# Research Vegetation Control

# Environmental Assessment

**USDA Forest**
**McKenzie River Ranger District**
**Willamette National Forest**
**Lane County, Oregon**

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# Summary

The McKenzie River Ranger District (MRRD) on the Willamette National Forest (WNF) proposes to treat competing vegetation occupying research plots on approximately 5416 $m^2$ with glyphosate. This treatment may occur at a yearly frequency for the next 10 years. The purpose of the project is to effectively remove vegetation interfering with the objectives of the research proposals. This action is tiered to the Willamette National Forest Invasive Plant EA (2007) and to direction provided in the Pacific Northwest Region Invasive Plant Program, Preventing and Managing Invasive Plants Record of Decision (USDA Forest Service 2005a).

The proposed action includes manual and/or herbicide treatment methods. The herbicide glyphosate would be approved for use according to project design criteria (PDCs).

In addition to the proposed action, the Forest Service also evaluated an Action Alternative which would only allow manual removal of competing vegetation currently interfering with the research plots.

# Chapter I: Introduction

## Background

The Research Vegetation Control EA applies to two specific sites on the McKenzie River Ranger District (MRRD) on the Willamette National Forest (WNF). The two sites are located in Linn and Lane Counties (Figure 1: Map of Willamette National Forest; Figure 2: Map of the McKenzie River Ranger District and research sites). The two sites under consideration are located at T15S, R7E, Section 10 (Bunchgrass Meadow) and at T15S R5E Sec 28 (H.J. Andrews). Urban areas the Forest serves are the Salem and Eugene/Springfield areas.

**Figure 1. Map of Willamette National Forest and Environs**

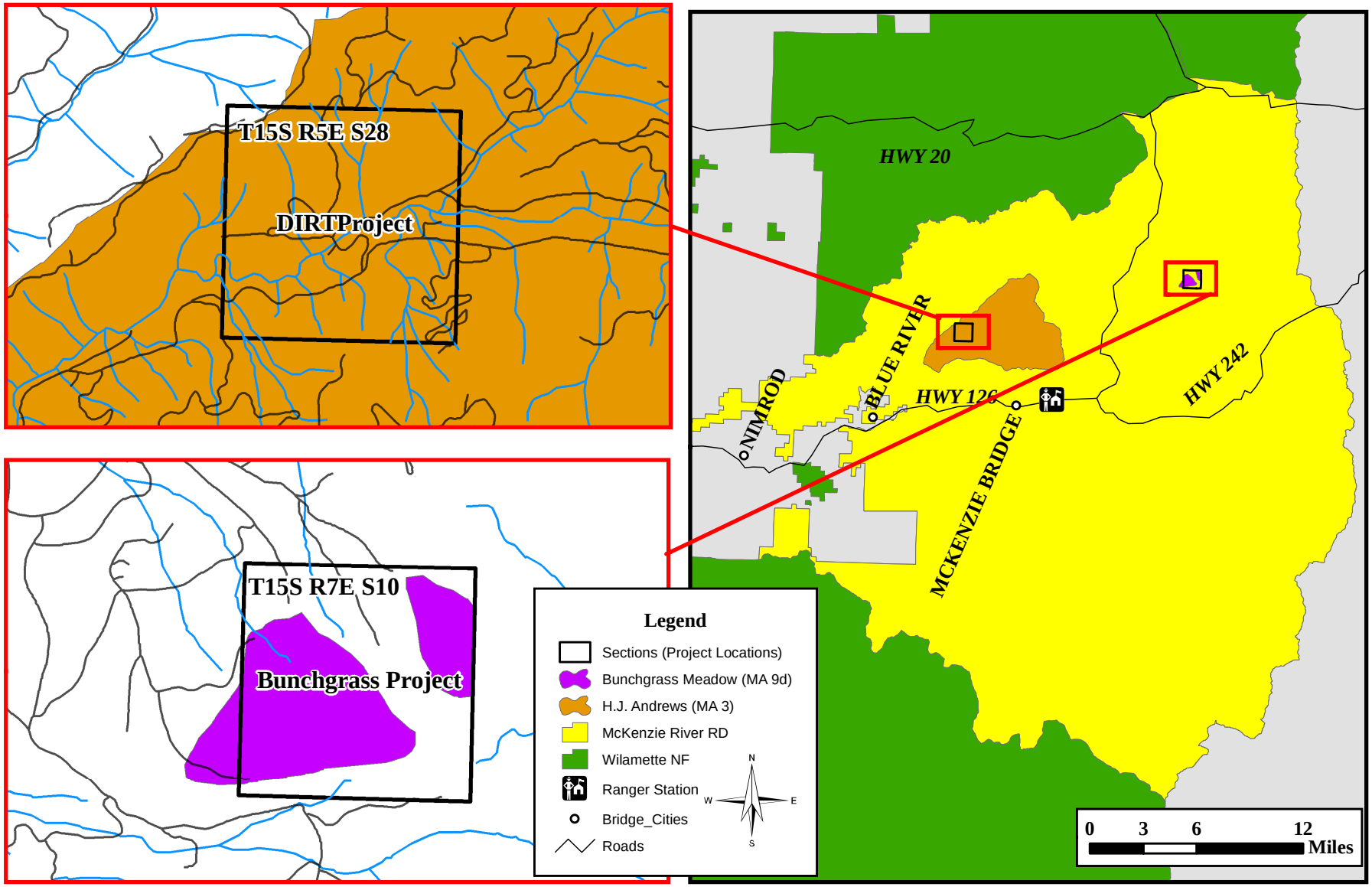


**Figure 2. Project vicinity map.**

**Research Sites**

There are two sites on the MRRD that we propose to use manual methods and/or the herbicide glyphosate to remove competing vegetation in study plots:

***DIRT Experiment (Detrital Input and Removal Treatments)***

In 1956, Francis Hole established the DIRT experiment (Detrital Input and Removal Treatments) in two grassland and two forested sites at the Wisconsin Arboretum . In this experiment, plots were mowed (grassland sites) or raked of litter (forested sites) to establish NO LITTER plots. Removed litter was added to plots of similar size to establish DOUBLE LITTER plots. CONTROL areas were also identified. Belowground inputs were not manipulated. These treatments have been maintained into this decade. Inspired by this unique, long-term experiment to study the time course of Stabilized Organic Mineral (SOM) formation and stabilization, several DIRT sites were subsequently established in both the U.S. and in Europe by various researchers, including Knute Nadelhoffer (Harvard Forest -1990 and the Michigan Biological Station in 2004), Rich Bowden (Bousson Experimental Forest - 1991), and Janos Toth and Kate Lajtha (Sikfokut Forest in Eger, Hungary - 2001). These DIRT sites added plot trenching (i.e. NO ROOTS plots, below) to allow for the analysis of the role of above- vs. below-ground detrital inputs on SOM stabilization. Most of these sites are well-maintained, but have not been extensively analyzed. However, they serve as long-term experiments that have soils systematically archived, and are excellent tools for future researchers.

DIRT plots that were established in 1997 in the H. J. Andrews Experimental Forest (HJA) on the MRRD, have the largest plots of all these DIRT installations (plots are 10m X 15 m) and each treatment is replicated 3 times (Table 1). The researchers also added a replicated wood addition treatment so that the effect of detrital quality (wood vs. needle) on SOM stabilization could be analyzed. In these DOUBLE WOOD plots, the same amount of Carbon is added as for the DOUBLE LITTER plots. NO ROOT and NO LITTER treatments allow us to assess the respective roles of above and below ground litter inputs to SOM chemistry and stability. NO INPUT plots serve as field SOM decomposition experiments, allowing us to follow the loss of specific SOM constituents over time, in the absence of any detrital input.

The researchers use newly sampled soils and archived soils to determine a time course for C accumulation and loss using novel techniques not used in the previous studies. Core measurements include sequential density fractionation (including Accelerator Mass Spectrometry or AMS dating and isotopic analysis of density fractions), analysis of

recalcitrant vs. labile Carbon using acid hydrolysis laboratory incubations, and measures of Carbon quality/stability using techniques such as thermal analysis, and analysis of lignin and lignin oxidation state. Analysis of cutin and suberin acids can offer information on the relative importance of above vs. belowground detrital inputs to Carbon stabilization.

**Table 1. Core treatments for the HJA DIRT experiment, established in 1997.**

| TREATMENT | METHOD |
|---|---|
| CONTROL | Norm litter inputs are allowed |
| NO LITTER | Aboveground inputs are excluded from plots |
| DOUBLE LITTER | Aboveground leaf/needle inputs are doubled by adding litter removed from NO LITTER plots |
| DOUBLE WOOD | Aboveground wood inputs are increased by adding large shredded wood pieces based on rates of C to the DOUBLE LITTER plots. |
| NO ROOTS | Roots are excluded with impenetrable barriers extending from the soil surface to the top of the C horizon. |
| NO INPUTS | Aboveground inputs are prevented as in NO LITTER plots; Belowground inputs are prevented as in NO ROOTS plots. |

The core goal of this DIRT experiment is to assess how rates and sources of plant litter inputs control the accumulation and dynamics of organic matter and nutrients in forest soils over decadal time scales. The study promotes an integrated and mechanistic understanding of how plant detrital input rates, soil biota (including bacteria, fungi, and invertebrates), enzymatic processes, substrate chemistry, and soil properties interact to control the proportions of plant detritus (leaf litter and root material) that are; (1) returned to the atmosphere as CO2, (2) exported as dissolved organic matter (DOM), (3) transformed into microbial products, and (4) stored as stabilized SOM in organic-mineral complexes.

It is critical that we develop this level of understanding, as primary production (net annual growth) in forests is changing due to anthropogenic effects. For example, longer growing seasons and warmer temperatures (associated with climate change), increases in CO2 concentrations and (perhaps) atmospheric N deposition can lead to increases in primary production and detrital inputs to soils. In contrast, factors such as air pollutants (e.g. ozone, NOx), drought stress, and invasive pathogens can decrease forest production and diminish detrital inputs to soils. Any sustained changes in detrital inputs to soils are likely to alter SOM accumulation or loss. The important point here, however, that it is not known whether SOM pool sizes in ecosystems will change in direct proportion to changes in detrital input rates, or whether non-linear interactions will lead to disproportional shifts in the amounts of C stored in soil organic matter.

The DIRT plots that would benefit from manual and/or herbicide application to control inputs. The total area to be treated with Glyphosate is 60 x 90 meters, or 5400 square meters (1.3acres).

***Bunchgrass Meadow Seed Germination Experiment***

The specific objectives of this study are to:

- Assess the relative strength of factors, and interactions among factors, influencing seed germination and establishment of *Abies* in grasslands;
- Assess the relative strength of factors, and interactions among factors, influencing survival and growth of *Abies* seedlings in grasslands;
- Compare *Abies* germination, survival, and growth in grassland and forest habitats; and
- Determine whether encroachment of *Abies* into grasslands is more limited by germination or seedling growth.

The study site, Bunchgrass Ridge, supports a mosaic of meadows and coniferous forests that have established over the past two centuries. The site supports an active research, education, and outreach program focused on its meadow ecosystems (see http://depts.washington.edu/bgridge/). The project will build on previous work focused on the restoration of grassland ecosystems. *Abies grandis* (grand fir) is the primary invader of montane meadows at this site). Therefore, this study will consist of an experiment examining limits to seed germination and establishment of *Abies*, and an experiment examining controls on the survival and growth of older *Abies* seedlings. The former study proposes to use herbicide and will be further described here.

The seed germination experiment will be replicated in 10 experimental blocks, each spanning a distinct grassland – forest boundary. At each block, 12 plots (experimental units) will be established in the grassland and six in the forest habitat. Plots will be established in Fall 2008. Plots will be defined by 30 cm diameter PVC tubes hammered into the ground to define plot boundaries, limit belowground competition to plants within the tube, and reduce granivory by gophers. A wire-mesh cage will be placed over each tube to further prevent granivory. Plots will be spaced 1 m apart. In the grassland, plots will be randomly assigned to one level of each of two factors – competing vegetation (all or no neighbors present) and shading (yes or no) – yielding a total of four treatment combinations. In the forest, only the competing vegetation treatment will be implemented. Each treatment combination will be replicated three times in each block x habitat, for a total of 180 plots. Vegetation in the "all neighbors" (AN) treatment will remain undisturbed. In the "no neighbors" (NN) treatment, native and non-native competing vegetation within 30 cm of each plot will be killed with glyphosate. Any subsequent regrowth of vegetation will be clipped at the ground surface. The total treated area is approximately 16.0$m^2$.

In the shading treatment, shade cards (40 cm wide, 30 cm tall; available from Quadel

Industries) will be installed on a stake directly south of each plot. The intent of this treatment is to reduce light and temperature in the grassland and approximate the microenvironment of the forest.

Seeds from local ecotypes of *Abies* will be purchased commercially. In Fall 2008, we will sow 50 seeds on the surface of each plot (total of 9000 seeds). Sowing at this time will enable winter stratification. Germination will be monitored in 2009, beginning as soon as the snow melts (approximately mid-May). Germinants will be identified and counted as they emerge, and marked with colored toothpicks to permit relocation. Seedling establishment will be assessed by monitoring survival bi-weekly over the course of the summer. Table 2 shows the plants most likely to be treated with this study.

**Table 2. Plants most likely to be treated with the DIRT and Seed Germination Studies.**

| ***Meadow Species*** | **Forest Species** |
|---|---|
| *Carex pensylvanica* | *Viola glabella* |
| *Festuca idahoensis* | *Smilacina stellata* |
| *Elymus glaucus* | *Melica subulata* |
| *Lupinus latifolius* | *Arenaria macrophylla* |
| *Phlox diffusa* | *Achlys triphylla* |
| *Bromus carniatus* | *Anamone oregana* |
| *Erigeron aliceae* | *Bromus vulgaris* |
| *Cirsium callilepis* | *Circaea alpina* |
| *Fragaria spp.* | *Galium oreganum* |
| *Danthonia intermedia* | *Galium triflorum* |
| *Orthocarpus imbricatus* | *Lactuca muralis* |
| *Achillea millefolium* | *Anemone deltoidea* |
| *Hieracium gracile* | *Oxalis oregana* |

## Regulatory Framework/ Management Direction

The proposed studies lie in two distinct land allocations from the Willamette Land and Resource Management Plan (USDA 1990). Language is provided that outlines direction--

- **Special Wildlife Habitat**. MA-9d. The goal of this management area is to:
  - Protect or enhance unique wildlife habitats and botanical sites which are important components of healthy, biologically diverse ecosystems.

- **H. J. Andrews Experimental Forest**. MA-3. The goals of this management area are to:
  - Develop better methods for managing forested lands in the Western Cascades by studying the effects of management activities on soils, fish, wildlife, site productivity, water quality and quantity.

- Research, monitor and conserve genetic diversity and ecosystem functioning as a designated International biosphere Reserve and Experimental Ecological Reserve.

- **Riparian Reserves.** MA15. The primary goal of this management area is to:
  - Maintain the roles and function of rivers, streams, wetland, and lakes in the landscape ecology.

In regards to undesirable plant removal, amendments have been written that pertain to invasive species. The Forest Plan was amended by the WNF Weed Management Plan in 1999 (Amendment 239). The amendment contained four sections: (1) weed prevention guidelines; (2) manual control on any infestation without additional NEPA analysis; (3) release of biological control agents approved by APHIS and the State of Oregon; (4) and treatment options for differing site types. The Plan specified treatment design factors based on proximity to water, TES species, Wilderness and administrative sites with high use. Glyphosate was approved for use under specific conditions.

In October 2005, the Pacific Northwest Region (Region 6) of the Forest Service completed a Final Environmental Impact Statement (Region 6 FEIS) addressing the invasive plant management program, culminating in a Record of Decision (Region 6 ROD) which added management direction to the WNF Forest Plan, The Region 6 ROD adopted a Desired Future Condition (DFC) statement, several goals and Objectives and 19 standards for invasive plant prevention and treatment/restoration.

## Purpose and Need for Action

The purpose of this proposed action is to effectively and economically control vegetation competing with research experiments.

## Proposed Action

The Forest Service proposes to remove competing vegetation on 5416 square meters (1.3 acres) of upland forest and meadow ecosystems for the purpose of better understanding ecosystem processes.

Herbicide use (glyphosate) and/or manual control would be limited to the specified plot locations associated with the DIRT and the Bunchgrass Seed Germination Study. The nearest water to these study sites is greater than 50 feet away. Following mitigation described in the WNF Weed EA, glyphosate can be used with a backpack hand sprayer. Treatment of competing plants would occur annually for at least the next 10 years.

## Decision Framework

The Responsible Official for this proposal is the District Ranger. Given the purpose and need stated above, the Responsible Official reviews the proposed action and the No Action alternatives to make the following determinations:

- The proposed actions as analyzed, complies with the applicable standards and guidelines found in the Willamette Forest Plan and all laws governing Forest Service actions.
- Sufficient site-specific environmental analysis has been completed.
- The proposed actions benefit the public and are in their best interest.

With these assurances the Responsible Official must decide:

- Whether or not to select the Proposed Action or the No-Action Alternative; and what, if any, additional actions should be required.
- Whether the selected alternative is consistent with the Willamette Forest Plan, or if the Forest Plan shall be amended in this action.

## Public Involvement

The proposal will be listed in the Schedule of Proposed Actions for Willamette National Forest beginning in July 2008. The proposal was provided to the public and other agencies for comment during scoping May 12 – June 1, 2008. In addition, Tribal Consultation was conducted. The Forest sent a scoping letter to the Klamath Tribes, the Confederated Tribes of the Grand Ronde, Siletz Tribes and the Confederated Tribes of the Warm Springs. Using the comments from the public, other agencies, and the Tribes listed above (see Issues section), the interdisciplinary team developed a list of issues to address.

## Issues

The Forest Service separated the issues into two groups: significant and non-significant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant issues were identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations require this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…" A list of non-significant/ tracking issues and reasons regarding their categorization as non-significant may be found in the project record. As for significant issues, the Forest Service identified 3 topics raised during scoping. These issues include:

**Issue #1: Effects on Aquatic and riparian habitats and their associated fish, wildlife and botanical species.**

The application of herbicides in riparian areas has the potential to contaminate terrestrial riparian habitat and water, causing mortality to amphibian and fish species. The largest risk is from drift of herbicide onto non-target vegetation used for food or habitat or drift into water. Some herbicides also pose a risk to water quality through leaching through the soil profile. There are potential indirect effects to food chain through removal of vegetation and sublethal effects on fish behavior.

Indicators for comparing alternatives:

- Acres of herbicide use within 50 foot buffer from a perennial stream or wetland
- Acres of occupied or historic Threatened, Endangered and Sensitive fish sites that would not be buffered from herbicide use

**Issue #2: Effects on Human health**

There is a potential for humans to be exposed to herbicides where they visit treated sites. Humans could inadvertently brush up against vegetation that has been treated with herbicides. Eugene Water and Electric Board staff noted concern (during scoping for the WNF Weed EA) that herbicides not be used in a way that they could migrate into drinking water. The most plausible method for herbicides to enter drinking water would be from herbicide drift, although some herbicides can leach through the soil profile.

*Indicators for comparing alternatives*:

- Acres of herbicide treatment proposed in areas of high human use such as campgrounds, trailhead parking lots and dispersed campsites
- Number of plausible exposure scenarios to drinking water that exceed the threshold of concern for herbicides proposed for use

Other issues brought forward by the public that are tracked through the document include:

**Issue #3: Culturally significant plants**

Members of the Grand Ronde, Klamath, Siletz and Warm Springs collect plants for food, medicine, basketry or other purposes on the Willamette National Forest. There may be sites where plants collected by Tribal members are slated for herbicide treatments and this may be a conflict. This was deemed a non-significant issue because of the small area treated, and an included mitigation for posting treated sites.

**Issue #4: Native Plant Communities**

Herbicide application may harm native plant communities. This was deemed a non-significant issue because herbicides will only be applied through hand-held wands to mitigate effects on non-target plants.

# Chapter II: Alternatives, including the Proposed Action

This chapter describes and compares the alternatives considered in the Competing Vegetation Removal for Research EA. It includes a description and map of treatment sites considered (Figure 3). This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative (i.e., acres treated with herbicides and/or manual methods; acres of herbicide use near areas of high human use) and some of the information is based upon the environmental, social and economic effects of implementing each alternative (i.e., acres treated within 50 foot riparian buffer).

Issues and purpose and need were used to drive Alternative development. Alternative A responds to issues of herbicide use in riparian areas (within 50 feet of water) and areas of high human use, restricting herbicides in these areas. Alternative B involves continued hand removal of competing vegetation from the research sites, Glyphosate would not be used.

## Alternatives Considered but Eliminated From Detailed Study

An alternative considered but eliminated from detailed study included a “no action alternative” that would suspend the studies as they are currently implemented. The rationale for not considering this alternative includes the loss of significant monetary investments in data collection/analysis to date, loss of information with potential significant applications to future resource management, and the fact that the DIRT study has been on-going for many years no adverse impacts.

Table 3 explains the types of treatment that may be conducted under each alternative.

**Table 3: Treatment methods available for use under Alternatives A and B.**

| Method | Description | Alternative |
|---|---|---|
| Manual Methods | | |
| Hand pulling | Hand pulling may be a good alternative in sites where herbicides or other methods cannot be used. The key to effective hand pulling is to remove as much of the root as possible while minimizing soil disturbance. For many species, any root fragments left behind have the potential to resprout. | Alternatives A and B |
| Pulling Using Tools | Tools (e.g., shovel, hoe, weed wrench) can be used to dig the entire plant, including the roots, out of the ground. This method can be used for plants with deep tap roots that can not be hand pulled adequately or that reproduce vegetatively. | Alternatives A and B |
| Herbicide Methods | | |
| Spot Spraying | Spray herbicide directly onto target plants and avoid spraying other desirable plants. Herbicide is usually applied with a backpack sprayer, This method is used where plants are far enough from each other to be individually discernable. | Alternative A |

## Alternatives

### Alternative A: Glyphosate Use and/or manual control of competing vegetation

This alternative responds to the issues of potential effects on human health and aquatic species. . No glyphosate (Rodeo formulation) treatment would be allowed within stream buffers, defined as 50 feet from a class 1-4 stream, pond or wetland. Areas treated would be posted to minimize contact with recreationists. Application rates would typically be 2 pounds active ingredient/acre (2% solution, with a 3 quart per acre application rate). Herbicides would be applied using backpack-mounted hand sprayers.

Adjuvants are mixed with herbicides to increase herbicide absorption through plant tissues and increase spray retention (Bakke, 2003a, 2003b, 2007). Oil adjuvants would include Hasten or Methylated Seed Oil. A pH reducing adjuvant (LI-700®) would also available for use. This adjuvant is sometimes recommended for use with herbicides because of greater absorption of weak acid type herbicides when the spray solution is acidic (Bakke, 2003a).

We would comply with annual reporting requirements from the State of Oregon for treatments within 6th field watersheds, detailing the amount and type of chemical used. We would also comply with the R6 ROD monitoring, if any of our sites are chosen as high risk.

## Alternative B: Hand removal only

Under this alternative, no herbicide use is proposed. Control measures would be confined to manual treatments to control competing vegetation in the research plots. This option would require frequent, labor-intensive, manual disturbance to maintain the research sites.

**Project Design Criteria (Mitigation Measures) for Alternative A**

In response to public comments on the proposal, mitigation measures were developed to ease potential impacts Alternative A may cause.

***Glyphosate Application***

1. Glyphosate will be used according to label instructions.

2. Glyphosate use will comply with standards in the *Pacific Northwest Regional Invasive Plant Program – Preventing and Managing Invasive Plants* FEIS (2005a), including standards on herbicide selection, broadcast use of some herbicides, tank mixing, licensed applicators, and use of adjuvants, surfactants and other additives (standards 15, 16, and 18- Appendix A)

3. Applicators will use Personal Protective Equipment when applying glyphosate. This includes long-sleeved shirts, long pants, gloves, shoes plus socks, eye protection for application and chemical-resistant apron for cleaning, mixing and loading herbicides.
4. Spray equipment will be calibrated prior to seasonal start-up and periodically throughout the season to assure accuracy in applications. Spray tanks will not be washed or rinsed within 150 feet of any live water. All glyphosate containers and rinse water will be disposed of where they will not cause contamination of waters.
5. No more than daily use quantities of glyphosate shall be transported to the project site.
6. Equipment used for transportation, storage, or application of glyphosate shall be maintained in a leak-proof condition.

7. Favor transportation routes with less traffic, less adjacent water bodies, and fewer blind curves. Use a guide vehicle when more than one vehicle is traveling to the site, or when large quantities or other circumstances dictate.

8. Applicators will develop an Emergency Spill Response Plan developed with and approved by the USDA Forest Service, on-site during treatments. The plan would identify reporting procedures, methods to clean up accidental spills, including reporting spills to the appropriate regulatory agency. Material Safety Data Sheets (MSDS) will be available at all locations where materials are stored, transported, or used on National Forest System Lands

9. Apply during the months of April-October. No application when rain is forecast within the next 24 hours and when wind speed exceeds 10 miles per hour. No glyphosate application would occur within 100 feet of water bodies when wind velocity is greater than 5 mph.

10. A pre-operations briefing will be required annually prior to treatment. A USDA Forest Service coordinator will brief spray personnel on the location of sensitive resources (streams, lakes, wetlands, sensitive plants) and to review operational details. The briefing will include safety issues, location, timing, application method, herbicides approved for use, project design criteria, and other pertinent topics.

11. To minimize glyphosate application drift, use low nozzle pressure; apply as a coarse spray, and use nozzles designed for herbicide application that do not produce a fine droplet spray.

***Public Protection***

12. Treated sites will be posted in advance of glyphosate application, normally 3 days, to ensure that no inadvertent public contact with herbicide occurs.

***Botanical Resources***

13. Surveys for Botanical Species of Concern (Region 6 sensitive and Survey and Manage) shall be completed 100 feet from glyphosate application prior to treatment if the area is potential habitat and the area has previously not been surveyed as part of a project area survey.

14. No glyphosate treatment will occur within 3 feet of a sensitive plant species (non-rhizomatous only) or within 5 feet of a sensitive non-vascular species

***Water Quality, Aquatic Organisms***

15. Glyphosate will not be applied within 50 feet of a class 1-4 stream, pond or wetland

***Wildlife***

16. No areas within 100 feet of a spring or seep will be sprayed with glyphosate.

## Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. Information in Table 4 is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

**Table 4. Comparison of Alternatives.**

| Issue Indicators | Alternative A | Alternative B |
|---|---|---|
| Acres of competitive plants within 50 feet of water treated with herbicides | None | None |
| Acres of TES Fish habitat adjacent to herbicide treatments | None | None |
| Acres of high human use with potential for herbicide treatment | None – areas treated posted | None |
| Potential for drinking water contamination | None | None |
| Maximum area treated with herbicides | 1516$m^2$ | None |
| Yearly cost for study plot maintenance[1] | $400 | $2000 |

**[1] Alternative B would include hand-removal of competing vegetation multiple times throughout the field season. Alternative A would include a one-time treatment.**

# Chapter III: Existing Condition

This chapter summarizes aspects of the environment that could be affected by the alternatives. This provides the baseline for the effects analysis in Chapter IV. Additional details on the affected environment can be found in the Project file, Appendices, and the Blue River and Upper McKenzie Watershed Analyses.

## General Existing Condition

The two research areas, which total 1516$m^2$(1.3 acres), are found within the 1.6 million acres of the Willamette National Forest on the McKenzie River Ranger District.

Treatment sites are located in three land allocations: Management Area 9d, Bunchgrass Meadow; Management Area 3, H.J. Andrews Experimental Forest; and Management Area 15, Riparian. The research plots are not near any perennial or permanent water body, stream, or wetland habitat. Vegetation includes a Douglas-fir plant series forest at HJA, and a montane community at Bunchgrass. Annual precipitation is usually concentrated in the fall, winter and spring. Percent slope is essentially flat.

**Ownership Patterns**

Ownership patterns within the boundaries of the WNF are predominately National Forest System lands (94 %). The McKenzie Watershed, which is the Fifth Field Watershed where the proposed action would occur, has mixed ownership patterns (See Figure 1, Map of Willamette National Forest). Limited information on the use of herbicides is available on the non-forest system lands in this watershed.

**Water Quality/Aquatic Resources**

Blue River Watershed, where the H.J. Andrews research site lies, is a 59,000 acre tributary to the McKenzie River. The Scott Creek watershed, where the Bunchgrass Meadow research site lies, is a tributary to the McKenzie River. Both creeks feed into the McKenzie Subbasin (Figure 3). Beneficial uses of the McKenzie River include habitat for fish and other aquatic species, recreational use, aesthetic values, power generation, and high quality drinking water for over 200,000 people. Consequently, activities within the subbasin that may result in impacts to water quality are a matter of public interest.

Fish species in the upper portions of the McKenzie Subbasin include cutthroat and rainbow trout, sculpin, long nose and speckled dace, redside shiner, and large scale sucker. Rainbow trout are both wild and of hatchery origin. The listed Chinook salmon and bull trout also occur in the

McKenzie River and some of its colder tributaries. Because of the dam at Blue River Reservoir, they do not occur in the Blue River Watershed.

## Plant Communities

The H.J. Andrews research site is dominated by a Douglas-fir/Western Hemlock forest with a varying age structure. Typical understory species include Oregon Oxalis, Oregon grape, salal, sword fern, and vine maple.

The Bunchgrass Meadow research site is dominated by a montane meadow interspersed with patches of grand and silver fir forest with an understory of Oregon grape and oxalis. Meadow species commonly include grasses such as carex. Festuca, and bromus with a variety of forbs such as phlox, danthonia, and lupine.

## Heritage Resources

Within the surrounding landscape, both research areas contain several documented prehistoric archaeological sites, none of which have been formally evaluated for the National Register of Historic Places (NRHP) eligibility. The sites include chipped lithic tool and debris scatters (often the only existing remnant of the prehistoric occupations in Western Oregon.), primarily composed of obsidian artifacts. These stone chips are interpreted as the byproducts of hunting and gathering people's ancient tool maintenance, use and manufacture. It is assumed that most of the debris scatters date to the Middle Archaic period of about 6.000-2000 years ago. The ethnic identity of the tool users is unknown; since the sites are largely on or near ridge top travel routes, the people may have been native to the Cascades or traveling through from the Willamette Valley or central Oregon.

## Fish and Wildlife Threatened, Endangered, Sensitive Species, and Management Indicator Species; and Migratory Landbirds

There are several categories of species of interest that may occur in the watersheds of the research sites. Species listed under the Endangered Species Act (ESA) by the U. S. Fish and Wildlife Service (USFWS) are categorized as proposed, threatened, or endangered. For this analysis area, they are listed in Table 5.

**Table 5: Threatened, Endangered, and Species Proposed for Federal Listing under the Endangered Species Act on the Willamette National Forest**

| Scientific Name | Common Name | Occurrence on the WNF |
|---|---|---|
| *Strix Occidentalis caurina* | Northern spotted owl | D |
| *Oncorhynchus mykiss* | Steelhead | D |
| *Oncorhynchus tshawytscha* | Chinook salmon | D |
| *Oregonichthys crameri* | Oregon chub | D |
| *Salvelinus confluentus* | Bull trout | D |

Sensitive species have specific requirements under the U.S. Forest Service Manual Direction (2600). Their management includes activities that avoid contributing to potential for future listing under ESA. For this analysis area, they are listed in Tables 6-7.

**Table 6: Sensitive Invertebrate Species on the Willamette National Forest**

| Common Name | Occurrence on the WNF |
|---|---|
| Evening fieldslug | S |
| Salamander slug | S |
| Crater lake tightcoil | D |
| Pristine springstail | D (no records) |
| Johnson's hairstreak | S |
| Mardon skipper | S |
| A Caddisfly | D |

**Table 7: Sensitive Vertebrate Species on the Willamette National Forest**

| Common Name | Occurrence on the WNF |
|---|---|
| Bufflehead | D |
| Yellow rail | S |
| Black swift | D |
| American peregrine falco | D |
| Bald eagle | D |
| Harlequin duck | D |
| Lewis' woodpecker | S |
| White-headed woodpecker | D |
| Purple martin | S |
| Northern waterthrush | D |
| Oregon slender salamander | D |
| Foothill yellow-legged frog | D |
| Oregon spotted frog | D |

| Common Name | Occurrence on the WNF |
|---|---|
| Northwestern pond turtle | D |
| Pallid bat | S |
| Townsend's big-eared bat | D |
| California wolverine | S |
| Fisher | S |
| Fringed myotis | D |

Sensitive fungi and Vascular/non-vascular plants are listed in Appendix x.

Management Indicator species (MIS) were addressed in the Willamette National Forest Plan (1990). They include both fish and wildlife species, listed in Table 8. Their management includes maintaining and improving their habitats.

**Table 8: Management Indicator Species of the WNF**

| Common name | Scientific Name |
|---|---|
| Bald eagle | *Haliaeetus leucocephalus* |
| Northern spotted owl | *Strix occidentalis caurina* |
| Pileated woodpecker | *Dryocopus pileatus* |
| Peregrine falcon | *Falco peregrinus anatum* |
| "Primary cavity excavators" | |
| Columbian black-tailed deer | *Odocoileus hemionus columbianus* |
| Roosevelt elk | *Cervus canadensis roosevelti* |
| American pine marten | *Martes Americana* |
| Anadromous and Resident Fish | |

There are two rare and uncommon species that are considered during project planning on the WNF: the great gray owl and the red tree vole. Their management includes activities that avoid contributing to potential for future listing under ESA.

All of these categories of species are generally habitat specific with narrow geographic and environmental distributions. Their habitat condition and population status can be found in the Upper McKenzie and Blue River Watershed analyses and the Biological Evaluations (found in the analysis file at the MRRD), and the ISSSP website www.fs.fed.us/r6/sfpnw/issssp/agency-policy/.

# Chapter IV: Environmental Consequences

This chapter analyzes, compares, and explains the effects of the alternatives. Direct, indirect, connected, and cumulative effects are described. An emphasis is place on resources related to the significant issues. Additional information on the environmental consequences can be found in the project analysis file.

## EFFECTS ON SIGNFICANT ISSUES

**Issue #1: Aquatic and riparian habitats and their associated fish, wildlife and botanical species.**

The application of some herbicides in riparian areas has the potential to contaminate riparian habitat and water, causing mortality to amphibian and fish species. The largest risk is from drift of herbicide onto non-target vegetation used for food or habitat or drift into water. Some herbicides also pose a risk to water quality through leaching through the soil profile. Some herbicides have potential indirect effects to food chain through removal of vegetation and sublethal effects on fish behavior.

There are no riparian areas near the Bunchgrass research site. The DIRT lies entirely on a river terrace 8 to 12 feet above flood plain level and several hundred feet from Lookout Creek. There are small streams immediately east and west of the site that were flowing water when inventoried in May 2008. There were no research markers within 50 feet of the western stream, and the nearest plot was over 100 feet away.

Direct/Indirect/Cumulative Effects

Indicators for comparing the alternatives are shown in Table 9. Glyphosate application, as proposed, i.e. targeting low growing plants from a hand-held wand, has been shown to result in almost non-existant drift. It has also been shown to have no direct effects to the aquatic system through the food chain. However, in both Alternatives, glyphosate will not be used within 50’ of any intermittent or perennial stream or wetland. There is no habitat occupied by TES fish, wildlife or botanical species within the vicinity of the research sites. Leaching through the soil profile is not expected because glyphosate becomes immobile as it binds to organic matter.

**Table 9: Indicators for assessing impacts of alternatives to aquatic and riparian habitats and their associated fish, wildlife, and botanical species.**

| Indicator for Assessing impact | Alternative A – Action | Alternative B – Action |
|---|---|---|
| Acres of herbicide use within 50 foot buffer from a perennial stream or wetland | None | None |
| Acres of occupied or historic Threatened, Endangered and Sensitive fish sites that would not be buffered from herbicide use | None | None |

**Issue #2: Human health.**

There is a potential for humans to be exposed to herbicides where they visit treated sites. Humans could inadvertently brush up against vegetation that has been treated with herbicides. Eugene Water and Electric Board staff noted concern (during scoping for the WNF Weed EA) that herbicides not be used in a way that they could migrate into drinking water. The most plausible method for herbicides to enter drinking water would be from herbicide drift, although some herbicides can leach through the soil profile.

Direct/Indirect/Cumulative Effects

*Indicators for comparing alternatives* are shown in Table 10. In both the Action and No Action Alternatives, glyphosate will not be used in areas with high human use such as campgrounds or parking areas. In Alternative A, areas treated with glyphosate will be posted to alert anyone passing through the research sites. There are no expected impacts to drinking water because glyphosate will not be applied within 50' of any drinking water sources, use of a hand-held sprayer in Alternative A will minimize the potential for any off-site drift; and leaching through the soil profile is not expected because glyphosate binds to organic matter in the soil. Analysis of effects to humans from Glyphosate has been assessed in SERA 1997 and 2003.

**Table 10: Indicators for assessing impacts of alternatives to human health.**

| Indicator for Assessing impact | Alternative A – Action | Alternative B – Action |
|---|---|---|
| Acres of herbicide treatment proposed in areas of high human use such as campgrounds, trailhead parking lots and dispersed campsites | None – research sites will be posted | None |
| Number of plausible exposure scenarios to drinking water that exceed the threshold of concern for herbicides proposed for use | None | None |

**Issue #3 -- Culturally significant plants.**

Members of the Grand Ronde, Klamath, Siletz and Warm Springs collect plants for food, medicine, basketry or other purposes on the Willamette National Forest. Identified species of interest are listed in Table 11.

**Table 11: List of culturally significant plants on the Willamette National Forest.**

| Common Name | Scientific Name |
|---|---|
| Blue Camas | *Camassia quamash* |
| Wild Celery | *Lomatium nudicaule* |
| Indian Carrot of False Caraway | *Perideridia gairdneri* |
| Field Mint | *Mentha arvensis* |
| Choke Cherry | *Prunus emarginata* |
| Huckleberry | *Vaccinium species* |
| Black Lichen | *Alectoria species* |
| Bear Grass | *Xerophyllum tenax* |
| Hazelnut | *Corylus cornuta* |

Direct/Indirect/Cumulative Effects

There are no direct, indirect, or cumulative effects associated with either alternative because the H.J. Andrews research site does not support plants of cultural interest. The Bunchgrass area does contain bear grass and hazelnut, but they are not located in any of the plots proposed for treatment.

**Issue #4 --Native Plant Communities.**

Direct/Indirect/Cumulative Effects

Glyphosate application may harm native plant communities if a large enough extent of the area is altered. There will be direct impacts to targeted plants within the research plots at both sites with both alternatives, however, there are no direct or indirect effects associated with either alternative to native plant *communities* because of the small extent of area treated. The activity will be directed specifically at the experimental plots, leaving the native communities at the H.J. Andrews Research Site and Bunchgrass Research Site unharmed. The purpose of both research projects is to better understand the ecology of these communities, and it is in the best interest of all parties to maintain their functionality while studying their ecological mechanisms.

Glyphosate will not be applied if wind speed is greater than 10 miles per hour and application may only occur using hand-held wands. Under Alternative B, control of competing vegetation in the research plots would be manually removed through intensive labor several times throughout each season. More bare soil may be created through this method, increasing potential for invasive plant invasion. However, because the treated areas are so small, and follow up/maintenance of treated plots will rapidly remove any new invasive plant species, there are no expected cumulative effects with this alternative. Because there are Project Design Features for herbicide application (such as application method, location, equipment and timing mitigate known risks), there are no expected cumulative effects anticipated from the Action Alternatives.

# EFFECTS ON OTHER ISSUES

## Aquatic Conservation Strategy Objectives

Direct/Indirect/Cumulative Effects

An integral part of the Northwest Forest Plan (NWFP) is the Aquatic Conservation Strategy (ACS). The ACS is intended to maintain and restore the ecological health of the watersheds and ecosystems within the NWFP area. The NWFP was amended in March 2004 to clarify provisions relating to the ACS. The objectives of the ACS are intended to apply only at the fifth-field watershed scale. Attaining these objectives at these large scales will take decades or longer in some cases and the effectiveness of the strategy can only be assessed over the long-term. Although application of the standard and guidelines in the NWFP limit the potential for adverse effects to occur from the implementation of individual projects, the ACS objectives are not intended to be interpreted as standard and guidelines for individual projects. Compliance with the

ACS in regard to ongoing and potential management activities within the Riparian Reserve and uplands on the Willamette National Forest should be evaluated at the fifth-field watershed scale.

Under the ACS of the Northwest Forest Plan, Riparian Reserves are used to maintain and restore riparian structures and functions of streams, confer benefits to riparian dependent and associated species other then fish, enhance habitat conservation for organism that are dependent on the transition zones between upslope and riparian areas, improve travel and dispersal corridors for many terrestrial animals and plants, and provide for greater connectivity of the watershed. The Riparian Reserves will also serve as connectivity corridors among the Late Successional Reserves. (B-13). Complying with the ACS objectives means that an agency must manage the riparian-dependent resources to maintain the existing conditions or implement actions to restore conditions (B-10, ROD, USDA Forest Service and USDI BLM, 1994).

There are no expected direct, indirect, or cumulative effects expected because compliance with proposed PDC associated with this project along with current standard and guidelines incorporating implementation of appropriate Best Management Practices should insure compliance with ACS objectives under both alternatives at the fifth-field scale.

### Fish and Wildlife Threatened, Endangered, Sensitive, and Management Indicator Species; and Migratory Landbirds

Direct/Indirect/Cumulative Effects

There are no expected direct, indirect or cumulative effects to TES, MIS, or migratory landbirds because:

1. Habitat at the research sites has been reviewed for potential to support any of the fish and wildlife species of interest, and no primary use was documented. Secondary use may occur on occasion, but because of the small extent of area being treated, it is not expected to contribute to changes in ability of these species to persist on the landscape.

2. The Project Design Criteria are likely to effectively reduce risk of adverse effects to species of interest because they minimize or eliminate herbicide exposure. For example, there will be no glyphosate use within 50’ of a class 1-4 stream, pond or wetland. Only the plots will be treated, and drift will be minimized through restriction on use during high winds. Toxicity to birds, mammals and amphibians is known to be very small. It is not known to be toxic to snails (U.S.D.A. 2005c).

### Botanical Species of Concern

Direct/Indirect/Cumulative Effects

Removal of vegetation competing with research plots, either manually or using glyphosate, may directly impact botanical species of concern by causing mortality. Habitat at the research areas was evaluated for the potential to support botanical species of concern. There are no expected direct, indirect, or cumulative effects associated with either alternative because the plots to be treated do not contain habitat for these species, and the pre-field review showed no sensitive plant populations within 200'. Botanical species competing with the research plots and targeted for treatment are not botanical species of concern.

### Vegetation Mortality

When targeted plants are sprayed with Glyphosate, they will die because of the disruption to enzyme production. Many of the targeted plants may resprout or reseeed in the long term, which will only effectively be controlled through continued application. Plants that only reproduce vegetatively may drop out over time, particularly at the DIRT site, where the plot size is larger. But none of the targeted plants are rare or uncommon within the vegetation communities they occur, and if all activity was halted, they would most likely re-occupy the sites.

### Endangered Species Act - Critical Habitat

Critical habitat has been designated for the TES listed Chinook salmon, steelhead, bull trout, and spotted owl. All of these species occur in the watershed where the research sites lie. There are no expected direct, indirect, or cumulative effects to critical habitat because water quality and native plant communities will not be impacted (see discussion in "Native Plant Communities" and "Aquatic and riparian habitats and their associated fish, wildlife and botanical species" above).

### Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance essential fish habitat (EFH) for those species regulated under a Federal fisheries management plan. Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all proposed actions that may adversely affect EFH. Adverse effects include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Chinook salmon are

the only MSA fish species on the Willamette National Forest. Essential fish habitat has been delineated in the Willamette River Basin based on the process described in MSA §303(a) (7). Federal agencies are to minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat (MSA §303(a) (7)).

There are no expected direct, indirect, or cumulative effects to EFH because water quality and native plant communities will not be impacted (see discussion in "Native Plant Communities" and "Aquatic and riparian habitats and their associated fish, wildlife and botanical species" above.

### Heritage Resources

There are no expected direct, indirect, or cumulative effects associate with either alternative because eradication or treatment of invasive plant species through the application of herbicides and manual treatments (including hand tools such as shovels) falls within the description of activities determined to have no potential to affect historic properties, as determined within the 2004 Programmatic Agreement between Pacific Northwest Region of the USDA Forest Service, the State Historic Preservation Office (SHPO), and the Advisory Council on Historic Preservation (ACHP). No heritage resource survey is required for any of these activities.

## Specifically Required Disclosures

*Adverse Environmental Effects that Cannot be Avoided*

Implementation of either action alternative would cause some adverse environmental effects that cannot be effectively mitigated or avoided. Unavoidable adverse effects often result from managing the land for one resource at the expense of the use or condition of other resources. Most adverse effects can be reduced, mitigated or avoided by limiting the extent or duration of effects. The application of Forest Plan standards and guidelines, Best Management Practices, Invasive Plant ROD standards (USDA Forest Service, 2005b), PDC, and monitoring are all intended to further limit the extent, severity, and duration of potential effects. Such measures are discussed throughout Chapters 2-3, and the purpose of this section is to fully disclose these effects. The discussion below summarizes the unavoidable potential adverse effects to the environment associated with the alternatives considered.

*Irreversible or Irretrievable Commitments of Resources*

Irreversible commitments of resources are those that cannot be regained, such as the extinction of species or the removal of mined ore. Irretrievable commitments are those that are lost for a period

of time, such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

Implementation of the Proposed Action would not produce irreversible or irretrievable commitment of resources. The treatment proposed would be conducted within the constraints of the Invasive Plant ROD standards (USDA Forest Service, 2005b), PDC, and other national and regional management direction (which incorporate applicable law, regulation, and policy). Adverse effects are likely to be localized and short-term.

*Cumulative Effects*

The cumulative effects discussed in this document include an analysis and a concise description of the identifiable present effects of past actions to the extent that they are relevant and useful in analyzing whether the reasonably foreseeable effects of the proposed action and its alternatives may have a continuing, additive and significant relationship to those effects. The cumulative effects of the proposed action are primarily based on the aggregate effects of the past, present and reasonable foreseeable future actions. Individual effects of past actions have not been listed or analyzed and are not necessary to describe the cumulative effects of this proposal or the alternatives. (CEQ Memorandum, Guidance on the Consideration of Past Actions in Cumulative Effects Analysis, June 24, 2005).

*Conflicts with Plans or Policies of Other Jurisdictions*

NEPA at 40 CRF 1502.25(a) directs “to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with . . . other environmental review lands and executive orders.”

Based on information received during scoping, informal consultation meetings, and analysis in the EA, none of the alternatives under consideration would conflict with the plans or policies of other jurisdictions, including the Confederated Tribes of Warm Springs, Confederated Tribes of the Grand Ronde, Siletz Tribes or Klamath Tribes. This project would not conflict with any other policies and regulations or laws, including the Safe Drinking Water Act, Clean Water Act, Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, Wild and Scenic Rivers Act, Wilderness Act, and National Historic Preservation Act. Refer to Chapter 4 for discussions related to these issues.

*Effects on Consumers, Civil Rights, Minority Groups, Women and Environmental Justice*

Executive Order #12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, directs Federal agencies to address effects accruing in a disproportionate way to minority and low income populations. No special or specific effects are anticipated for these populations.

*Effects on American Indian Rights*

No impacts on American Indian social, economic or subsistence rights are anticipated. No impacts are anticipated related to the American Indian Religious Freedom Act. The Confederated Tribes of Warm Springs, the Confederated Tribes of the Grand Ronde, the Siletz Tribe, and the Klamath Tribe have historic interests in this area and have been contacted in reference to this Proposed Action and environmental analysis, as discussed in the Heritage Resources section.

*Prime Farmlands, Rangelands, Forestlands, or Parklands*

No prime farmlands, rangelands, forestlands or parklands exist within the project area. Since none of these lands exist, there would be no direct, indirect or cumulative effects would occur.

*Wetlands and Floodplains*

Floodplains are areas within the riparian areas of Class 1, 2, and 3 streams, and vary from only a few feet, to the entire riparian area in width. Wetlands are areas that regularly are saturated by surface or ground water and subsequently are characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions. Proposed treatments will not occur within riparian areas, as discussed in Chapters 2-3.

The environmental effects are consistent with the standards and guidelines for the Willamette National Forest Land and Resource Management Plan (as amended). In addition, the proposed treatments would be implemented using the standards from the Invasive Plant ROD (USDA Forest Service, 2005b) and PDC. No adverse effects are anticipated to occur to wetlands and floodplains with any alternatives. As such, no direct, indirect, or cumulative effects to wetlands and floodplains are expected to occur.

## Consultation and Coordination

The Forest Service consulted the following individuals, Federal, State, and local agencies, tribes and non-Forest Service persons during the development of this environmental assessment:

ID TEAM MEMBERS:

Cheryl Friesen, Science Liaison
Jennifer Lippert, Forest Botanist
Shane Kamrath, Wildlife Biologist
Ray Rivera, Fisheries Biologist
Neal Forrester, Forest Planner
Cara Kelly, Archaeologist
Doug Shank, Geologist

Dave Kretzing, Hydrologist

FEDERAL, STATE, AND LOCAL AGENCIES:

Salem District BLM
Eugene District BLM
Deschutes NF
Umpqua NF
Mt. Hood NF
USFS Regional Office
Bonneville Power Administration
Oregon Department of Agriculture, Weed Control Program
Oregon Department of Transportation
Portland Gas and Electric
Eugene Water and Electric
East Lane Soil and Water Conservation District
City of Salem Public Works
Lane County Public Works
Linn County Public Works
Marion County Public Works
Clackamas County Dept. Transportation
Northwest Weed Management Partnership (100 member organization)
Upper Willamette Cooperative Weed Management Area

TRIBES:

Confederated Tribes of the Grand Ronde
Klamath Tribes
Confederated Tribes of the Warm Springs
Siletz Tribes

OTHERS:

Native Plant Society of Oregon
Oregon Wild
Northwest Coalition for Alternatives to Pesticides
Giustina Land and Timber Company
Cascade Timber Consulting
Weyerhaeuser Corporation
JH Baxter and Company

Seneca Lumber
Oregonians for Food and Shelter

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Growth Forest Related Species Within the Range of the Northern Spotted Owl. Washington, D.C.: U.S. Government Printing Office. (*Please note these documents are also referred to as the Northwest Forest Plan)*

U.S. Department of Agriculture, Forest Service and U.S. Department of Interior, Bureau of Land Management. 2001. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines. Oregon, Washington and Northern California.

# Appendix A

# Herbicides, Adjuvants, Surfactants, Inert Ingredients, Risk assessments, and Definitions

The effects from the use of any herbicide and additives depends on the toxic properties (hazards) of that chemical, the level of exposure to that chemical at any given time, the duration of that exposure and the documented laboratory dose/response to the specific chemical. The Region 6 Invasive Plant FEIS (2005a) used the herbicide risk assessments displayed in Table 1 to evaluate the potential for harm to non-target plants, wildlife, human health, soils and aquatic organisms from the herbicides considered for use in this EIS. This section summarizes the known information about herbicides and additives, discusses the approach taken in this EIS, and discloses the uncertainties associated with herbicides and additives.

## Herbicide Risk Assessments

Risk assessments were completed by Syracuse Environmental Research Associates, Inc (SERA) using peer-reviewed articles from the open scientific literature and current EPA documents, including Confidential Business Information. Information from laboratory and field studies of herbicide toxicity, exposure, and environmental fate was used to estimate the risk of adverse effects to non-target organisms.

The risk assessments considered worst-case scenarios including accidental exposures and application at maximum label rates. The Invasive Plant FEIS (USDA Forest Service, 2005b) added a margin of safety to the SERA Risk Assessments (2001a, 2003a, 2003b, 2004a, 2004b) by making the thresholds of concern substantially smaller than normally used for such assessments due to the fact that Region 6 used the Threatened and Endangered Species thresholds (much more stringent). Although the risk assessments have limitations, they represent the best science available and have been peer-reviewed.

**Table 1: Risk Assessments for Herbicides Considered in this EA. These risk assessments are available at: http://www.fs.fed.us/r6/invasiveplant-eis/Risk-Assessments/Herbicides-Analyzed-InvPlant-EIS.htm.**

| Herbicide | Date Final | Risk Assessment Reference |
|---|---|---|
| Glyphosate | March 1, 2003 | SERA TR 02-43-09-04a |

In addition to the analysis of potential hazards to human health from every herbicide active ingredient, SERA Risk Assessments (2001a, 2003a, 2003b, 2004a, 2004b) evaluated available scientific studies of potential hazards of other substances associated with herbicide applications:

impurities, metabolites, inert ingredients, and adjuvants. There is usually less toxicity data available for these substances (compared to the herbicide active ingredient) because they are not subject to the extensive testing that is required for the herbicide active ingredients under FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act).

Typical application rates of herbicides are found in Table 2.

**Table 2. Typical Application Rates for Glyphosate (Taken from Region 6 Invasive Plant FEIS, page 4-2).**

| Herbicide | Typical Rate lbs. active ingredient/acre |
|---|---|
| Glyphosate | 2.00 |

**Herbicide Toxicology Terminology**

The following terminology is used throughout this chapter to describe relative toxicity of herbicides proposed for use in the alternatives.

- Exposure of Concern: A level of exposure greater than the level determined to have "no observable adverse effect." This level was made more conservative in the Invasive Plant FEIS (USDA Forest Service, 2005a) to add a margin of safety to the risk assessment process.

- Exposure Scenario: The mechanism by which an organism (person, animal, fish) may be exposed to herbicides or additives. The application rate and method influences the amount of herbicide to which an organism may be exposed.

- Hazard Quotient (HQ): The Hazard Quotient (HQ) is the amount of herbicide or additives to which an organism may be exposed divided by the exposure level of concern. An HQ less than or equal to 1 indicates an extremely low level of risk.

- Plausible Effects: The effects analysis in chapter 3 focuses on plausible herbicide exposure scenarios given site conditions, life history of organisms in the area, herbicide application methods and herbicide properties and risks. Project Design Criteria minimize or eliminate the chance that exposures of concern may occur.

**Definitions of Chemical Types**

*Adjuvants*: Adjuvants are spraying solution additives that are mixed with an herbicide solution to improve performance of the spray mixture. Adjuvants could either enhance activity of an herbicide's active ingredient (activator adjuvant) or offset any problems associated with spray

application, such as adverse water quality or wind (special purpose or utility modifiers). Activator adjuvants include surfactants, wetting agents, sticker-spreaders, and penetrants (Bakke, 2003a).

Adjuvants are not under the same registration guidelines as pesticides. The U.S. Environmental Protection Agency (EPA) does not register or approve the labeling of spray adjuvants. All adjuvants are generally field tested by the manufacturer with several different herbicides against many weeds and under different environments (Bakke, 2003a).

*Inert Ingredients*: Identified inert ingredients found in herbicide formulations include some relatively innocuous substances, such as distilled water. Effects of inert ingredients are included in the risk assessment for specific herbicide formulations (Invasive Plant FEIS, USDA Forest Service, 2005a).

## Adjuvants, Surfactants and Inert Ingredients

Information on adjuvants and surfactants is taken from *Analysis of Issues Surrounding the Use of Spray Adjuvants With Herbicides* (Bakke, 2003a), *Human and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications* (Bakke, 2003b), and Invasive Plant FEIS (2005a). The adjuvants being proposed for use in this analysis include: Hasten, Methylated Seed Oil and LI-700®. Only LI-700 has been specifically approved for use by Washington State Department of Agriculture for use in riparian areas; this is the only surfactant being proposed for use in 50 foot buffers under Alternative C.

The primary ingredient in many of the non-ionic surfactants used by the USDA Forest Service when applying herbicides is a compound known as nonylphenol polyethoxylate (NPE). A separate risk assessment (Bakke, 2003b) for NPE surfactants was completed because concerns have been expressed about toxicity of the chemical components and breakdown products of NPE surfactants. All of the adjuvants proposed contain NPE.

NPE surfactants are appropriate for some applications where the herbicide label requires the addition of a surfactant. NPE surfactants may also improve efficacy in other herbicide applications where addition of a surfactant is optional. In some, but not all of these situations, there are alternative surfactants that would be effective that do not contain NPE (Invasive Plant FEIS, USDA Forest Service, 2005a).

The typical application rate of NPE for USDA Forest Service, Pacific Northwest Region is 1.67 pounds per acre (Invasive Plant FEIS, USDA Forest Service, 2005a). PDC #2 states that the WNF will not exceed this rate.

## Incomplete and Unavailable Information

Risk assessments have a high degree of uncertainty in interpretation and extrapolation of data.

Uncertainty may result from a study design, questions asked (and questions avoided), data collection, data interpretation, and extreme variability associated with aggregate effects of natural and synthesized chemicals on organisms, including humans, and with ecological relationships. Numbers used, particularly in ecological realms, are uncertain, and there are limits on our ability to understand or demonstrate causal relationships. Due to data gaps, assessments rely heavily on extrapolation from laboratory animal tests (2005a). Regardless of disadvantages and limitations of ecological and human health risk assessments, risk assessments can determine (given a particular set of assumptions) whether there is a basis for asserting that a particular adverse effect is plausible. The bottom line for all risk analyses is that absolute safety can never be proven and the absence of risk can never be guaranteed (SERA, 2001).

Further, a risk assessment has only been completed on one surfactant type (NPE) (Bakke, 2003b). Limited information on other surfactants, adjuvants, and inert ingredients is available in Bakke (2003a; 2007) and various risk assessments. Since risk assessments have not been completed for the surfactants, adjuvants and inert ingredients, information regarding the toxicity and effects of these chemicals is largely unavailable.

For risk assessments considering adjuvants, surfactants and inert ingredients in herbicide mixtures, the information within the risk assessment may not be complete. SERA (2001b) discusses how the risk assessments apply generally accepted scientific and regulatory methodologies to encompass these uncertainties in predictions of risk. SERA risk assessments identify and evaluate incomplete and unavailable information that is potentially relevant to human health and ecological risks. Each risk assessment identifies and evaluates missing information for that particular herbicide and its relevance to risk estimate. Such missing information may involve any of the three elements needed for risk assessments: hazard, exposure, or dose-response relationships in order to characterize risk. A peer-review panel of subject matter experts reviews the assumptions, methodologies and analysis of significance of any such missing information. SERA addresses and incorporates the finding of peer review in the final herbicide risk assessment.

# Appendix B

# Herbicide Use on Other Lands: Cumulative Effects Analysis

An analysis of herbicide use on adjacent lands was conducted using data from the state Department of Agriculture Weed Control Program, Oregon Department of Transportation, the counties in which the Forest resides and adjacent federal neighbors. The analysis was restricted to the Townships and Ranges in the upper part of the watersheds because information would be unavailable from agricultural and private lands downstream of the Forest.

The Bureau of Land Management's Eugene and Salem Districts border the Forest on the west. The Eugene District conducts no herbicide spray activities. The Salem District BLM, Cascade Resource Area sprayed 1,765 gross acres of glyphosate, using 27 pounds active ingredient and 0.5 acre of Picloram using 0.0004 pounds active ingredient in 2006 in Linn County.

The Counties bordering the National Forest also use herbicides. Lane County applied 0.0 gallons of herbicide in 2006. Linn County treated approximately 6 acres of road shoulders in the project area and used 12 lb active ingredient/acre of 4 different herbicides. Marion County applied a little over one gallon of Picloram and Triclopyr within the roads on county land above Mill City adjacent to the Willamette NF. In addition to herbicide treatments, ODA and the counties apply manual, mechanical and cultural treatments on their lands.

BPA and EWEB have powerline corridors that run through the Forest but they use manual and mechanical methods on these lands. Some herbicide treatments on privately owned lands can be tracked through the Oregon Department of Forestry's (ODF) permitting program. Records tabulated from ODF show 1,078 acres in Lane County, 2,859 acres in Linn County and 124 acres in Marion County in lands adjacent to the Willamette NF were sprayed with a variety of herbicides in 2006. The Union Pacific Railroad also runs through the Forest and applies 4-8 pounds Diuron and 1-2 pounds Oust per acre within its right of way through the Middle Fork District in Lane County. Oregon Department of Transportation sprayed 39 gallons of herbicide on 70.5 acres within the project area in Linn County and 64 gallons of herbicide on 139 acres within Lane County.

In 2005, Oregon Department of Agriculture Weed Control Program members applied 1,067 gallons of Rodeo and 531 gallons of Garlon 3A on 800 acres of the Willamette National Forest in Lane, Linn and Marion counties as part of our existing herbicide treatment program. This number will be used as a baseline for the annual cumulative effects.

Additional herbicides are certainly used downstream of the Forest on private lands but information on the types of herbicides and quantities used is unavailable. Herbicides are

commonly applied on lands other than the Forest for a variety of agricultural, landscaping and invasive plant management purposes.

The importance of this information is to show the relative size of the herbicide treatment program on the Willamette National Forest in comparison to other landowners. Because information from private lands is unavailable, it is impossible to quantify precisely the percentage of acres on which herbicide used that comes from the WNF, but it is certainly a very small amount compared to others such as private forestland and agricultural land.

# Appendix C:
# Standards and Guidelines from 1999 Integrated Weed Management EA

FW-259a: Every effort should be made to integrate prevention of noxious weed establishment and spread into all ground-disturbing projects. This shall include projects such as road construction and decommissioning, timber harvest, and proposed and active quarry sites. Specific actions should include but not be limited to:

- The Forest should use certified weed-free seed and mulch for all revegetation projects, roadside seeding and fire rehabilitation seeding. The preferred mix shall be comprised of weed-resistant native and non-invasive non-native species.

- The Forest shall initiate an education program for users and employees which state the detrimental effects of noxious weeds on ecosystems and how people are responsible for spreading weeds from place to place. This should include all contractors involved in ground-disturbing activities, wilderness users, hunters, dispersed campers, hikers and other groups identified as aiding movement of weeds.

- The Forest should use machine-cleaning provisions for ground-disturbing projects that use equipment that may be moved from infested areas onto the Forest (where the Regional Office accepts provisions).

- The forest should use designated weed-free rock sources for any additional gravel needed for road construction and reconstruction.

- The Forest shall take every opportunity to close unnecessary roads in project areas to reduce weed travel corridors and revegetate the corridor once closed if needed.

FW 259b: Implementation of the Integrated Weed Management (IWM) program will allow for manual control (pulling and/or digging) of any noxious weed population within disturbed areas such as road prisms, trailheads, or landings on the National Forest at any time.

FW 259c- Implementation of the IWM program shall allow for release of biological control agents wherever established weed populations would support them. Agents released must be tested and sanctioned by the U.S. Department of Agriculture. Other control methods that can serve as alternatives to herbicides such as grazing or mechanical control may be conducted on established weed infestations if site-specific analysis of effects of those control methods is analyzed in an environmental document.

FW 259d- The following table shall be used to determine the appropriate action for new invader weed species in each site type:

| Site Type | Site Description | Available Control Method Non-Riparian | Available Control Method Riparian |
|---|---|---|---|
| 1 | Roadside, quarry, roadside waste disposal, cutbank; little to no competing vegetation | No Action, Manual, Biological, Mechanical, Mulch, Chemical-Rodeo | No Action, Manual, Mechanical, Mulch, Chemical-Rodeo in backpack outside 50 foot buffer only |
| 2 | Roadside, disturbed, with competing vegetation; disturbed meadows; skid roads and landings | No Action, Manual, Biological, Mechanical, Mulch, Competitive Planting, Prescribed Burning, Chemical-Rodeo, Garlon 3A | No Action, Manual, Mechanical, Mulch, Chemical-Rodeo in backpack outside 50 foot buffer only |
| 3 | Wilderness, Threatened, Endangered or Sensitive Plant or Animal Site; Heritage Site | No action, Manual, Biological, Mulch, Competitive Planting, Prescribed Burning, Chemical-Rodeo in Heritage sites only | Same as non-riparian |
| 4 | Administrative Sites with high human use: campground, trail, trailhead, District compound | No action, Manual, Biological, Mulch, Competitive Planting, Chemical-Rodeo in backpack on District compounds only | No Action, Manual, Mechanical, Mulch, Chemical-Rodeo in backpack outside 50 foot buffer only |
| 5 | Administrative Sites with little human use: powerline corridor, ski areas in summer | No Action, Mulch, Competitive Planting, Chemical- Rodeo, Garlon 3A | No Action, Manual, Mechanical, Mulch, Chemical-Rodeo in backpack outside 50 foot buffer only |

# Appendix D:
# Sensitive fungi and vascular/non-vascular plants on the Willamette National Forest

## Sensitive Vascular Plants

| *Scientific Name* | Common Name | Occurrence on the WNF |
|---|---|---|
| *AGOSERIS ELATA* | TALL AGOSERIS | S |
| *ARABIS HASTATULA* | HELLS CANYON ROCKCRESS | C |
| *ARNICA VISCOSA* | SHASTA ARNICA | S |
| *ASPLENIUM SEPTENTRIONALE* | GRASS-FERN | S |
| *BOTRYCHIUM MINGANENSE (*)* | GRAY MOONWORT | D |
| *BOTRYCHIUM MONTANUM* | MOUNTAIN GRAPE-FERN | D |
| *BOTRYCHIUM PUMICOLA* | PUMICE GRAPE-FERN | S |
| *CALAMAGROSTIS BREWERI* | BREWER'S REEDGRASS | S |
| *CAREX ABRUPTA* | ABRUPT-BEAKED SEDGE | D |
| *CAREX CAPITATA* | CAPITATE SEDGE | S |
| *CAREX DIANDRA* | LESSER PANICLED SEDGE | S |
| *CAREX LASIOCARPA VAR. AMERICANA* | SLENDER SEDGE | S |
| *CAREX LIVIDA* | PALE SEDGE | D |
| *CAREX SCIRPOIDEA VAR. STENOCHLAENA* | ALASKAN SINGLE-SPIKED SEDGE | D |
| *CAREX VERNACULA* | NATIVE SEDGE | S |
| *CICENDIA QUADRANGULARIS* | TIMWORT | S |
| *CIMICIFUGA ELATA VAR. ELATA* | TALL BUGBANE | D |
| *COPTIS TRIFOLIA* | THREE-LEAF GOLDTHREAD | S |
| *CORYDALIS AQUAE-GELIDAE* | COLD-WATER CORYDALIS | D |
| *ELATINE BRACHYSPERMA* | SHORT SEEDED WATERWORT | S |
| *EUCEPHALUS GORMANII* | GORMAN'S ASTER | D |
| *EUCEPHALUS VIALIS* | WAYSIDE ASTER | S |
| *GENTIANA NEWBERRYI* | NEWBERRY'S GENTIAN | D |
| *HIERACIUM HORRIDUM* | SHAGGY HAWKWEED | D |
| *ILIAMNA LATIBRACTEATA* | CALIFORNIA GLOBE-MALLOW | D |
| *LATHYRUS HOLOCHLORUS* | THIN-LEAVED PEAVINE | D |
| *LEWISIA COLUMBIANA VAR. COLUMBIANA* | COLUMBIA LEWISIA | D |
| *LYCOPODIELLA INUNDATA* | BOG CLUB-MOSS | D |
| *LYCOPODIUM COMPLANATUM* | GROUND CEDAR | D |
| *OPHIOGLOSSUM PUSILLUM* | ADDER'S-TONGUE | D |
| *PELLAEA ANDROMEDIFOLIA* | COFFEE FERN | S |
| *POA RHIZOMATA* | TIMBER BLUEGRASS | D |
| *POLYSTICHUM CALIFORNICUM* | CALIFORNIA SWORD-FERN | D |
| *POTENTILLA VILLOSA* | VILLOUS CINQUEFOIL | D |
| *RHYNCHOSPORA ALBA* | WHITE BEAKRUSH | D |
| *ROMANZOFFIA THOMPSONII* | THOMPSON'S MISTMAIDEN | D |
| *ROTALA RAMOSIOR* | LOWLAND TOOTHCUP | S |
| *SCHEUCHZERIA PALUSTRIS VAR. AMERICANA* | SCHEUCHZERIA | D |
| *SCHOENOPLECTUS SUBTERMINALIS* | WATER CLUBRUSH | D |
| *SISYRINCHIUM SARMENTOSUM* | PALE BLUE-EYED GRASS | S |
| *UTRICULARIA MINOR* | LESSER BLADDERWORT | D |
| *UTRICULARIA OCHROLEUCA* | NORTHERN BLADDERWORT | D |
| *WOLFFIA BOREALIS* | DOTTED WATER-MEAL | S |
| *WOLFFIA COLUMBIANA* | COLUMBIA WATER-MEAL | S |

## Sensitive Non-Vascular Plants

| *Scientific Name* | Type | Occurrence on the WNF |
|---|---|---|
| *ANDREAEA SCHOFIELDIANA* | MOSS | S |
| *BARBILOPHOZIA LYCOPODIOIDES* | LIVERWORT | D |
| *BRACHYDONTIUM OLYMPICUM* | MOSS | S |
| *BRYUM CALOBRYOIDES* | MOSS | D |
| *CALYPOGEIA SPHAGNICOLA* | LIVERWORT | D |
| *CHILOSCYPHUS GEMMIPARUS* | LIVERWORT | D |
| *CONOSTOMUM TETRAGONUM* | MOSS | S |
| *ENCALYPTA BREVICOLLIS* | MOSS | S |
| *ENCALYPTA BREVIPES* | MOSS | S |
| *ENTOSTHODON FASCICULARIS* | MOSS | S |
| *GYMNOMITRION CONCINNATUM* | LIVERWORT | S |
| *HELODIUM BLANDOWII* | MOSS | S |
| *HERBERTUS ADUNCUS* | LIVERWORT | S |
| *JAMESONIELLA AUTUMNALIS VAR. HETEROSTIPA* | LIVERWORT | D |
| *JUNGERMANNIA POLARIS* | LIVERWORT | D |
| *LOPHOZIA LAXA* | LIVERWORT | D |
| *MARSUPELLA EMARGINATA VAR. AQUATICA* | LIVERWORT | D |
| *POLYTRICHUM SPHAEROTHECIUM* | MOSS | S |
| *RHIZOMNIUM NUDUM (*)* | MOSS | D |
| *SCHISTOSTEGA PENNATA (*)* | MOSS | D |
| *SCOULERIA MARGINATA* | MOSS | S |
| *SPLACHNUM AMPULLACEUM* | MOSS | S |
| *TAYLORIA SERRATA* | MOSS | S |
| *TETRAPHIS GENICULATA (*)* | MOSS | S |
| *TETRAPLODON MNIOIDES* | MOSS | D |
| *TOMENTYPNUM NITENS* | MOSS | D |
| *TREMATODON BOASII* | MOSS | D |
| *TRITOMARIA EXSECTIFORMIS* | LIVERWORT | D |
| *BRYORIA SUBCANA* | LICHEN | D |
| *CHAENOTHECA SUBROSCIDA (*)* | LICHEN | D |
| *DERMATOCARPON MEIOPHYLLIZUM (*)* | LICHEN | S |
| *HYPOGYMNIA DUPLICATA (*)* | LICHEN | S |
| *LEPTOGIUM BURNETIAE (*)* | LICHEN | S |
| *LOBARIA LINITA* | LICHEN | D |
| *NEPHROMA OCCULTUM (*)* | LICHEN | D |
| *PANNARIA RUBIGINOSA (*)* | LICHEN | S |
| *PELTIGERA PACIFICA (*)* | LICHEN | D |
| *PILOPHORUS NIGRICAULIS* | LICHEN | D |
| *PSEUDOCYPHELLARIA MALLOTA* | LICHEN | D |
| *PSEUDOCYPHELLARIA RAINIERENSIS (*)* | LICHEN | D |
| *RAMALINA POLLINARIA* | LICHEN | D |
| *STEREOCAULON SPATHULIFERUM* | LICHEN | D |
| *THOLURNA DISSIMILIS (*)* | LICHEN | D |
| *USNEA LONGISSIMA (*)* | LICHEN | D |

## Sensitive Fungi

| *Scientific Name* | Occurrence on the WNF |
|---|---|
| *ALPOVA ALEXSMITHII* | D |
| *BOLETUS PULCHERRIMUS* | D |
| *BRIDGEOPORUS NOBILISSIMUS* | D |
| *CHOIROMYCES VENOSUS* | S |
| *CHROOGOMPHUS LOCULATUS* | D |
| *CORTINARIUS BARLOWENSIS* | D |

| | |
|---|---|
| *CUDONIA MONTICOLA* | D |
| *CYSTANGIUM IDAHOENSIS* | D |
| *DESTUNTZIA RUBRA* | D |
| *GASTROBOLETUS IMBELLUS* | D |
| *GASTROBOLETUS VIVIDUS* | D |
| *GOMPHUS KAUFFMANII* | D |
| *GYMNOMYCES FRAGRANS* | D |
| *HELVELLA CRASSITUNICATA* | D |
| *LEUCOGASTER CITRINUS* | D |
| *MYTHICOMYCES CORNEIPES* | D |
| *OCTAVIANIA MACROSPORA* | S |
| *PHAEOCOLLYBIA ATTENUATA* | D |
| *PHAEOCOLLYBIA DISSILIENS* | D |
| *PHAEOCOLLYBIA PSEUDOFESTIVA* | D |
| *PHAEOCOLLYBIA SIPEI* | D |
| *PSEUDORHIZINA CALIFORNICA* | D |
| *RAMARIA AMYLOIDEA* | D |
| *RAMARIA AURANTIISICCESCENS* | D |
| *RAMARIA GELATINIAURANTIA* | D |
| *RAMARIA LARGENTII* | D |
| *RAMARIA SPINULOSA VAR. DIMINUTIVA* | S |
| *RHIZOPOGON EXIGUUS* | S |
| *RHIZOPOGON INQUINATUS* | D |
| *SOWERBYELLA RHENANA* | D |
| *STAGNICOLA PERPLEXA* | S |

# Appendix E

## Herbicide Hazards and Project Design Criteria Designed to Mitigate Hazards

Trade Name(s): **Rodeo; Aquamaster**

| **Glyphosate** | | | | |
|---|---|---|---|---|
| **Herbicide Characteristics** | **Basic Hazard Identification** | **Risk Characterization (SERA Risk Assess.)** | **Label Restrictions & Information** | **Project Design Criteria** |
| Broad spectrum, Non- selective | Will kill contacted desirable plants, | No risk from runoff; boom-spray drift may adversely affect non-target species | Keep people and pets off treated areas until spray solution has dried to prevent transfer of this product onto desirable vegetation. | #4, 17. Use calibrated spray equipment and coarse spray to reduce drift. Use backpack, wick or stem injection for chemical applications to reduce potential for drift. |
| Very high water solubility | Runoff, leaching potential | | Rainfall within 6 hours may reduce effectiveness; | #9. No application when rain is forecast within the next 24 hours. |
| Human health effects | May damage mucosal tissue, weight loss in mammals; mild liver toxicity | All exposures for workers and public far below level of concern | Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks, and protective eyewear. | #3. Applicators will use personal protective equipment when applying herbicides. |

| Glyphosate | | | | |
|---|---|---|---|---|
| **Herbicide Characteristics** | **Basic Hazard Identification** | **Risk Characterization (SERA Risk Assess.)** | **Label Restrictions & Information** | **Project Design Criteria** |
| | Mild to moderate irritant to skin and eyes. | | Do not get in eyes or on clothing; Avoid breathing vapor or spray mist; | |
| Wildlife effects | Can cause diarrhea, weight loss in mammals; weight loss in birds at very high doses; some mortality to pregnant rabbits observed | Mortality to some large vegetation-eating mammals plausible at highest application rates only; some risk to insect-eating birds & mammals at high rate | | Use lowest effective application rates. |
| | | Chronic risk to insect-eating birds at typical rate unknown; at highest rate, chronic risk to insect-eating birds and mammals unknown | | |
| Surfactants (tallow amine or POEA) in non-aquatic use formulations very toxic to aquatic organisms | Low toxicity to fish; surfactant in some formulations much more toxic than glyphosate | Even aquatic formulation exceeds level of concern for **endangered fish**, with max risk assumptions; surfactant formulations may cause mortality at high application rate only | | Use Rodeo and Aquamaster which contain no POEA |

| Glyphosate | | | | |
|---|---|---|---|---|
| **Herbicide Characteristics** | **Basic Hazard Identification** | **Risk Characterization (SERA Risk Assess.)** | **Label Restrictions & Information** | **Project Design Criteria** |
| | Surfactants may be highly toxic to aquatic organisms | | Do not apply (surfactant formulations) directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment. | No spray within 10 feet of water to reduce potential for contact with aquatic organisms.<br><br>Use LI-700 as only surfactant in 0-50 feet from water.<br><br>#13 Spray tanks will not be washed within 150 feet of live water. |
| | Low or no toxicity to bees, beetles, spider mites, wasps, isopods, earthworms, or snails. | Highest application rate may pose risk to some individual bees, but not likely to populations | | Use lowest effective application rates. |