already present. –
- Do not release plants and animals into a waterbody unless they came from that waterbody.
- Involve Lake Associations in NNIS control / establish Cooperative Weed Management Areas/ CWMA's

LANDSCAPING

- Until removal of NNIS is completed, remove and destroy seed heads of NNIS (deadhead).
- Do not share NNIS species with gardeners
- Do not use NNIS or potentially NNIS in landscaping. Cross reference planting lists with NNIS lists.
- Use non invasive or preferably locally native alternatives for landscaping.
- Be aware of where topsoil is collected and transported from when bringing soil in from a different location for a project. Inquire about potential NNIS in topsoil sources.

RANGELAND/PASTURE

- Ensure that NNIS prevention and controls are considered in management of all grazing allotments.
- Minimize or exclude grazing on newly planted or restored areas until vegetation is will established.
- Control the timing, duration and intensity of livestock grazing to maintain and enhance desirable plant vigor and ground cover.
- Purchase only certified weed free forage, hay and other feed.
- If livestock are carrying seed in their hair or digestive tract, quarantine them for five days before moving them from infested to noninfested areas.
- Refrain from grazing or moving cattle through populations of NNIS while NNIS is setting seed or when fruit is ripening.
- Check areas of concentrated livestock use for NNIS establishment and treat new infestations.

FOREST PESTS AND PATHOGENS

- Bait – see Recreation section.
- Do not transport leaves, mulch, compost, or soil from one place to another unless it is certain that there are no earthworms or their cocoons present.
- Landscaping products, soil, and topsoil may contain worms and/or their cocoons and should not be used if there is a concern for the introduction of worms.
- Do not introduce additional earthworms to compost piles in forested areas. If there is concern for the spread of earthworms used in composting (vermicomposting), worm and their egg cases/ cocoons can be killed by freezing the compost for at least one week.
- ATV's and other vehicle with tread that can hold soil should be washed before transporting the vehicle elsewhere.
- Do not move firewood or other materials that may harbor insect pests.

- Follow prescribed monitoring eradication efforts
- Inspect equipment and materials for egg cases before moving.
- Use appropriate replacement tree species and realize that some species previously recommended for this purpose now present invasive problems. Never replace with NNIS.

HUMAN HEALTH

- Follow labeling on pesticide/ herbicide use.
- Provide information on exposure risks to toxic NNIS.

FIRE MANAGEMENT

Aviation Resources

The Forest shall compile a list of known sources of any NNIS. This list will be incorporated into the Forest Air Operations Plan. The Forest AIR Operations Plan will address cleaning and certification procedures.

Mobilization/Demobilization

Pre-Use Inspection. When feasible, upon initial arrival to the incident on the Forest and prior to use, equipment that will have contact with a water source will be washed. A final visual inspection for any mud or aquatic plants will complete the inspection process. If plants or mud are detected, then repeat the process until the bucket, tank or other equipment that will have contact with a water source is completely clean.

1. This process should be done a minimum of 300 ft away from any body of water or in a manner that will prevent contaminated water from reaching surface water, riparian, and wetland areas.
2. When the aircraft is demobilized from the incident, the process will be repeated to ensure that no NNIS species are transported to a new incident at another location. Documentation of cleaning will be issued by the helicopter manager to the helicopter pilot stating the bucket was cleaned in accordance with the Forest Air Operations Plan.
3. An exemption to the washing requirement can be granted if documentation is presented to verify that the visiting equipment was treated prior to arrival to the Forest.

During Actual Suppression Operations

1. Known NNIS sites should be avoided as a first precautionary measure. Private ponds will be considered suspect unless tested otherwise.
2. During the operational period if an NNIS infected dip site is used to provide water to the fire via aerial delivery, the equipment contacting the water will be cleaned and inspected before moving to a new dip site if feasible.
3. If using NNIS contaminated waters, aerial drops will occur at a minimum of 50 feet away from any live body of water.
4. When situations permit safe operations, aircraft should dip or draft water from the deepest portion of a lake or stream to avoid picking up bottom sediments from the water source. Aircraft operation safety takes precedence.
5. Resource advisors should be assigned by the local unit for extended attack operations and multiple aircraft situations to ensure prevention practices are being adhered to.
6. Tarps should be placed under NNIS infested cargo areas and net loading areas if NNIS exists and can not be removed or avoided.
7. Minimize soil disturbance to no more than needed vegetation management objectives. Prevention practices to reduce soil disturbance include, but are not limited to: treating fuels in place instead of piling; minimizing heat transfer to soil in burning; minimizing fireline construction.

Ground Equipment - Standard Prevention Guidelines

The Forest shall compile a list of known sources of any NNIS. The Forest Fire Management Plan or equivalent will address NNIS prevention and mitigation procedures.
This list will be incorporated into the Standard Operations Plan, as will these mitigation procedures. None of these procedures will take precedence over protection of human life.

Mobilization/Demobilization

Pre-Use Inspection. When feasible, upon initial arrival to the Forest or Incident and prior to use, equipment (fire trucks, water tenders, pumps, intake hoses and screens, etc) that will have contact with a water source will be washed and inspected for plant parts and soil. If plants or soil are detected, then repeat the process until the equipment is completely clean.

1. This process should be done a minimum of 300 ft away from any body of water or in a manner that will prevent contaminated water from reaching surface water, riparian, and wetland areas.
2. When the equipment is mobilized from the Forest or Incident, the process will be repeated to ensure that no NNIS species are transported to a new incident at another location. On contracted equipment, the equipment manager, contracting officer representative or designated inspector will issue documentation to the equipment user as to verify equipment is cleaned in accordance with the Forest NNIS plan.
3. A bleach solution will be circulated through pumps, intake hoses, and screens.
4. An exemption to the washing requirement can be granted if documentation is presented to verify that the visiting equipment was treated prior to arrival to the Forest.
5. Equipment that is moved from one water source to another will require re-treatment.

During Actual Suppression Operations

1. Avoid sucking organic and bottom material into water intakes when drafting from stream or ponds.
2. Avoid entering waterbodies or contacting mud and aquatic plants. Avoid transferring water between drainages or between unconnected waters with in the same drainage.

Post Fire Restoration/ BAER

- See restoration above

Forestry Vegetation Removal/ Prescribed Burning Activity

- Clean equipment to avoid the spread of NNIS.
- Use equipment cleaning sites where proper disposal of waste water or other waste material can take place. The method chosen must be selected based on the type of NNIS believed to be present on the equipment and availability of cleaning operations.
- After being at a site with NNIS, personal sanitation measures include: cleaning shoes and clothing of plant parts, insects, insect eggs, larvae, and mud.
- During intermediate treatments remove NNIS when possible.
- Minimize time of mineral soil exposure.
- Ground disturbance should be minimized and monitored.
- Ground disturbance should not extend beyond the area where regeneration is desired. NNIS can become established (even via wind) and existing populations can expand.
- Reestablish vegetation on bare ground and exposed soil as soon as possible after objectives have been met. Consider the prospect for the reestablishment of vegetation via native seed bank.
- Before conducting soil exposing activities such as scarification, logging, roller chopping, prescribed burning, or tilling consider the NNIS at the site or likely to arrive. If there is an NNIS seed bank or if NNIS seed producing individuals are nearby, it may be desirable to treat the NNIS and/ or seed bank before disturbing the soil.

- Some NNIS are limited by the availability of sunlight; before conducting activities that remove part or the entire canopy, treat NNIS in the understory to prevent them from dominating after harvest.
- Encourage operators to maintain NNIS free mill yards, equipment parking, and staging areas.
- Time ground disturbing activities (including prescribed burns) to reduce NNIS.
- Recognize that prescribed fire can increase annual and biennial NNIS and plan for the additional control measures that will be necessary after the fire.

8.12 PLANT SPECIES OF CONCERN

SCIENTIFIC NAME	COMMON NAME	STATUS*		
		CNPS	G	State
Asplenium septentrional e	northern spleenwort	2.3	G4G5	S2.3
Campanula scabrella	rough rarebell	4.3	G4G5	S3.3
Carex lasiocarpa	wooly-fruited sedge	2.3	G5	S1.3?
Carex limosa	shore sedge	2.2	G5	S3?
Collomia larsenii	talus collomia	2.2	G4	S1.2
Draba aureola	golden draba	1B.3	G4	S1.3
Drosera angelica	long-leafed sundew	2.3	G5	S2S3
Erigeron elegantulus	volcanic daisy	4.3	G4G5	S3.3
Lycopus uniflorus	northern dugleweed	4.3	G5	S3.3
Penstemon cinicola	ash beard-tongue	4.3	G4	S3.3
Penstemon heterodoxus sha.	Shasta beard-tongue	4.3	G5T3	S3.3
Phlox muscoides	moss phlox	2.3	G5?	S3.3
Potamogeton praelongus	white-stemmed pondweed	2.3	G5	S1S2
Rhynchospora alba	white-beaked rush	2.2	G5	S3.2
Scheuchzeria palustris amer.	American scheuchzeria	2.1	G5T5	S1.1
Scirpus subterminalis	water bulrush	2.3	G4G5	S2S3
Silene suksdorfii	Cascade alpine catchfly	2.3	G4	S2.3
Smelowskia ovalis congesta	Mt.Lassen smelowskia	1B.2	G5T1	S1.2
Stellaria obtusa	obtuse starwort	4.3	G5	S3.3
Trimorpha acris debilis	northern-daisy	2.3	G5T4	S2S3

*None on Federal List by Fish and Wildlife Service or state list by California Dept of Fish and Game.

Key:

CNPS Listed by Calif Native Plant Society

1B= rare, threatened, or endangered in CA and elsewhere
2= rare, threatened, or endangered in CA. More common elsewhere.
3= plants needing more information about them.
4= plants of limited distribution.
.1= Seriously endangered in California (over 80% of occurrences threatened / high degree and immediacy of threat)
.2= Fairly endangered in California (20-80% occurrences threatened)
.3= Not very endangered in California (<20% of occurrences threatened or no current threats known)

State State rank by Calif Native Plant Society

S1 = Less than 6 EOs OR less than 1,000 individuals OR less than 2,000 acres
- S1.1 = very threatened
- S1.2 = threatened
- S1.3 = no current threats known

S2 = 6-20 EOs OR 1,000-3,000 individuals OR 2,000-10,000 acres
- S2.1 = very threatened
- S2.2 = threatened
- S2.3 = no current threats known

S3 = 21-80 EOs or 3,000-10,000 individuals OR 10,000-50,000 acres
- S3.1 = very threatened
- S3.2 = threatened
- S3.3 = no current threats known

? = uncertainity

G Global rank Calif Native Plant Society

G4 = Apparently secure; this rank is clearly lower than G3 but factors exist to cause some concern; i.e., there is some threat, or somewhat narrow habitat.
G5 = Population or stand demonstrably secure to ineradicable due to being commonly found in the world.
T= rank of subspecies

8.13 MINIMUM REQUIREMENT ANALYSIS WORKSHEET

Project Title: Lassen Volcanic National Park Weed Management Plan

Start Date: March 31, 2008

Prepared by: Michelle Cox

Step 1: Determine whether the proposed action takes place in designated wilderness, proposed wilderness, or winter backcountry areas within Lassen Volcanic National Park.

YES

Step 2: Determine whether the proposed action is required for the administration of the Lassen Volcanic Wilderness. Why is this action necessary? Does the purpose of the action meet Minimum Requirements, that is, does it support a) Visitor Enjoyment and Recreation, b) Resource Protection and Visitor Management, or c) Resource Protection and Research?

YES. The removal of weeds to promote the native plant community and wildlife habitat supports Visitor Enjoyment and Recreation and Resource Protection Research.

Step 3: Determine if the objectives of the proposed action can be met with actions outside of wilderness, proposed wilderness, or winter backcountry zones.

NO.

Step 4: Develop a list of alternatives to meet the objective of the proposed action. Include ways to reduce or mitigate the impacts of each alternative.

See attached environmental assessment for details of affected areas and impacts.

Alternative #1 – No Action, Continue with current management program

This alternative would continue implementing surveying, treating (all manual treatments with non-motorized equipment and no measurable noise), monitoring, and adaptive management.

Alternative #2 – Preferred Action, Implement an Integrated Pest Management Plan

Alternative 2 is the preferred alternative. It builds upon Alternative #1 with four additions. First, it would include the use of chemical treatments. Second, it would provide for fire treatments. Third, it would provide a set process for determining the strategies, treatments, and prioritization of species in the future if new exotic species are discovered. Fourth, Best Management Practices (BMP) would be implemented. No motorized equipment will be used and there will be no detectable increases in noise level.

Step 5: Choose an alternative. What is the Minimum Activity?

Alternative #2 was chosen.

The minimum tool/treatment or combinations of treatments that pose the least risk to wilderness values while still accomplishing weed management objectives will be implemented. These include: hand tools, hand pump sprayers, mulch, weed cloth, reseeding, and/or wilting. Currently, no infestations greater than 50% total relative cover that are over .5 acre have been documented; therefore, impact to existing native plant communities will be patchy. A majority of the herbicide and wilting techniques would be used in non-wilderness areas where disturbance is greatest. The infrequent use of herbicides and wilting in wilderness would have minor and short-term adverse effects.

A temporary change in wilderness character and associated values would occur during weed management activities. Some aspects of weed management may be intrusive on the wilderness experience. The presence of park personnel and equipment could impact visitor solitude and self-discovery. However, the removal of weed species could also improve the wilderness experience for those individuals who find that weed species detract from their overall experience. The adverse impacts of weed management on wilderness would be minor and short-term and the beneficial impacts would be moderate and long-term.

Cumulative Impacts. The primary impacts to wilderness in the past have been from noise from aircraft and park fire operations and visitor use. Actions proposed under Alternative #2 would contribute a negligible to minor adverse effect to wilderness values in localized areas.

Conclusion. Both the preferred alternative would have minor and short-term adverse effects as well as minor and long-term beneficial effects. Neither alternative would impair wilderness values in the Park. The plan's objective to restore functioning native plant communities supports Wilderness Values and, in many cases, it is the health of these ecosystems that initially supported wilderness designation.

Please check any Wilderness Act Section 4(c) uses approved in this alternative:
NONE OF THE USES BELOW WERE PROPOSED.

___ mechanical transport ___ landing of aircraft ___ motorboats ___ structure or installation

___ motorized equipment ___ temporary road ___ motor vehicles

Approvals

Prepared by: _____ _____
(name and title) Date

Recommended: _____ _____
Louise Johnson Date
Chief of Natural Resources Management
Wilderness Coordinator

Approved: _____ _____
Darlene M. Koontz Date
Superintendent

See Lassen Volcanic National Park Weed Management Plan and Environmental Assessment for maps and photos.

8.14 GLOSSARY

Action threshold - the point at which approved exotic plant management treatments will be implemented because of current or potential levels of intolerable impacts to environmental resources.

Adaptive management - The NPS must use adaptive management to fully comply with 40 CFR, which requires a monitoring and enforcement program to be adopted, where applicable, for any mitigation activity. Adaptive management (516 DM 4.16) is a system of management practices based on clearly identified outcomes; monitoring to determine if management actions are meeting outcomes; and if not, facilitating management changes that will best ensure that outcomes are met or by reevaluating outcomes. Adaptive management recognizes that knowledge about natural resource systems is sometimes uncertain and is the preferred method of management in these cases.

Additive impacts - impacts that accumulate by adding more of the same impact on a resource. For example, one impact- causing occurrence, such as a single gas well, may be of little significance. A hundred wells in the same area, however, may have significant impacts on a resource.

Adjuvant - a substance added to a pesticide to aid its action, but has no pesticide action by itself. Some pesticides require the addition of an adjuvant to work effectively.

Alternatives - different ways to meet the purpose and objectives, while resolving needs or issues.

Archeological resource - Any material remains or physical evidence of past human life or activities, which are of archeological interest, including the record of the effects of human activities on the environment. They are capable of revealing scientific or humanistic information through archeological research.

ARPA - Archaeological Resources Protection Act

Beneficial impacts - a positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.

Best Management Practices - practices taken to minimize potential impacts to resources.

Biological treatments - biological control, or biocontrol, is the use of “natural enemies” (such as insects) to reduce the abundance of an exotic plant. Natural enemies are imported from areas where the target exotic plant occurs as a native plant and are deliberately released into areas where the plant is exotic. Examples include plant- feeding insects such as flea beetles for leafy spurge and leaf beetles for purple loosestrife.

Chemical treatments - applying herbicides as prescribed by their labels, using a variety of application methods. Methods of applying chemicals include portable sprayers.

Critical habitat - defined within the Endangered Species Act as an area occupied by a species listed as threatened or endangered within which are found physical or geographical features essential to the conservation of the species, or an area not currently occupied by the species, which is itself essential to the conservation of the species.

Cultural landscape - a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.

Cultural resource - aspects of a cultural system that are valued by or significantly representative of a culture or that contain significant information about a culture. A cultural resource may be a tangible entity

or a cultural practice. Tangible cultural resources are categorized as districts, sites, buildings, structures, and objects for the National Register of Historic Places, and as archeological resources, cultural landscapes, structures, museum objects, and ethnographic resources for NPS management purposes.

Cultural treatments - practices that promote the growth of desirable plants and reduce opportunities for exotic plants to grow. Examples include prevention, irrigation, and seeding of native plant species.

Cumulative impacts - impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non- federal) or person undertakes such other actions (40 CFR 1508.7).

Cut stump method - a pesticide application method where a tree or shrub is cut near the base of the trunk, and pesticides are sprayed or painted directly onto the cut stump.

Decision Making Tool - a tool developed for this plan to assist resource managers in exotic plant management planning and compliance. The Decision Making Tool includes a series of decision trees. These include: Decision Making Tool Overview, Identify Exotic Plants and Justify Management Needs, Guidance for Setting Management Priorities, Optimum Tool Analysis for Treatment Options, Justify and Confirm Compliance for Chemical and Biological Treatments, Confirm Compliance of Proposed Treatment Method with NEPA.

Desired Condition - the condition(s) that current laws and policies require parks to achieve for each resource.

Direct impact - an effect that is caused by an action and occurs in the same time and place.

Disruptive species - Disruptive species have community- level or ecosystem- level effects and significantly alter natural processes such as fire regimes, nutrient cycling, hydrology or successional patterns; or altering species composition and reducing populations of native species; or through hybridization with native species. Some species may also be considered disruptive if they affect localized resources, such as archaeological or scenic qualities, on a broad scale.

Droplet size - the volume of individual droplets of herbicide mixed with water, usually controlled by nozzle settings.
Ecosystems - interacting systems of organisms considered together with their environment; for example, marsh, watershed, and lake ecosystems.

Edaphic - pertaining to or influenced by the physical, chemical, or biological conditions of soil.

Environmental impact - a change in condition of the resource or environment under examination caused by the proposed action.

Environmentally preferred alternative - the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources.

Ethnographic Resource - a site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it.
Executive Orders (E.O.) - directives from the President to departments and agencies of the executive branch.

Exotic species – (introduced, alien adventive, weed) species that reached an area by neolithic or post-neolithic human activities, or via domestic animals.

Expanding – species that are native species whose abundance and distribution are increasing.

Fauna - the animal life of a particular region or period, considered as a whole.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) - requires that certain useful poisons, such as chemical pesticides, sold to the public contain labels that carry health hazard warnings to protect users. FIFRA is administered by the USEPA.

Flora - plant life, especially all the plants found in a particular country, region, or time, regarded as a group.

Herbicide - a type of pesticide that controls unwanted plants.

Historic property - a district, site, structure, or landscape significant in American history, architecture, engineering, archeology, or culture; an umbrella term for all entries in the National Register of Historic Places.

Historical significance - the meaning or value ascribed to a structure, landscape, object, or site based on the National Register criteria for evaluation. It normally stems from a combination of association and integrity.

Historic site - the site of a significant event, prehistoric or historic occupation or activity, or structure or landscape whether extant or vanished, where the site itself possesses historical, cultural, or archeological value apart from the value of any existing structure or landscape.

Host- specific - a biological control agent that only attacks one plant species (the host).

Impairment - an impact to any park resource or value may constitute an impairment, but would be more likely to do so to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is: necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park, key to the natural or cultural integrity of the park, or identified as a goal in the park's general management plan or other relevant NPS planning documents.

Indirect impact - an effect that is caused by an action but is later in time or farther removed in distance, but is still reasonably foreseeable.

Innocuous species - innocuous species do not significantly harm park resources and do not require management. Most innocuous species do not invade native ecosystems without human caused disturbance, and their populations generally do not expand within the park. Other innocuous species may invade native ecosystems, but do not significantly displace native species.

Integrated Pest Management (IPM) - a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost- effective means, while posing the least possible risk to people, resources, and the environment. Each exotic plant's natural history is evaluated before developing management strategies.

Interactive impacts - impacts that accrue as a result of assorted similar or dissimilar actions being taken that tend to have similar impacts, relevant to the valued resource in question. Examples of interactive impacts could include unmitigated overgrazing by cattle, horses, bison or elk, plus motorcycle/off- road vehicle use, industrial development, and roads.

Invasive – (naturalized, weed) species are exotics whose abundance or distribution are increasing.

Local impact - the action would affect land adjacent (sharing a boundary) to a park unit.

Long-term impact - a change in a resource or its condition that does not return the resource to pre-disturbance condition or appearance within one year.

Major impact – an impact that is severe and highly noticeable.

Management objective - the desired state of the system that the resource manager wants to achieve. Management objectives can be stated generally or as specified numerical targets.

Manual treatments - physically damaging or removing exotic plants through non- mechanical means.

Mechanical treatments - the use of tools to remove or physically damage exotic plants.

Minor impact – an impact that is localized and slight but detectable.

Moderate impact – an impact that is readily apparent and appreciable.

Native species –species that arrived in an area independent of human activities or before the Neolithic period.

Negative impact - a change that moves the resource away from a desired condition or detracts from its appearance or condition.

Negligible impact – an impact that is localized and either not measurable or is at the lowest level of detection.

Non- native plant - a non- native plant, or exotic plant, is a plant that occurs outside its native range in a given place as a result of actions by humans.
Noxious weed - a weed specified by law as being especially undesirable, troublesome, and difficult to control. The definition of a noxious weed will vary according to legal interpretations.

Optimum Tool Analysis for Treatment Options - a decision tree that is used to identify a proposed treatment option and to assess whether there are alternate cost- effective treatment options available that would result in lower impacts.

Palustrine - non- tidal wetlands dominated by trees, shrubs, or persistent emergent vegetation or small, shallow wetlands.

Pesticide - (1) any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pests; (2) any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant; and (3) any nitrogen stabilizer, except that term “pesticide” shall not include any article that is a “new animal drug” within the definition of the Federal Food, Drug, and Cosmetic Act (FIFRA 1972).

Pesticide drift - the movement, generally caused by wind, of spray droplets suspended in air onto areas not targeted for spraying.

Policies - guiding principles or procedures that set the framework and provide direction for management decisions. They may prescribe the process by which decisions are made, how an action is to be accomplished, or the results to be achieved.

Personal protective equipment (PPE) - designed to protect employees from serious workplace injuries or illnesses resulting from contact with chemical, physical, electrical,

mechanical, or other workplace hazards. Besides face shields, safety glasses, hard hats, and safety shoes, PPE includes a variety of devices and garments such as goggles, coveralls, gloves, vests, earplugs, and respirators.

Prohibited impairment - an impact that, in the professional judgment of the responsible National NPS manager, would harm the integrity of park resources or values.

RAVE - The Relative Aquifer Vulnerability Evaluation is used to assess risk of ground water contamination for chemicals applied to either agriculture systems or ecosystems.

Regional impacts - the action would affect the park, land adjacent to the park, and surrounding communities.

Regulations - rules for complying with a federal law developed by the authorized department or agency that also include codification of agency policy. For example, 36 CFR §1- 199 contains general and specific regulations for the management and use of the National Park System (these regulations are augmented by the superintendent's compendium for each unit).

Restricted use pesticide - sale or use of these pesticides are limited to licensed pesticide applicators or their employees, and only for uses covered by the applicator's certification.

Riverine - of a river: relating to or produced by a river.

Resource Management Plan (RMP) - this plan details how both natural and cultural resources will be managed in a given park.

Scenic River - free- flowing river segment that has been designated by Act of Congress and is administered as a component of the National Wild and Scenic Rivers System, and is free of impoundments, with shore lines largely primitive and undeveloped, but accessible in places by roads.

Selective herbicides - selective herbicides control certain targets plants, while leaving the desired plants to survive.

Short- term impacts - an effect that within a short period would no longer be detectable as the resource is returned to its predisturbance condition or appearance, generally less than 1 year.

Site- specific impacts - the action would affect areas within the park unit boundary.

State species of concern - includes state endangered, state threatened, state candidate, or state sensitive species that are not part of a federal designation of threatened or endangered species made by the USFWS.

Surfactants - adjuvants used in conjunction with pesticides to increase absorption. A surfactant is a surface- active ingredient that lowers surface tension of the solvent in which it is dissolved or the tension between two immiscible liquids.

Weed - a plant that is not valued where it is growing and is usually of vigorous growth. Weeds may tend to overgrow or choke out more desirable plants. See Exotic and Invasive.