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Environmental Assessment

Willamette National Forest

Integrated Weed Management

Willamette National Forest
Marion, Linn, Lane and Douglas Counties, Oregon

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Summary

The Willamette National Forest (WNF) proposes to treat approximately 800 invasive plant sites found on about 9700 acres throughout the National Forest. Currently unknown sites that are newly detected would also be treated over the next 10 years using the "early Detection Rapid Response" approach. The purpose of the project is to effectively control invasive plants according to new management 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 the following treatment methods: manual, mechanical, cultural (grazing), herbicide and active restoration. Herbicides Glyphosate, Imazapyr, Triclopyr, Clopyralid and Sethoxydim would be approved for use according to project design criteria (PDCs). These criteria limit the rate, extent and selection of herbicides that would be used in streamside and other specific areas. This integrated weed management program would cover treatment of invasive weeds annually for at least the next 10 years.

In addition to the proposed action, the Forest Service also evaluated the following alternatives:

- Alternative 1, No Action: Use prevention activities and manual and/or mechanical control activities to eradicate, contain or suppress existing infestations across the Forest.
- Alternative 2, Current Program: Use prevention measures and manual, mechanical, cultural (grazing), and limited herbicide control methods to treat existing infestations.

Chapter I: Introduction

Background

This site-specific invasive plant EA applies to the entire Willamette National Forest (WNF). The majority of the project area is located in Marion, Linn and Lane Counties. A small part of Douglas County is also located on the WNF. The lands total approximately 1.6 million acres, exclusively on the west side of the Cascade Mountains (see Figure 1, Map of Willamette National Forest). Urban areas the Forest serves are the Salem and Eugene/Springfield areas.

Figure 1. Map of Willamette National Forest and Environs

Invasive plants are defined as "non-native plants whose introduction does or is likely to cause economic or environmental harm or harm to human health" based on the definition provided in Executive Order 13112 issued in 1999. Invasive plants are compromising our ability to manage the Forest for a healthy native ecosystem (the Desired Future Condition for Region 6, USDA, 2005a). In the past, it was assumed that invasive plants simply invaded disturbed habitats and once those habitats were restored or reforested, the weeds would cease to exist. However, several new species such as false brome and Japanese knotweed have shown that unmanaged habitats such as riparian areas or second growth forested stands are also prone to invasion. Researchers have found that few habitats are invulnerable to invasion (Crawley, 1987; Di Castri, 1990).

Invasive plants can create a host of environmental effects through directly altering the site by changing resource availability or disturbance regimes or both (Brooks et. al, 2004; Gordon, 1988). A variety of environmental effects may result from invasions including displacement of native plants, reduction in habitat and forage for wildlife (DiTomaso, 2000), increased potential for soil erosion and sedimentation, altered hydrologic cycling, alteration of physical and biological properties of soil (Macdonald, 1989), loss of long-term riparian function, loss of habitat for culturally significant plants, high cost to control invasive plants and increased cost in maintaining transportation systems and recreation sites.

This EA addresses inventoried invasive plant species as well as additional invasive plant populations that may be treated using the early detection-rapid response strategy (see Alternative Descriptions).

The invasive species included in this analysis may be found in Table 1. Plants are categorized as potential invaders, new invaders and established invaders and control strategies will differ, depending on species' classification. **Potential invaders** are those species located in adjacent National Forest or other lands that have a high probability of being detected on the Forest in the foreseeable future (next 15 years) because potential habitat exists here. **New invaders** are those weed species just entering the National Forest and whose populations are possible to eradicate. **Established infestations** include weed species that are so widespread on the Forest they are not likely to eradicate. Some species, such as blackberry, can have both new invader populations that are less than 10 plants and are outliers as well as established infestations such as those that are found bordering streams at lower elevations.

Invasive plants have been inventoried by botanists, contractors and cooperators for the past 13 years. Sites analyzed in this EA are primarily composed of new invaders. Sites of established infestations are targeted for treatment in unique areas such as Special Wildlife Habitats, meadows being restored or powerline corridors being enhanced for wildlife forage.

Table 1. Invasive Plant Species Currently Documented or Suspected on the Willamette National Forest.

Potential Invaders	New Invaders	Established Infestations
Leafy spurge	Spotted knapweed	Canada thistle
Yellow starthistle	Diffuse knapweed	Bull thistle
Distaff thistle	Yellow toadflax	Scotch broom
Squarrose knapweed	Dalmatian toadflax	Tansy ragwort
Gorse	Japanese knotweed	St. Johns-wort
Orange hawkweed	Meadow knapweed	Foxglove
French broom	Climbing nightshade	Oxeye daisy
Garlic mustard	Field bindweed	
Himalayan knotweed	Evergreen blackberry*	
	Himalayan blackberry*	
	False brome	
	Reed canarygrass*	
	Sweetclover	
	Houndstongue	
	English ivy	
	Butterfly bush	
	Yellow hawkweed	
	Purple loosestrife	
	Everlasting peavine	
	Vinca	
	Evening primrose	
	Bladder campion	
	Creeping buttercup	
	Creeping charlie	
	Yellowflag iris	
	Shinyleaf geranium	
	Sulphur cinquefoil	
	Herb robert	
	Depford pink	
	Burdock	
	Feverfew	
	Anise	

* Species with a star may be considered either new or established weed infestations, depending on their densities. For example, blackberry at low elevations along river corridors are established, but sincle clumps at high elevations are newly invading. Reed canarygrass around reservoir fringes is established but clumps around alpine lakes are newly invading.

Regulatory Framework/ Management Direction

Several standards and guidelines from the Willamette Land and Resource Management Plan (WNF Forest Plan, USDA, 1990) provide direction for management of invasive plants directly or indirectly:

- **Wilderness**- MA-1-60 There should be no long-term modification, and only limited short-term modification, of natural plant succession as a result of human activity.
- **Research Natural Areas**- MA-4-15 Introduction of exotic plant and animal species shall not be permitted. Reintroduction of former native species, including fish stocking, may be permitted if the objectives of the RNA are met.
- **Special Interest Areas-** "Plant and animal communities inhabiting these unique or special areas will flourish in a mostly undisturbed environment" where maintenance of the physical, cultural or biological attributes of note should be maintained
- **Special Wildlife Habitat**. MA-9d-07 Habitats of native wildlife and plants shall be maintained. This analysis tiers to the United States Department of Agriculture Region 6 Forest Service's Record of Decision (heretofore called the Region 6 ROD), signed in October 2005 (USDA, 2005a). The Region 6 ROD provides a Desired Future Condition (DFC), specific Goals and Objectives for National Forests to follow in their noxious weed management and amends Forest Land and Resource Management Plans with twenty-three standards to follow to ensure weed prevention and management (see Appendix A for DFC, Goals and Objectives and Standards).

The Forest Plan was amended by the WNF Weed Management Plan in 1999 (Amendment 239, see Appendix B). 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 (Appendix C). The Plan listed potential, new and established weed infestations and prioritizes treatment of new invaders. It specified treatment design factors based on proximity to water, TES species, Wilderness and administrative sites with high use. Glyphosate and Triclopyr (Garlon 3A only) were approved for use under specific conditions. It prescribed a method for early detection-rapid response including up to 25 new sites per year.

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 (See Appendix A for DFC, Goals and Objectives and Standards).

The current Weed Management Plan is not fully consistent with the R6 ROD. Three of the four sections of the current plan (prevention guidelines, manual treatments and biological agents) are generally consistent with the ROD. However, Section 4, treatment methods, does not allow for use of new herbicides approved in Standard 16, and has not been effective at eradicating rhe new invader species on the Forest. The project analysis in this EA is tiered to the R6 FEIS. The focus of the effects analysis is on the portion of the Invasive Plant Management Program that must be updated to be in compliance with the new Standards.

Watershed Analyses were written for all the 5th field watersheds on the Forest. They provide direction for maintenance and restoration activities. All Watershed Analyses suggest that management of invasive plants is a crucial factor in maintaining the health of these ecosystems.

Purpose and Need for Action

Desired Future Condition (from the R6 ROD): Healthy native plant communities remain diverse and resilient, and damaged ecosystems are being restored. High quality habitat is provided for native organisms. Invasive plants do not jeopardize the ability of National Forests to provide goods and services communities expect. The need for invasive plant treatment is reduced due to the effectiveness and habitual nature of preventative actions, and the success of restoration efforts.

Current condition: Approximately 9,700 acres of the Willamette National Forest are currently degraded by infestations of invasive plants. Three hundred twelve (312) new weed sites have been found since the 1999 environmental analysis was conducted. Fourteen new weed species have been added to the new invader or potential invader list and management needs to be prescribed for them (surveys were conducted yearly to develop a database of weed sites- see Appendix D- but areas are likely underestimated due to incomplete inventory and yearly spread). Current management methods are not effective at eradicating the new invader species found on the Forest.

- Additional herbicides have been approved for use (Standard 16).
- The current approach to early detection-rapid response is not adequate to address the need for timely treatment (Objective 1.5)
- Current direction is not prescribed for long-term site strategies for restoring/revegetating treatment sites, preferably with native plant materials (Standards 12 and 13)

Action is needed to update Section 4 od the invasive plant management plan so that treatments are timely, effective, and result in long-term restoration, The purpose of this project is to reverse the negative impacts caused by invasive plants and to restore ecological communities and function at impacted sites in a cost-effective manner that meets current management direction.

Without action invasive plant populations would continue to grow, compromising our ability to manage the forest for healthy native ecosystems.

Proposed Action

The Forest Service proposed to contain established infestations and to eradicate new invader infestations at 753 weed sites on 9700 acres of the Willamette National Forest. The program would allow treatments within road corridors and in documented sites. All tools described in Table 2 would be available for use; the most effective tool would be used on the infestation, taking into consideration the location of Threatened, Endangered and Sensitive species, proximity to water, soil types, traditional uses and weed population size and species. Manual and biological treatments could occur anywhere on the Forest. Mechanical treatments could be used outside Wilderness and may be seasonally restricted in response to TES bird species. Cultural methods such as grazing with goats could be used outside Wilderness or roadsides.

Herbicide use would be limited within 50 feet of streams, ditches that lead to streams, and other water bodies:

▪ Within 10 feet water	Stem injection of aquatic glyphosate Wiping of aquatic glyphosate and imazapyr
▪ 10-50 feet from water	all of the above plus backpack spot spray with Aquatic imazapyr and glyphosate
▪ Greater than 50 feet from water	Backpack or truck-mounted hand sprayer with glyphosate, impazypyr, chlopyralid (for knapweeds, except for areas of high water table and permeable soils), sethoxydim (for grasses), and triclopyr (Garlon 3A only)

Treatment of invasive weeds would occur annually for at least the next 10 years. Project Design Criteria (PDC) would be used to determine treatment method for each site. These are developed to integrate effectiveness of treatment, herbicide label restrictions and mitigation measures. A matrix is developed to determine appropriate treatment method. If herbicide treatments were the only effective method to control a weed infestation, the site would go through a screening process to determine whether the site is in Wilderness (no mechanical, grazing), a TES or Survey and Manage species site (no herbicide application or selective wiping or shielding; seasonal restrictions on mechanical treatments), whether the site is within a 50-foot riparian buffer (only certain herbicides available), whether the site is near a wetland or has highly permeable soils (only certain herbicides available).

This alternative would allow for Early Detection and Rapid Response (EDRR) in treatment of uninventoried invasive plant infestations as long as treatments and site types are consistent with those analyzed in this document. EDRR treatments would total no more than 3,000 additional acres. Under EDRR, no more than 10 contiguous acres or 1.5 stream miles per 6th field watershed would be treated per year.

The proposed action would approve treatment of terrestrial and riparian infestations but does not address aquatic invasive species, Amendment 239d (WNF Weed Management Plan) would be replaced with a new list of site types and approved treatment methods. Prescribed burning and aerial or broadcast herbicide applications are not proposed. All management activities on Forest land would incorporate prevention activities to prevent movement into uninfested areas as directed by the R6 2005 ROD.

Decision Framework

Given the purpose and need, the Forest Supervisor, Deciding Official, will review the proposed action and the other alternatives, including the No Action Alternative, to determine how to meet the Desired Future Condition and Goals and Objectives in the Region 6 EIS for Invasive Plant Management.

Specific elements that the Deciding Official will consider in the decision include:

- Protection of ecosystems from the impacts of invasive plants through an integrated, cost-effective approach?
- Protection of the health of persons who work, visit or live in or near National Forest
- Protection of sensitive ecosystem components and maintain biological diversity

Public Involvement

The proposal was listed in the Schedule of Proposed Actions for Willamette National Forest beginning in January 2005. The proposal was provided to the public and other agencies for comment during scoping January 3-February 4, 2005. In addition, Tribal Consultation was conducted. The Forest sent maps of proposed treatment sites to the Klamath Tribes, the Confederated Tribes of the Grand Ronde, Siletz Tribes and the Confederated Tribes of the Warm Springs. Meetings were held with Tribes that wanted a briefing and had comments on specific treatment sites: the Confederated Tribes of the Grand Ronde on May 2, 2006; Confederated Tribes of the Warm Springs on April 18, 2006; and the Siletz Tribes on March 15, 2006. We also met with EWEB to brief them on the project on May 15, 2006. Notes from meetings are in the project file.

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:

Effects on aquatic and riparian fish and wildlife: 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

Human health: There is a potential for humans to be exposed to herbicides where they visit treated sites, for example at trailheads or in campgrounds. Humans could inadvertently brush up against vegetation that has been treated with herbicides. Eugene Water and Electric Board staff noted concern 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:

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 there is only one known site where these conflicts may arise and it is being mitigated by using manual controls at the site. Other sites will be mitigated through signing of treatment sites before and after treatments.

Native Plant Communities

Invasive plant treatments, especially herbicide application, may harm desirable, non-target plants. Herbicides differ in their effects on plants; some may selectively target broadleafs (Garlon 3A) or grasses (Poast). Application methods differ in their probability for drift. As invasive plants are eradicated, it is expected that native plant communities will benefit because of an increased opportunity to expand. This was deemed a non-significant issue because herbicides will only be applied through wiping, stem injection or hand-held wands to mitigate effects on non-target plant species.

Chapter II: Alternatives, including the Proposed Action

This chapter describes and compares the alternatives considered for the Willamette NF Integrated Weed Management Plan. It includes a description and map of treatment sites considered. 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, manual and mechanical 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. The No Action alternative was developed to set a baseline, and includes no herbicide use. Alternative 2 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 3 responds to the need to fully implement the Region 6 ROD.

Treatment Types

A variety of weed treatment types are proposed under the various Alternatives and range from manual to mechanical, cultural and chemical. Table 2 explains the types of activities that may be conducted under each broad heading.

Table 2: Treatment methods available for use under Alternatives A-C

Method	Description
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.
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 invasive plants with deep tap roots that can not be hand pulled adequately or that reproduce vegetatively.
Cutting	Cutting the seed head of some species can be used an intermediate step; especially if the species is spread primarily by seed. Can use loppers, hand-pruners or chainsaws.

Method	Description
Mulching	Mulching is a method that can be used to smother weeds using black or clear plastic or plant-derived materials such as straw or bark mulch.
Competitive Planting	Using seed of native species to out-compete new infestations of weeds on site.
Mechanical Methods	
Mowing, brushing, weed eating	Mowing and cutting can reduce seed production and retard invasive plant growth, especially in annuals cut before they flower and set seed. Some species however, resprout when cut, replacing a few stems with many that can flower and set seed.
Cultural Methods	
Grazing goats	Grazing can either promote or reduce invasive plant abundance at a particular site. When grazing treatments are combined with other control techniques, such as herbicides, severe infestations can be reduced and small infestations may be eliminated.
Herbicide Methods	
Wiping	Treatment of individual plants to avoid spraying other desirable plants. There is a low likelihood of drift or delivery of herbicides away from treatment sites. This is used in sensitive areas, such as near water, to avoid getting any herbicide on the soil or in the water. Specific method includes wicking using a sponge or wick on a long handle to wipe herbicide onto foliage and stems.
Stem Injection	This method was developed to treat knotweed species in riparian areas. A hypodermic needle is used to inject herbicide into the hollow stem of the target weed, reducing the risk that any herbicide would enter the water.
Spot Spraying	Spray herbicide directly onto target plants and avoid spraying other desirable plants. Herbicide is usually applied with a backpack sprayer, although a hose from a truck-mounted tank with a hand-held wand can be used where necessary. This method is used where plants are far enough from each other to be individually discernable. The timing for spot spraying, as with any type of herbicide treatment, varies by plant species. The herbicide label would provide this information as well as wind and rain restrictions, which vary by herbicide.

Alternatives

Alternative 1: No Action

Under the No Action alternative, no herbicide use is proposed. Control measures would be confined to manual and mechanical treatments to reduce or contain noxious weeds on the Willamette National Forest. The existing Weed Management Plan would be discontinued. The Forest would continue to implement the Willamette National Forest Weed Prevention Guidelines (Appendix C) No mechanized equipment would be allowed into Wilderness.

This direction would not be consistent with either the R6 ROD or the Willamette LRMP standards and guidelines. Specifically the goals/objectives and standards from the Region 6 ROD that would not be implemented include: protection of ecosystems from the impacts of invasive plants through an integrated approach that emphasizes early detection and early treatment (Goal 1), long-term restoration planning for invaded sites (Standards 12 and 13), overall prioritization of treatments (standard 11), implementation of strategies that protect sensitive ecosystem components and maintain biological diversity and function (Goal 4), and expansion of collaborative efforts using an adaptive management approach to invasive plant management (goal 5).

The estimated cost for full implementation is approximately $12.5 million dollars/year[1] (Table 5).

<u>Definitions common to all action Alternatives</u>

All action alternatives would provide a range of available tools and prescriptions, depending on the site type. Tools (treatment types) vary depending on what issues the alternative is attempting to address and the site type. Site types would be the same across all alternatives:

- Site type 1: Roadside, quarry, waste disposal, cut bank, little to no competing vegetation
- Site type 2: Roadside, disturbed, with competing vegetation; skid roads, landings
- Site type 3: Wilderness, TES plant, animal or fish site, Survey and Manage wildlife or botanical species site

[1] This number was calculated using the number of acres at year 1=9700 and allowing manual to reduce populations by 25% per year (mechanical was reduced by 20%/yr and herbicide 80%/yr). Cost of controls were applied to number of acres in population and added up for the 10 year period (manual- $340/acre, mechanical- $ 100/acre, chemical- $250/acre). Similar methodology was used for Alternatives 2 and 3 except growth rates of populations and available treatments differed by Alternative. These numbers are meant to show relative cost for Alternatives as compared to one another. Costs and estimates of reduction were taken from Olympic NF EIS: Beyond Prevention-Site Specific Invasive Species Plant Treatment Project.

- Site type 4: Administrative and recreation sites with high human use: campgrounds, trailhead parking areas, District compound
- Site type 5: Administrative and recreation sites with little human use: Powerline corridors, ski areas
- Site type 6: forested habitats
- Site type 7: non-forested habitats: meadows, rock gardens, wetlands

Activities common to All Action Alternatives

Under all action alternatives, an **annual program of work** would be developed. This would prioritize treatment and restoration sites and an analyze new treatment sites to determine whether they are within the scope of this analysis. The plan would be reviewed by an interdisciplinary team to determine if there need to be any restrictions on proposed treatments or changed conditions. The highest priority would be to treat new invaders whose populations we have a chance of eradicating from the WNF. The next priority would be treatment of highly sensitive areas with high biodiversity or value such as meadows and Wilderness areas.

All action alternatives would have **restoration strategies** built into them. Strategies would be based on site types. For type 1, where only the hardiest weeds survive, a no treatment and high emphasis on prevention of activities that would introduce new weeds would be the strategy. For type 2, disturbed but vegetated roadsides, native grass seed mixes would be used to reduce erosion following weed control efforts. For the rest of the site types, treatment areas would be assessed to determine treatment strategies and whether revegetation or restoration was the goal. In all cases, native plant materials will be used.

Alternative 2: Current Program

This alternative responds to the issues of potential effects on human health and aquatic species. Control methods would be dependent on whether the weed site is within or outside of a **stream buffer**. Stream buffers would be defined as 50 feet from a class 1-4 stream, pond or wetland. Control methods would also depend on proximity to areas of high human use such as campgrounds, trailhead parking lots and dispersed campsites.

The existing program includes appropriate guidance for manual treatments and prevention. These would continue to be an important part of the program as a whole. Mechanical methods would be available for use everywhere except Wilderness, as long as mitigation measures for spotted owls and bald eagles have been met. Grazing by goats could occur anywhere but roadsides (site types 1 and 2) and Wilderness.

Two herbicides are currently available to treat new invaders outside of stream buffers (3232 acres) and areas of high human use (410 acres). The largest number of acres that could be treated with herbicides would be 6058. Glyphosate (Rodeo formulation) is a non-selective herbicide that would often be used in site type 1 where the only vegetation is the targeted weeds. It would only be used outside the 50 foot riparian buffer under this alternative. Application rates would typically be 2 pounds active ingredient/acre (2% solution, with a 3 quart per acre application rate).

Triclopyr (Garlon 3A formulation) is selective on broadleaf plants and would be appropriate for use where there is competing grass vegetation such as in site types 2, 6 and 7. This herbicide would only be used outside the 50 foot riparian buffer under this alternative. Application rates would typically be 1 pound active ingredient per acre (1% solution or 11/2 quarts per acre).

Estimated cost for full implementation of this Alternative is 5.7 million dollars per year (Table 5).

Table 3. Control Methods Available Under Alternative 2

Site Type	Control Method Available Non-stream buffer	Control Method Available- Stream buffer
1- Roadside, no vegetation	Manual; Mechanical; Chemical: 2 herbicides- Glyphosate, Triclopyr	Manual; Mechanical (hand-held power tools only)
2- Roadside, competing vegetation	Same as site type 1	Same as site type 1
3- Wilderness, TES	Same as site type 1 but ▪ no mechanical in Wilderness ▪ no mechanical in seasonal wildlife restriction ▪ mitigations for TES plant sites ▪ mitigation for TES/Survey and Manage salamander sites	Same as site type 1 ▪ no mechanical in Wilderness ▪ no mechanical in seasonal wildlife restriction ▪ mitigations for TES plant sites ▪ mitigation for TES/Survey and Manage salamander sites
4- Administrative sites: high human use	Same as site type 1 plus cultural	Same as site type 1
5- Administrative sites: low use	Same as site type 1 plus cultural	Same as site type 1
6- Forested	Same as site type 1 plus cultural	Same as site type 1
7- Non-Forested	Same as site type 1 plus cultural	Same as site type 1

Herbicides would be applied using backpack or truck-mounted hand sprayers, by wick or injection. No herbicides would be available for use inside stream buffers.

Adjuvants are mixed with herbicides to increase herbicide absorption through plant tissues and increase spray retention (Bakke, 2002). 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, 2002).

Priority would be given to treating new invaders over established infestations. The most economical method would be used to treat infestations. Most weed populations along roadsides and within administrative sites would be treated with herbicides except where they come within 50 feet of a road. Sites within stream buffers and in wilderness would need to be treated with manual methods. Multiple treatments would be expected at these sites to keep plants from going to seed.

This Alternative provides for **Early Detection Rapid Response**. Up to twenty-five new sites per year would be added to those already approved for treatment if an analysis of the sites by an Interdisciplinary Team shows that proposed treatments of new sites are within the scope of the project design criteria of this Alternative. New sites would be published in the newspaper to inform the public

Monitoring is an integral part of this Alternative. There would be annual reviews of new sites proposed for treatment. If sites are treated with herbicides, we would follow up with manual control (at least of flowering heads) and would monitoring effectiveness late in the season for at least the sites along major highway corridors and major road systems (20% of all sites).

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. These reports would be used to update the regulatory agencies as part of annual informational updates.

Alternative 3: Proposed Action

Alternative 3 responds to the issue of treatment effectiveness. It differs from Alternative 2 in that it would allow treating weeds with herbicides within the stream buffer and would increase the number of herbicides available to five. Herbicides will be available for use in wilderness. All 753 sites could be sprayed with herbicides; 9700 acres could be sprayed. Cost of full implementation of this alternative would be approximately $2.9 million dollars per year.

In this alternative, the Forest Prevention guidelines would be important in limiting new infestations. For existing weed populations, manual control could occur in all site types. Mechanical methods would be available for use everywhere except Wilderness, as long as mitigation measures for spotted owls and bald eagles have been met. Grazing by goats could occur anywhere but roadsides (site types 1 and 2) and Wilderness.

Glyphosate (Rodeo and/or Aquamaster formulation- see Alternative 2 for discussion) and imazapyr (Habitat formulation) would be available for use in stream buffers. Adjacent to water, from 0-10 feet, only stem injection (Aquamaster only) and wiping of weeds (with Rodeo, Aquamaster or Habitat) would be allowed. In addition, within 10-50 feet of a stream backpack spray of glyphosate and imazapyr would be allowed.

Table 4. Control Methods Available Under Alternative 3

Site Type	Control Method Available Non-stream buffer	Control Method Available- Stream buffer
1- Roadside, no vegetation	Manual; Mechanical; Chemical: 5 herbicides-Rodeo, Triclopyr, Clopyralid, Sethoxydim, Imazapyr	Manual; Mechanical (hand-held power tools only); Chemical: Rodeo or Habitat via wiping 0-50 ft, backpack within 10-50 ft., stem injection with Aquamaster 0-50 ft
2- Roadside, competing vegetation	Same as site type 1	Same as site type 1
3- Wilderness, TES	Same as site type 1 <u>but</u> - no mechanical in Wilderness - no mechanical in seasonal wildlife restriction - mitigations for TES plant sites - mitigation for TES/Survey and Manage salamander sites	Same as site type 1 <u>but</u> - no mechanical, hot foam in Wilderness - no mechanical in seasonal wildlife restriction - mitigations for TES plant sites - mitigation for TES/Survey and Manage salamander sites
4- Administrative sites: high human use	Same as site type 1 <u>but</u> ▪ add cultural	Same as site type 1
5- Administrative sites: low use	Same as site type 1 plus cultural	Same as site type 1
6- Forested	Same as site type 1 plus cultural	Same as site type 1

7- Non-Forested	Same as site type 1 plus cultural	Same as site type 1

Imazapyr is a non-specific herbicide used on post-emergent vegetation. It can be absorbed via leaves or roots. The Habitat formulation would be used within riparian buffers (wipe in the 0-50 foot riparian zone and backpack spray in the 10-50 foot riparian zone). In upland sites, either the Habitat or Arsenal formulation could be used. Application rates would typically be 0.45 pounds active ingredient/acre.

Two other herbicides would be available for use outside 50 foot riparian buffers. Sethoxydim (Poast formulation) is grass-specific and would be appropriate for use where there is competing broadleaf vegetation such as in site types 2 or 7. Application would be limited to false brome and reed canarygrass sites with high amounts of herbaceous vegetation. No application would occur within 50 foot buffers or in sites with high water table and permeable soils. Application rates would be 0.3 pounds active ingredient per acre (2 pints/acre).

Clopyralid (Transline formulation) is very effective on members of the aster family and would be used along road corridors to treat spotted knapweed. Under this alternative, clopyralid would not be used in 50 foot stream buffers or where there are highly permeable soils and a high water table. Rates would average 0.35 pounds active ingredient/acre (1/3-2/3 pints/acre).

Herbicides would be applied using backpack or truck-mounted hand sprayers, by wick or injection.

Adjuvants could be mixed with herbicides to increase herbicide absorption through plant tissues and increase spray retention (Bakke, 2002). Oil adjuvants to be used include Hasten or Methylated Seed Oil. A pH reducing adjuvant (LI-700®) would also be 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, 2002). Only LI-700 would be available for use within the 50-foot riparian buffer.

Priority would be given to treating new invaders over established infestations. The most economical method would be used to treat infestations. A decision Matrix for treatment options under Alternative 3 is displayed in Figure 2. Most weed populations along roadsides and within administrative sites would be treated with herbicides where manual control has been ineffective. These sites would be posted before and after treatment (see Mitigation Measures).

Early Detection Rapid Response would be a part of this alternative. A total of 3,000 additional acres could be treated under the life of this Environmental Assessment. Within riparian 50 foot buffers, there would be a cap on the number of acres that can be treated per 6th field watershed: no greater than 10 contiguous acres and 1.5 miles along a river corridor would be treated yearly.

New sites would be analyzed by an Interdisciplinary Team to ensure that proposed treatments are consistent with Project Design Criteria and that they need no additional surveys or mitigation measures. New sites would be published in the newspaper to inform the public as part of our annual announcement of treatment areas.

Figure 2. Example of a Decision Matrix for Weed Control Under Alternative 3

1. Is the weed population small (< 50 plants) and manual control effective?
   - Yes………………………………………………… Manual
   - No…………………………………………………. 2

2. Is the site known for culturally used plants?
   - Yes………………………………………………….. Manual
   - No…………………………………………………… 3

3. Are you dealing with established weed infestations that can be reduced in biomass using mechanical means or is your goal simply to stop seed set?
   - Yes……………………………………………… …….. Mechanical with PDC for TES birds and Arch sites; no mechanical treatment in Wilderness
   - No……………………………………………..……… 4

4. Is the site within a riparian buffer zone? (within 50 feet of water)
   - Yes…………Is your site 0-10 feet from the bank? …..... Manual , Inject with Glyphosate, or Wipe with Glyphosate or Imazapyr
   - …………Is your site 10-50 feet from water?.............. Manual, Mechanical, Inject with Glyphosate, or Backpack or wipe with Glyphosate or Imazapyr
   - No……………………………………………….……. 5

5. Are there TES species or habitat?
   - Yes……………………………………………………. Manual or follow PDCs for Botanical or Fisheries resources with herbicide use
   - No…………………………………………………… 6

6. Is the soil permeable and near a high water table?
   - Yes…………………………………………………….. Manual , Mechanical, Spot spray with all chemicals except clopyralid
   - No…………………………………………………….. 7

7. Choose the method that is most effective. This will probably be herbicide treatments followed up by manual control of plants missed. Use the herbicide that is most specific for the species you want to eradicate. For example, clopyralid is highly effective on knapweeds. Sethoxydim is grass specific so it would be a good choice to use on a grass like false brome where there is a competing stand of vegetation.

Monitoring would be an integral part of this alternative. There would be annual reviews of new sites proposed for treatment. If sites are treated with herbicides, we would follow up with manual control (at least of flowering heads) and monitoring effectiveness late in the season for at least the sites along major highway corridor and major road systems (20% of all sites). For sites where access is more difficult, we would use the comparison of herbicide being applied per site as a measure of effectiveness from year to year.

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.

Alternatives Considered But Eliminated from Detailed Consideration

There were several control methods that were discussed but eliminated from detailed consideration. Biological control was considered as a method to be discussed under the Alternatives. The current Willamette LRMP standard and guideline FW 259c reads, "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." This standard was consistent with new direction (Standard 14, R6 ROD, USDA2005a), so a decision was made not to include this treatment method in the analysis.

Prescribed burning was also considered as a control method to be discussed under the Alternatives. However, the use of prescribed burning is rarely only for noxious weed treatment; it is used to reduce fuels, to stimulate wildlife forage, to emulate natural disturbance regimes. The specific places where weeds may be treated with prescribed burning have not been delineated, so it would be impossible to conduct site-specific analysis on them. The Team felt that this control method was better treated in environmental analyses when prescribed burning projects are proposed.

The Deciding Official deemed aerial herbicide application not an option in this analysis due to potential adverse effects on water resources. The ID Team discussed the need for boom spraying and decided that we wanted to be as conservative as we could with our herbicide treatment methods and that boom spraying, having a greater potential for drift than hand-held spray methods, was not necessary.

Many other herbicides were available for use under the R6 ROD. The Team analyzed the new and potential invader weeds on the Forest and looked at the list of herbicides available and their environmental effects, and chose the herbicides that would be most effective on the target weeds with the least environmental effects. If a herbicide were to become available that was less environmentally hazardous while being equally or more effective on our target weeds, we would conduct a supplemental analysis and potentially add it.

Project Design Criteria (Mitigation Measures) Common to All Action Alternatives

In response to public comments on the proposal, mitigation measures were developed to ease some of the potential impacts the various alternatives may cause. The mitigation measures may be applied to any of the action alternatives.

Herbicide Application

1. Herbicides will be used according to label instructions.

2. Herbicide use will comply with standards in the *Pacific Northwest Regional Invasive Plant Program – Preventing and Managing Invasive Plants* FEIS (2005), 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 herbicides. 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 herbicide containers and rinse water will be disposed of where they will not cause contamination of waters.

5. No more than daily use quantities of herbicides shall be transported to the project site.

6. Equipment used for transportation, storage, or application of herbicides 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.

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 herbicide 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 between a USDA Forest Service weed coordinator and the lead contractor or employee and documented to 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. Mechanized spraying equipment should remain on roadways, trails, parking areas or other disturbed areas to prevent damage to vegetation and soil, and potential degradation of water quality and aquatic habitat.

12. All water bodies, campgrounds, wetlands and meadows as well as roadsides will be clearly marked in the field at least one week prior to and following application of herbicides in a project area.

13. To minimize herbicide 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

14. Public notice of proposed herbicide applications locations will be published in the local papers one month in advance of herbicide application (Standard 23)

15. Administrative sites and developed campgrounds will be posted or closed in advance of herbicide application, normally 3 days, to ensure that no inadvertent public contact with herbicide occurs. All roadsides and trailhead parking lots will be posted at least one week in advance and after application of herbicides to provide advanced notice to the public.

Botanical Resources

16. Surveys for Botanical Species of Concern (Region 6 sensitive and Survey and Manage) shall be completed 100 feet from herbicide 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.

17. Where an invasive plant species is to be treated within 3 feet of a sensitive plant species (non-rhizomatous only) or within 5 feet of a sensitive non-vascular species, the invasive plant should be either manually treated (for perennial species, as close to all of the roots as possible) or herbicide application should be hand-wiping. Use a non-leaching herbicide such as glyphosate, to ensure herbicide is not taken up by roots of sensitive plant.

18. When using selective/hand herbicide treatment methods, reduce further invasive plant invasions on the sites by protecting non-target vegetation when possible.

Water Quality, Aquatic Organisms

19. Herbicides will not be applied within 50 feet of a class 1-4 stream, pond or wetland (Alternative 2 only).

20. Glyphosate may be used for stem injection and plants may be wiped with glyphosate or imazapyr from 0-10 feet from bank edge. These methods plus spot spray with glyphosate and imazapyr may be used from 10-50 feet. (Alternative 3 only).

21. Where the road ditch line flows directly into surface water (e.g. stream, pond, reservoir) spray only when the ditch line is dry. Treat ditches connected to the stream network as intermittent streams.

22. Do not use clopyralid where there is a high water table and rapid soil permeability. Do not use

clopyralid, sethoxydim, or Garlon 3A in riparian buffer areas.

23. Ground-based mechanized equipment will not be allowed within 25 feet of streams, ponds, or wetlands.

24. Use erosion control measures (e.g., silt fence, native grass seeding) where de-vegetation may result in delivery of sediment to adjacent surface water. Soil scientists or hydrologists will assist in evaluation of sites to determine if treatment is necessary and the type of treatment needed to stabilize soils.

Wildlife

25. No mechanized activity within 0.25 miles, or 0.50 mile line-of-sight of a bald eagle nest site, shall occur between January 1 and August 31, unless the nest is verified to be unoccupied by the District Wildlife Biologist. Exceptions to this standard are the well-traveled state highways that bisect the Forest- Highway 20, 22, 126 and 58.

26. No mechanized activity within .25 miles , or .5 mile sight distance, of a known bald eagle communal roost, unless the roost is verified to be unoccupied by the District Wildlife Biologist.

27. Chainsaw use within 65 yards of known spotted owl activity centers or unsurveyed suitable habitat will be prohibited during the critical breeding period (March 1 to July 15) to avoid disruption of breeding owls.

28. No areas within 100 feet of a spring or seep will be sprayed with an herbicide without appropriate surveys for sensitive salamanders or mollusk as determined by the unit biologist.

Comparison of Alternatives

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

Table 5. Comparison of Alternatives.

	Alternative 1: No Action	Alternative 2: Modified Current	Alternative 3: Proposed Alternative
Acres of invasive plant habitat within 50 feet of water treated with herbicides	**None**	**None**	**3232**
Acres of TES Fish habitat adjacent to herbicide treatments	**None**	**None- PDC is 200 foot buffer**	**1552 acres**
Acres of high human use with potential for herbicide treatment	**None**	**None**	**410**
Potential for drinking water contamination	**None**	**None- No herbicide within 50 foot buffer**	**None-No application results in reaching threshold of harm**
Cost of full implementation over 10 year period	**$12,579,444**	**$ 5,775,260**	**$2,929,456**
Maximum number of acres treated with herbicides	**0**	**6058**	**9700**

Early- Detection Rapid Response	**None**	**25 new sites can be added/year**	**3000 acres can be added over 10 years, not to exceed 10 contiguous acres and 1.5 miles along a river corridor**

Chapter III: Environmental Consequences

This section summarizes the physical, biological, social and economic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. It also presents the scientific and analytical basis for comparison of alternatives presented in the chart above.

General Existing Condition

The project areas, which total 9700 acres, are found within the 1.6 million acres of the Willamette National Forest. In addition, 3000 acres of EDRR acres are being analyzed. This totals 12,700 acres or 0.8% of the National Forest. A total of 753 weed populations are being analyzed for treatment. Sites are located on the Detroit (70 sites), Sweet Home (131 sites), McKenzie River (225 sites) and Middle Fork (129 sites) Ranger Districts. There are oftem more than oone weed population per site.

The majority of weed infestations analyzed for treatment are found along road corridors, site types 1 and 2 (see Table 6). Four sites are found in wilderness and several sites are at trailheads that access them. One hundred twelve sites are within TES fish, TES wildlife or TES/Survey and Manage botanical habitats (the majority are within a quarter mile of TES bird nests which require seasonal operation restrictions for mechanical disturbance). Not surprisingly, one hundred-thirty four sites are found in recreational areas experiencing high human use, such as campgrounds, trailheads and Ranger District offices. Some forested sites have weed infestations (18 sites). Meadows and wetlands are also affected (19 sites). Many infestations encompass multiple site types such as roadside corridors that intersect with TES habitat or Bonneville Power Administration corridors with meadow habitat that cross a stream with TES fish.

Table 6. Weed Infestations By Site Type

Site Types	Number of Infestations	Acreage By Site Types
1-unvegetated roadside	375	5020
2-vegetated roadside	287	1755
3- TES or Wilderness	116	222
4- High recreation use	134	410
5-Low recreation use	9	1474
6- Forested	18	760
7- Meadow/Wetland	19	59
Multiple Site Types	126	

Treatment sites are located in a variety of land allocations and land types. Some are located in congressionally designated areas such as Wild and Scenic River corridors. One site is within a Special Wildlife Habitat and one in a Botanical Special Interest Area.

Many sites are within or cross areas with perennial or intermittent water bodies. These areas will be termed riparian buffer zones and include land adjacent to rivers, streams, wetlands, ponds and lakes. Special management considerations are defined for these riparian buffer zones under action alternatives.

Since sites are located across the Forest, conditions vary widely. Vegetation ranges from the Douglas fir plant series, through the western hemlock plant series to the true fir and subalpine habitats found along roadsides in the Willamette and Santiam Passes. Annual precipitation is usually concentrated in the fall, winter and spring. Percent slope varies from flat to 70 percent.

Invasive Plant Species and Infestations

The Integrated Weed Management program on the Willamette National Forest focuses on a select group of weed species because of the threat these species pose to healthy native plant communities and ecosystems that in turn affect water quality, wildlife and fish habitat and recreational experiences. A total of forty invasive plant species are targeted for treatment (Table 1). The most common **new invader** species are knapweed (130 sites), false brome (146 sites), and blackberry (196 sites). These species along with Japanese knotweed are the highest priority for treatment because they have the greatest ability to alter our native ecosystems:

Spotted, Meadow and Diffuse Knapweed (*Centaurea maculosa, C. pratense and C. diffusa)*: These knapweed species are like dandelions in that they have plumed seeds that are easily transported. Knapweeds are Eurasian in origin and may be found in commercially available wildflower seed mixes. They have a basal rosette and pink or white flowers. They can grow in dense monocultures and although they are mainly restricted to disturbed roadsides, can adversely affect plant diversity in drier meadow habitats. Seed is transported on vehicles, so populations are found along roadsides, and in dispersed campsites, trailhead parking lots, campgrounds and timber sale landings (popular hunting camp sites). Populations are found along all of the major highway corridors that run though the forest (highways 22, 20, 126, and 58) and these highway corridors make up a significant portion of the acreage being analyzed. Populations are scattered along the highway corridors, so the acreage being treated is significantly smaller than that being analyzed. Some large populations are also found in BPA and EWEB powerline corridors. Knapweeds are deep-rooted perennials; scattered plants may be manually controlled, but larger populations require application of herbicides to eradicate.

False Brome (*Brachypodium sylvaticum)*: False brome is a perennial grass species of Eurasian origin. It has short bunches of bright green leaves that persist into fall and early winter. False brome can quickly become the dominant plant species in forest understories and in streamside corridors, demonstrating both shade-tolerance and moisture tolerance. On the McKenzie River District, we have documented this species presence along skid roads in sixty year old commercial thinning stands. Large infestations occur in the Fall Creek watershed of Middle Fork District, in the Foley Ridge and HJ Andrews Experimental Forest on McKenzie Ranger District and in the Wiley and Moose Creek watersheds of Sweet Home Ranger District. The species moves along road corridors by being deposited from the undercarriages of vehicles or by foot traffic. Once established, false brome is spread by road maintenance equipment. From the road shoulder, the species can move into forested stands, especially those with openings such as thinned timber sale units. Luckily seed is short-lived, so treatments for 3 years or less can exhaust the seed bank. Small populations may be manually controlled but large populations require herbicide application to eradicate because the populations, once established, can grow exponentially in short periods of time.

Himalayan and Evergreen Blackberry (*Rubus procerus* and *R. laciniatus)*: Blackberry plants are ubiquitous throughout western Oregon and are found in significant numbers in streamside corridors at lower elevations. They create monocultures of thorny thickets. Most populations of blackberry are considered established infestations and the WNF strategy is to contain these. Small outlier populations may be proposed for treatment using spot spray herbicide applications to make sure they do not spread to higher elevations. These populations are mostly along roads. Some established populations are proposed for treatment via mechanical and follow up spot herbicide treatments in powerline corridors where the aim is to create wildlife forage habitat.

Japanese Knotweed (*Polygonum cuspidatum*): Japanese knotweed is a perennial weed that grows 4-9 feet tall and features creeping rhizomes. It typically grows in streamside habitats, creating a monoculture that excludes even tree seedlings. It is a species of Eurasian origin and was planted as an ornamental. Infestations on the Willamette come from root fragments from upstream populations (Westfir and Oakridge areas) and from lawn clippings illegally dumped in the forest. Only six infestations are documented on the Willamette NF.

Manual control has been shown to be ineffective at sites in the Middle Fork Ranger District and other sites throughout the Pacific Northwest. A new technology of injection of herbicides into the stem has shown 85% effectiveness at sites in the Sandy River watershed. Application of backpack spot spray of herbicide for small stems increased eradication rates to 95% (Soll et al., 2003). Miller (2004) found similar rates of reduction, 84-95%, with Glyphosate (Aquamaster formulation) injection and foliar spray with imazapyr (Habitat formulation).

Rate of Spread and Mechanism of Infestation

Invasive plant populations increase in acreage at an estimated rate of 8 to 12 percent per year on National Forest System lands in the United States (USDA Forest Service, 1999b), which means the invasive plant infestations will continue to spread on the Forest and on adjacent federal, tribal, county, and state lands if they remain unchecked. Most of the invasive plant infestations (95% of inventoried acreage) are in disturbed areas. The mechanisms of spread for invasive plants include natural vectors such as birds, insects, or wildlife, and natural forces, such as water and wind. Wind and water in particular, are major natural dispersal agents. Disturbance-based vectors are also mechanisms of spread for invasive plants. Invasion and dominance by invasive plants is highly correlated with soil disturbance, but are not limited to disturbed areas (Cox, 1999). Invasive plants readily invade, occupy and dominate conifer plantations, road prisms, trails and trailheads, mined sites, gravel pits, river corridors, wildlife wallows and bedding areas, and rangelands. Many invasive species also establish in naturally occurring small openings. Section 3.1 of the Region 6 Invasive Plant FEIS (2005a) describes the many vectors for invasive plant spread, including timber and other vegetation management activities, roads management, livestock grazing, fire and fuels management, recreation and recreation management, and minerals and mining. Prevention standards have been estimated to reduce the spread by 50% (USDA, 2005a)

Herbicides, Adjuvants, Surfactants and Inert Ingredients

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 7 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 7: 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
Clopyralid	December 5, 2004	SERA TR 04 43-17-03c
Glyphosate	March 1, 2003	SERA TR 02-43-09-04a
Sethoxydim	October 31, 2001	SERA TR 01-43-01-01c
Triclopyr	March 15, 2003	SERA TR 02-43-13-03b
Imazapyr	December 18, 2004	SERA TR 04-43-17-05b

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 8.

Table 8. Typical Application Rates for Herbicides (Taken from Region 6 Invasive Plant FEIS, page 4-2).

Herbicide	Typical Rate lbs. active ingredient/acre
Glyphosate	2.00
Clopyralid	0.35
Imazapyr	0.45
Sethoxydim	0.30
Triclopyr	1.00

Appendix F lists the hazards of each herbicide proposed for use and the project design criteria meant to address those hazards.

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.

Ownership Patterns

Ownership patterns within the boundaries of the Forest are predominately National Forest System lands (94 %). All Fifth Field Watersheds containing treatment areas have mixed ownership patterns (See Figure 1, Map of Willamette National Forest).

Limited information on invasive plant treatments and herbicide use are known on the other ownership lands in all watersheds. As the mixed ownership indicates, invasive plants could very easily spread from the Forest to other ownerships and vice versa, which would continue to contribute to the problem of invasive plants. This concern is the most predominant in the watersheds located primarily on the west side of the Forest, where ownership intermingles with privately-owned timberlands.

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 .5 acre of Picloram using .0004 pounds active ingredient in 2006 in Linn County.

The Counties bordering the National Forest also use herbicides. Lane County applied 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 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.

Vegetation and Treatment Effectiveness

Existing Conditions

In the long-term, the threat from invasive plants to native plants and native plant habitats is greater than effects from invasive plant treatments. Invasive plants have the ability to deplete nutrients and water in the soil to levels lower than native plant species can tolerate, allowing invasive plants to displace native vegetation (DiCastri, 1990). Many invasive plants are early successional species, meaning they colonize areas that have been recently disturbed. Since invasive plants have the ability to deplete available resources to lower levels than native vegetation can tolerate, they can quickly dominate disturbed sites. When invasive plants dominate native plant communities, native plant species diversity is decreased. Invasive plants can out-compete native species because they produce abundant seed, have fast growth rates, have no natural enemies, grow vegetatively through rhizomes that confer a reproductive advantage and are often avoided by large herbivores. Some invasive plants also produce secondary compounds, which can be toxic to native plant species or animals. Weed infestation can therefore lead to a decrease in native plant species, which can alter the ability of wildlife to find suitable edible forage.

From a broad ecological standpoint, invasive plants alter native plant communities and ecosystems, cause a loss in biological diversity of plants and animals (loss of habitat and food), lead to ecosystem-level changes that affect soil and water, and at the landscape scale can even displace entire native communities with monocultures (e.g., false brome, Japanese knotweed) (D'Antonio and Vitousek, 1992; Vitousek, 1986).

Invasive plants tend to colonize disturbed ground, including roadsides, utility (powerline) corridors, quarries, landings, recreational residences, trails, and campgrounds where vegetation has been removed and growing space for plants adapted to disturbance has been created, but also can invade undisturbed habitats. Roads are conduits for the spread of invasive plants, providing vectors for dispersal (e.g., seeds and vegetative reproductive parts of plants attached to vehicles) and disturbed ground for invasive plant colonization and establishment. Timber harvest, road building, and other ground disturbing management activities occurring on the Forest all contribute to the establishment and spread of invasive plants.

Direct/Indirect Effects

Alternative 1 – No Action Alternative

The No Action alternative would have a long-term negative impact on the native flora on the

Forest. Because only prevention measures, manual and mechanical control will be instituted, it is estimated that weed populations will increase at approximately 5 % per year. In the case of some species such as Scotch broom, thistles and tansy that are found in timber harvest units (site type 6), the overstory will eventually shade them out and plants will die. On road shoulders that are brushed and maintained (site types 1 and 2) and powerline corridors (site type 5), these species will continue to thrive. Shade-tolerant and riparian species such as false brome, knotweed and blackberry, will continue to invade unique habitats such as meadows (site type 7) and streamside corridors as well as the timbered landscape (site type 6).

Prevention activities would help to curb new infestations, but are not expected to affect the 500+ established weed infestations that will continue to grow in size approximately 5% per year (prevention guidelines are estimated to reduce growth from 8-12%/year to 5% per year, USDA, 1995b).

Treatment Effectiveness

Generally, species that are annuals or biennials can be effectively treated manually if the populations are small (1-25 plants). It is important to remove most of the root and not break off the plant at the soil surface since it can resprout and still flower later in the season (e.g., spotted knapweed, knotweed). Moderate to large infestations of invasive plants, however, are difficult to treat manually or mechanically because of treatments needing to be repeated over many years, the high likelihood of plants reproducing from vegetative parts (e.g., rhizomes, root fragments, stolons), and dormant seeds remain viable in soils for many years. Some species like spotted knapweed will flower after mowing plants in the bud stage.

Some small populations of the following species can be eradicated through manual means:

- Spotted knapweed (biennial or short-lived perennial) can be removed by digging up plants, as long as the entire root crown is completely removed.
- Diffuse knapweed (biennial or short-lived perennial) can be hand pulled successfully if done before seed set, and if done several times in one year during its growing season treating the rosette, immature, and mature plant stages.
- Houndstongue (biennial or short-lived perennial) can be reduced up to 85 percent with handpulling, if roots are completely removed. Severing the root crown 1 to 2 inches below the soil surface and removing top growth could be effective with small populations when done before flowering. New plants can sprout, however, from seeds stored in the seedbank.
- St. Johnswort (taprooted perennial) may be treated effectively by handpulling or digging of young plants, but repeated treatments are necessary because new plants can grow from the “runner” root system (lateral roots). Plants can also sprout from seed.

- Tansy ragwort (biennial or short-lived perennial) can be treated effectively by handpulling or mowing small populations. The perennial form of this plant often has large woody rootstocks and more than one flowering stem, complicating removal. Seeds could also remain viable in the soil for many years.

For many invasive plants, including those listed above, effective manual or mechanical treatment is difficult regardless of the size of the population. For example, manual treatment is not recommended for Japanese knotweed because digging out its rhizomes, in addition to being extremely labor-intensive, tends to spread rhizome fragments, which could produce new plants. Meadow knapweed is difficult to pull out because of its tough perennial root crown. Himalayan blackberry could be dug out but requires removal of the massive root crown and a large workforce to do it.

Dramatic takeovers of native plant communities along stream and river corridors by knotweed have already occurred in northwestern Oregon (Soll, 2004). Invasions have resulted in the loss of wildlife and fish habitat, decreases in species diversity and reduction in the available water supply (Weston et. al., 2005). Knotweed canes (woody stems) could be cut by hand (manually) or with a machine (mechanically) to set the plant back and curtail the spread of individuals and populations; however, these resilient plants grow back quickly after cutting (within weeks). It is estimated that cutting would need to occur once a month through the growing season to reduce underground biomass (Seiger and Mercant, 1997). To eliminate knotweed manually or mechanically, the entire plant must be carefully dug up and removed without leaving any rhizome fragments. Otherwise, the plant could survive, regenerate, and eventually reproduce (Seiger and Merchant, 1997; Weston et al., 2005).

In the MacDonald-Dunn Forest near Corvallis, Oregon, false brome has taken over the forested understory, riparian areas and meadows with ESA listed plants and butterflies (Morre, 2003). False brome is most prevalent on skid roads and roadcuts (Dexter et. al. 2001). On average, native species diversity has decreased by 64% due to competition with false brome (Morre, 2003). In places within the Forest, there is little to no evidence of the former native plant communities because the false brome creates a monoculture. It has also invaded undisturbed meadows and is an excellent competitor with our native grassland species. Herbicides are being used to contain infestations of false brome at the MacDonald-Dunn Forest because other methods have been ineffective. (OSU College of Forestry, 2005).

Knapweeds are also highly invasive and reproduce by seed. Knapweeds within the Forest include spotted, diffuse, and meadow knapweed. They produce abundant seed that can remain viable for many years in the soil. Seeds can be dispersed up to three feet from plants and much farther when attached to vehicles and trains (Mazzu, 2005). Manual treatment (handpulling) could be effective for small populations of spotted and diffuse knapweed, but manual treatment for meadow knapweed is difficult due to the species' tough perennial root crown. Repeated mechanical treatment (mowing) of spotted knapweed and meadow knapweed could be moderately effective, but mechanical treatment may actually increase populations of diffuse knapweed. Mowing of spotted knapweed on the Forest has resulted in resprouting of plants that produce flowers lower than the mower blades can reach.

An analysis was conducted to determine how many acres of land would be infested by weeds after 10 years under this Alternative. The population starts at 10,000 acres. Treatment effectiveness using manual, mechanical and prevention is estimated at 25% reduction per year. Those plants that are not eradicated will grow 5 % in size (because prevention has cut weed expansion rates from an average of 10% to 5%). The result is a theoretical reduction after 10 years to 769 acres, if all acres are treated every year (Table 4).

Native Plant Communities

Invasive plant infestations disrupt ecosystem function and process which have evolved over time in native plant communities and set in motion changes that compromise and degrade healthy native ecosystems. Table 3-5 in Invasive Plant FEIS (USDA Forest Service, 2005a) provides a more substantial list of effects of invasive plants on ecosystems. A severe invasive plant infestation could displace an entire native plant community (e.g., a westside riparian plant community replaced by knotweed or a forested understory overtaken by false brome) with dramatic negative repercussions for native plant and wildlife species, including fish, which are dependent on the environment created by a community of native plants.

Manual or mechanical treatment of invasive plant infestations could negatively affect native plants and plant communities. Direct effects would be unintentional removal or trampling of flowers, fruits, or root systems of native plants (USDA Forest Service, 2005a). Other direct effects would be reduced plant vigor due to plants being damaged, reduced native seed production, soil disturbance, and canopy removal (understory, shrub layer, or overstory depending on the species). Indirect effects brought about by these direct effects could include microsite shifts such as reduction in productivity, reduction in soil moisture, increases in bulk density (compaction), disruption of mycorrhizal connections, and increase in soil temperature (USDA Forest Service, 2005a). These effects could produce a shift in species composition further away from a native community, and the removal of one invasive species could encourage another invasive species to take its place via windborne seeds or human transport (USDA Forest Service, 2005a).

Effects on Riparian Vegetation from Herbicide Use

One of the issues identified during scoping was potential adverse effects on riparian habitats due to the use of herbicides. No herbicides will be used in this alternative, so there will be no effect on riparian habitat as a consequence of herbicide use. However, native riparian vegetation will be displaced by invasive weeds under this alternative so that there would be a long-term negative effect on riparian vegetation under this alternative.

Alternative 2: Current Program

Treatment Effectiveness

Under Alternative 2, treatment effectiveness would be greater than the No Action Alternative but less than Alternative 3. Integrated weed management, a combination of invasive plant treatments, including herbicides, is considered more effective for moderate to large populations than using a single method. Repeated manual treatments may be effective for controlling and containing some invasive species, but for highly invasive species and for larger populations, herbicide treatment may be the most effective and practical means. Manual or mechanical treatments are ineffective and often highly difficult and expensive for moderate to large populations of invasive plants that could reproduce by seed or vegetatively by stolons (e.g., hawkweed species), rhizomes (e.g., hawkweed species), or root fragments (e.g., Japanese, giant and Himalayan knotweeds).

Under this Alternative, only upland areas (> 50 feet from water) may be treated with herbicides and no areas of high human use such as campgrounds or trailheads may be treated. Herbicides are often the only known effective way to control, contain, or eradicate invasive plant species that could reproduce from vegetative fragments. For example, herbicide treatment with aquatic glyphosate is the only effective way to treat all but small populations of knotweed species due to their ability to produce extensive rhizomes that could reach 50 to 65 feet in length and to reproduce from root fragments. Without the option to treat infestations of invasive plants with a combination of techniques, infestations of riparian invasives such as knotweed and false brome would continue to expand and new populations would become established across the landscape, reducing or displacing native vegetation, habitat for wildlife and fish, and forage for native ungulates and grazing livestock.

This Alternative has the potential to leave weedy riparian corridors and weedy areas where there is high human use. Preventing movement off-site could prove difficult as campgrounds and trailheads do not have washing stations for vehicles that can pick up weed seed. In wet years, floods can pick up false brome seed and knotweed stem fragments and transport them downstream.

Because of the cap on the number of sites that can be added under EDDR (25/year), the backlog of sites would result in many plant communities remaining at risk from further invasion. Over 300 weed infestations have been allowed to go untreated because there is no way to add them to the treatment schedule.

Under this Alternative, reduction of weed infestations was modeled. It was assumed that only manual controls would occur in riparian areas (2323 of the total 10,000 acres) and that reductions would be similar to the No Action Alternative (25% reduction plus 5% growth for remaining population). For the upland sites that are allowed to be sprayed with herbicide, it was assumed that there would be an 80% reduction with herbicides with a 5% growth for the remaining population. The result is that after 10 years, there would be 232 acres of weeds remaining, most of which would be riparian (Table 4).

Native Plant Communities

Although it has been noted that manual or mechanical treatment of invasive plant infestations could negatively affect native plants and plant communities (see discussion under No Action), the most probable direct effect to non-target vegetation is through unintended effects if herbicides on non-target plants through direct deposition, spray drift of herbicides or movement in soil or water. Under this Alternative, glyphosate, a non-selective herbicide and triclopyr, a selective herbicide for broadleaf plants, can be used in upland sites, 50 feet from water.

Although glyphosate remains bound in the soil, there is a risk that triclopyr can move through the soil profile in areas with high rainfall rates (SERA, 2003b).

Translocation of herbicide between rhizomatous same-species individuals, or from plant-fungi, rootlet-mycorrhizal interactions can also result in herbicide movement. The result may include mortality, reduced productivity e.g., physiological, structural, and abnormal growth (R6 2005 FEIS Chapter 4.27). Effects, such as mortality, brown spots, and chlorotic coloration, may not be immediate, and may become apparent months later.

Herbicides have the potential to shift species composition and reduce diversity of native plant communities, as less herbicide-tolerant species are replaced by more herbicide-tolerant species. The type of herbicide and the application method may also affect plant pollinators. A reduction or shift in pollinator species could also lead to changes in plant species composition or diversity (R6 2005 FEIS Chapter 4.27). For example, the repeated use of triclopyr, a broadleaf selective herbicide, might shift the species composition resulting in a reduction of woody vegetation and an increase in the herbaceous and grass component.

Native plants in treatment areas could be killed with the potential for short-term or even longer-term changes in the composition of native plant communities. It is expected, however, that native plants would return to occupy growing space released by killed plants. Boateng et. al (2000) studied the change in forested plant communities following spot spray treatments with glyphosate and found that no significant differences in plant community structure or diversity could be detected after 12 years. Active restoration, such as seeding with native or non-native, non-invasive grass species or planting with native trees, shrubs, or herbs, would insure that the released growing space is occupied by native species and not allowed to be re-colonized by invasive plants.

Under this Alternative, there is moderate selectivity in herbicides. Triclopyr is selective on broadleaf species, so it will not damage non-target grasses.

Several mitigation measures are in place to ensure that risk to non-target vegetation remains small, localized and short-term. Spot and hand application methods substantially reduce the potential for loss of non-target vegetation because there is little potential for drift. A study of the effects of herbicide spray drift on non-target species examined the distances drift affected non-target vascular plants using broadcast treatment methods similar to those considered in this EA. Their observations are consistent with drift-deposition models in which the fallout of herbicide droplets has been measured. The maximum safe distance at which no lethal effects were found was 20 feet, but for most herbicides the distance was 7 feet (Marrs, 1989). Droplet size is key to drift as larger droplets are heavier and therefore less affected by wind and evaporation. Spray units will be calibrated for low nozzle application so that herbicides can be applied as a coarse spray. Herbicides will not be applied if wind speed is greater than 10 miles per hour (PDC-9). Unintentional spray will be mitigated by having sprayers well-versed in target weed identification (PDC-10).

Effect on Riparian Vegetation from Herbicide Use

Areas adjacent to streams, ponds and wetlands will be buffered from herbicide use by 50 feet under this Alternative. It is expected that PDCs such as treatment methods include only wiping and spraying from backpacks and trucks with hand-held wands, using calibrated spray equipment to ensure accurate delivery (PDC 4), using low nozzle pressure and deliver as a coarse spray to reduce drift (PDC13) will mitigate drift into riparian areas. Some highly sensitive plants could be directly affected by the nonspecific herbicide allowed under this alternative, glyphosate, but this is expected to be very infrequent.

Alternative 3

Treatment Effectiveness

Alternative 3 is the one that responds best to treatment effectiveness while reducing the potential effects to non-target species. Under this alternative, riparian corridors (within 50 feet of water) can be treated with Glyphosate or Imazapyr using a variety of methods (injection, wand, and backpack sprayer). It will allow for successful eradication of knotweed and false brome along riparian corridors, alleviating the potential for downstream movement via these species propagules.

Alternative 3 will also allow for treatment of weed infestations at campgrounds, trailhead parking lots and boat launches that have not been successfully eradicated using manual control methods over the past 5 years.

The addition of Clopyralid (Transline) will allow for treatment of spotted knapweed in upland areas where there is little chance of off-site leaching. It will be used to target species within the Aster family. This Alternative will allow for the treatment of false brome in upland sites with Sethoxydim (Poast) where there is little chance of runoff. This will allow treatment of false brome where competing broadleaf species are located, as it is a grass-specific herbicide. And it will add the herbicide imazapyr (aquatic label, Habitat) to the list of available herbicides. This chemical has been shown to be more aggressive in the treatment of Japanese knotweed than glyphosate (J. Soll, pers. comm.). All of these chemicals are used in much smaller amounts than glyphosate and triclopyr.

Reduction of weed infestations was modeled for this Alternative. For all sites, riparian and upland, it was assumed that there would be an 80% reduction with herbicides with a 5% growth for the remaining population. The result is that after 10 years, there would be 0.6 acres of weeds remaining (Table 4).

Native Plant Communities

The effects on native plant communities could be up to 30% higher under Alternative 3 because this much more of the infested acreage could be treated with herbicides. Effects would be similar in upland communities. Some non-target plants could be killed by herbicide drift or direct contact in riparian communities. This will be minimized by herbicide application methods (stem injection, wiping and backpack sprayer only).

Sethoxydim, clopyralid and imazapyr all have the ability to leach through the soil in areas with high rainfall. Clopyralid is not tightly bound to the soil but is rapidly metabolized by microbes (SERA, 2004a). Sethoxydim and clopyralid are taken up by leaves but Imazapyr can be taken up by leaves or absorbed through the roots. To avoid potential adverse indirect effects to plants in the vicinity of herbicide spot treatments, mitigation measures include the restriction on use of clopyralid, sethoxydim or imazapyr where there is a high water table and rapid soil permeability (sand, cobble). PDCs ensure that imazapyr should not be used in a backpack sprayer within the 50-foot buffer to avoid potential soil contamination.

Selectivity of an herbicide refers to it being selective for particular kinds of plants, whereas the ability to damage a broad spectrum of plant species makes an herbicide non-selective. The additional herbicides proposed for use in this Alternative are more selective, damaging fewer desired natives. Clopyralid is selective for plant species in four plant families. Sethoxydim is selective for grasses and not other broadleaf plants.

Effects on Riparian Vegetation from Herbicide Use

Under Alternative 3, invasive plants in riparian areas can be treated with herbicides. This accounts for approximately 3232 acres (See Table 5) out of 9700 total acres being analyzed. As in Alternative 2, PDCs are designed to reduce any adverse effects to riparian vegetation which, in turn, provides habitat for riparian species. Herbicide application methods are confined to stem injection, wiping and backpack spraying. All of the PDCs regarding reduction of spray drift through calibrated machinery and large droplet size are applicable. Wiping and injecting are not expected to affect any adjacent vegetation, but backpack spray can drift. Some adjacent vegetation could be directly affected by contact with either of the two herbicides allowed in the riparian zone- glyphosate or imazapyr. Direct effects are expected to be small, localized and of short duration. In the long-term, the beneficial effects of this alternative will be greatest to riparian vegetation as invasives will be removed and replaced by desired natives that can function as habitat and food for riparian-dependent species.

Cumulative Effects

No Action Alternative

Under the No Action Alternative invasive plant infestations would persist, expand, and spread over time within the Forest because most of the new invader species cannot be effectively controlled with prevention and manual/mechanical control methods. Acker and Dewey (2005) suggest that annual rate of weed increase on western federal lands is 10-15% on 9700 acres of the Willamette NF.

Other invasive plant species, not currently known to be within the Forest, would become established. Native plants, including special status plants, may be lost as native plant communities are negatively altered or displaced. High priority invasive plant sites would continue to increase in size over time. Examples include the following:

- Increasingly more riparian corridors would come under threat of knotweed infestations since herbicide treatment with stem injected glyphosate is the only proven way to control this highly invasive species. Except perhaps in the case of very small populations (containing only a few individuals), manual treatment of knotweed is ineffective. Manual treatment may actually be a drawback since it could facilitate the spread of knotweed downstream because of knotweed's ability to regenerate and reproduce from root fragments.

- More forested understories and riparian corridors would be at risk to loss from competition with false brome because the only way to eradicate large populations of this species is through herbicide treatment. Manual control may be effective on small populations but seed banks would ensure the need for repeated manual control.

Action Alternatives

While some adverse effects on non-target vegetation are possible from herbicide treatments considered in the action alternatives, they are unlikely to be significant because the extent and threats posed by treatment are generally very small and localized. Project Design Features for herbicide application such as application method, location, equipment and timing mitigate known risks. The development of restoration plans for sites over the long term ensures that duration of effects will only be small-scale and short-term. Thus, there are no cumulative effects anticipated from herbicide treatment.

However, there could be cumulative effects to riparian vegetation under Alternative 2 because the most effective treatment methods would not be available for use in these areas. Currently 3232 acres of riparian habitat are infested by new invaders. This number could increase by 10-15% per year in the future if populations are not treated in the most effective manner (Acker and Dewey, 2005). This would result in the additional displacement of native riparian vegetation with undesired weed species. Under Alternative 3, the most effective treatment method would be used on invasive weeds in riparian areas and restoration activities would follow. This will result in an overall reduction of invasive in riparian areas- no cumulative adverse effect.

Soils

Existing Conditions

Soils across the 9700 acres being analyzed in this EA are quite variable. They range from stream terraces in the valley bottoms, to colluvial veneers on steep volcanic side slopes, to upland benches and flats that resulted from glacial growth and retreat. Each soil has its own set of productivity factors as well as numerous management ratings such as erosion risk and compaction hazard. Generally, all soils in the proposed treatment areas on the Forest, once disturbed, tend to be susceptible to establishment of the invasive plant species listed in Table 1. Both riparian areas and uplands have been impacted by the invasion of non-native plants. Although they provide some groundcover, many invasive plants generally tend not to have the fibrous root system found in many native grasses and forbs. Fibrous root systems tend to provide more effective erosion control compared to tap-rooted plants, such as knapweed species. The major exception to this is Japanese Knotweed, which produces an extremely fibrous, difficult to eradicate root system.

One function of soil is the cycling of nutrients from dead organic matter into forms that are available to plants. This nutrient cycling is essential for the health and productivity of the ecosystem. Nutrient cycling is a complex process that depends on a multi-level food web that is specific to the site. Biota involved in nutrient cycling includes bacteria, actinomycetes, fungi (pathogenic, saprobic, and mycorrhizal), amoebas, and a wide range of invertebrates. Since this entire system is powered by root exudates and decomposing vegetation from the plant community, changes in plant communities caused by non-native invasives could have effects on the native soil food web (Hobbie, 1992; Van der Putten, 1997). Some invasive plants are allelopathic to other plants, and may produce secondary compounds that affect soil organisms. If an invasive plant produces a secondary compound, the population of soil microbes that could metabolize this compound would increase, while the populations of other microbes would decrease (Sheley and Petroff, 1999). These changes would affect the soil food web and nutrient cycling, and may have impacts on the native plant community.

One group of soil organisms that is of particular concern is mycorrhizal fungi. These fungi form a mutualistic relationship with plants in nearly all ecosystems and are critical in supplying water and nutrients to plants, as well as protection from root pathogens. Research on the impact of invasive plants on mycorrhizal fungi is lacking, but since plants and mycorrhizal fungi are strongly dependent on each other, it seems likely that drastic changes in the plant community caused by the invasion of non-natives would be accompanied by changes in the mycorrhizal fungus community. Sylvia and Jarstfer (1997) compared the mycorrhizal status of young slash pines (*Pinus elliottii var. elliottii*) in plots with invasive plants and plots that were kept invasive plant free with herbicide treatment. After 3 years, the number of pine root tips colonized by mycorrhizal fungi was 75 percent lower in the invasive plant plots than the invasive plant free plots.

Analysis Area, Applicable Standards and Guidelines, and Concerns

The analysis area for soils in this environmental assessment is the 9700 acres of weed treatment within the Willamette National Forest boundary. Willamette Forest Plan standards and guidelines FW-079 to FW0-86 (those that apply to maintaining soil productivity, limiting erosion and maintaining nutrient cycling) will apply for this analysis. Private lands within the Forest boundary are subject to Oregon Department of Forestry rules. A relative comparison of alternatives will be conducted using forest plan standards and risk of herbicide leaching as guidance to address specific concerns and as a basis for risk of subsequent impacts such as sedimentation and impacts to aquatic organisms. The main concerns for this analysis include the following:

<u>Erosion Hazard:</u> Possible impacts include soil erosion from disturbance caused by mechanical equipment, and erosion from bare soil areas. Bare soil area can result from the loss of ground cover with the removal of undesirable plants, or denuded areas that are created by the spread of invasives that do not provide suitable ground cover. This hazard rating is based upon the potential for soil movement into nearby watercourses.

<u>Soil Productivity:</u> Poor or non-functioning soil biological systems may lead to difficulties in revegetation efforts, or decline in existing desirable vegetation. Soil biology is extremely difficult to evaluate because of infinitely complex interactions occurring between organisms and their physical environment, including soil physical and chemical characteristics, microclimates, and disturbance history. It is assumed that soil biological systems would properly function over time when the appropriate habitat components are present and soil is not compacted from management activities.

<u>Leaching Risk:</u> Existing forest plan standards do not directly discuss this concern. However, using a combination of soil and herbicide characteristics with existing scientific studies there is sufficient information to compare this risk by the type of herbicide proposed. There are two aspects regarding leaching and herbicides – the potential to contaminate groundwater (i.e. wells), and the potential to contaminate surface water through groundwater movement into streams, springs, etc.

This analysis is *risk-based*; the relative *risk* of erosion occurring may be higher with one alternative versus another.

<u>Direct/Indirect Effects</u>

Alternative 1 – No Action

Erosion Hazard: Alternative 1 does not mean that the control of invasives would stop, but that efforts would continue only by manual and mechanical methods. Manual treatments, such as lopping or shearing, that remove the aerial parts of invasive plants would cause an input of organic material (dead roots) into the soil. In lower intensity infestations, non-target vegetation could provide erosion control. As the roots are broken down in the soil food web, nutrients would be released. Soil loosened through treatments such as weed wrenching may slightly increase the potential for delivery of fine sediment to streams. However due to the small areas impacted, the risk would be very low.

Mechanical treatments using mowing equipment are not expected to impact soils. Mechanized equipment on roadways, landings and skid roads would result in no more impact than is currently present. Some increased soil disturbance may occur, but this would be in part mitigated by the mulch cover that is created from the mowing. Mowing equipment used off established roads has the potential to compact soil. The only sites where mowing is proposed off-road is along powerline corridors. Potential compaction can be controlled by limiting the size of the equipment, the season of operation, and that number of trips. Compaction caused by mowing is not anticipated. Other mechanical treatments, such as the use of motorized hand tools, are expected to have effects similar to manual treatments.

Soil Productivity: With an expansion in invasive plant densities, there could be negative effects on soil properties by changing the soil microbiology over time. Some invasive plants could increase the proportion of bare ground by producing toxic chemicals that affect soil organisms. Some of these changes may be difficult to reverse and could lead to long-term soil degradation and difficulty in reestablishment of native vegetation. Knotweeds recycle different nutrients and reduce nitrogen release into the system. This effects soil productivity as well as invertebrate populations (Bulkin, pers. comm.).There would be no risk to soil biota from any herbicide application.

Risk of Leaching: With only manual and mechanical methods, no leaching risk from herbicide application would occur. Infiltration rates may be slightly slowed over the natural conditions, as mechanized equipment on the soils might slightly alter surface soil permeability.

Alternative 2 – Current Program and Alternative 3 - Proposed

Herbicide treatment effects on the soil depend on the particular characteristics of the herbicide used, how it is applied, and soil physical, chemical and biological conditions. In Alternatives 2 and 3, herbicide treatment of invasives is proposed. This is the main difference between the No Action Alternative and the Action Alternatives. Under the Action Alternatives, manual and mechanical methods would continue as described in Alternative 1. Alternative 3 proposes 3000 additional acres of herbicide treatment and 3 additional chemicals (imazapyr, Chlopyralid and Sethoxydim) than Alternative 2 (glyphosate and triclopyr only).

Erosion Risk: As with Alternative 1, erosion may occur where herbicides kill invasive vegetation and native ground cover has not yet been reestablished. This will depend of the size of the exposed area, the type of soil, the side slopes affected, and surrounding vegetation. To minimize the potential off-site movement of soil on sites where exposed mineral soil does not meet the applicable standard, native or sterile cover crops will be replanted under both action alternatives.

Soil Productivity: Soil biology could be affected by herbicide application. All action alternatives allow the use of herbicides in treatment of invasive plants. All herbicides have some evidence of temporary effects to soil microorganisms. The known effects on soil organisms from the individual herbicides proposed for use in the preferred alternative are presented in Table 9. It is likely that all herbicide treatments would have some effect on soil biota, but these effects would be more or less transitory depending on the timing, frequency, and herbicide used. The known effects of herbicide treatments on soil would be weighed against the effects of invasive plants on

Table 9: Effects of Herbicides on Soil Organisms.

Herbicide	Effects
Clopyralid	No effect on nitrification, nitrogen fixation, or degradation of carbonaceous material at 1-10 ppm (parts per million) in soil (SERA, 2004b)
Glyphosate	Readily metabolized by soil bacteria. Substantial information indicating it is likely to enhance or have no effect on soil microorganisms. One study showed transient decreases in the populations of soil fungi and bacteria (SERA, 2003a)
Imazapyr	Toxic to some bacteria at relatively high concentration (SERA, 2004d)
Sethoxydim	No effect on mixed bacterial populations at 50 ppm in soil. At 1000 ppm, substantial but transient increases in actinomycetes and bacteria, and slight decreases in various fungi. *Azobacter* in culture showed no inhibition until 5000 ppm (SERA, 2001b)
Triclopyr	One study showed inhibition of mycorrhizal fungi only at high (1000 ppm) levels, another study showed inhibition of one mycorrhizal fungus at 0.1 ppm. Expected levels in soil would be well below effect levels for most mycorrhizal fungi (SERA, 2003c)

soil that result from no treatment or less effective treatments. All herbicides could persist under some circumstances related to soil texture, organic matter content, and soil moisture level, among others. None of the herbicides under consideration has been shown to result in notable effects to overall long-term soil productivity or permanent impairment of soil ecosystems. In addition, the areas proposed for herbicide applications are in specific spots or narrow bands, such as along roadsides. Consequently, potential impacts from a watershed or drainage perspective are small and localized.

Under Alternative 2, invasive plant infestations are expected to increase in riparian areas where there are buffers from herbicide treatments. Weeds would be expected to continue to slowly spread and expand. This would result over time in potential long-term changes to the physical, chemical, and biological properties of soils where significant infestations occur. Alternative 3 (Proposed) treats more acres and sites with herbicides. The application of herbicides may, in the short term, adversely affect soil micro-organisms. However, the use of herbicides will provide a much greater opportunity to more quickly eradicate the invasives, begin restoration, and return the sites to native vegetation. Alternative 3 would result in the most desirable long-term impact on soils, as it most quickly reduces the spread of undesirable plants.

Risk of Leaching: The potential exists for herbicide products to leach into the soil or be carried away with run off. Factors that determine the fate of herbicides in soil include adsorption rates, herbicide solubility, and degradation times. Soil characteristics, which affect these factors, include organic matter content, pH, temperature, moisture content, clay content, and microbial degradation potential. Degradation rates generally decrease with increasing soil depth and decreasing temperatures. General characteristics for the proposed herbicides are displayed in Table 10. Herbicides are listed in order of most leach risk to least.

As the table indicates, some of the proposed herbicides are highly soluble in water. Generally this is often taken as an indicator of the mobility of the herbicide in water. While glyphosate has high solubility it also binds tightly with soil particles resulting in very low mobility. Herbicides with high mobility potential and long half-lives have a greater potential for leaching into near surface or ground water. Table 10 was constructed by ranking measured levels of adsorption, persistence, and solubility for each chemical against each other (a relative ranking) in order to display less technical and more understandable results. Examining each of the three ranked criteria together for each chemical indicates the highest leach risk chemical proposed for use in this EA is clopyralid. Herbicides with the lowest risk for leaching appear to be sethoxydim, triclopyr, and glyphosate. For the herbicides considered under Alternative 3 (Proposed), clopyralid would have the highest risk of moving off-site in water. However, use of this herbicide would be restricted to outside of the 50-foot riparian buffer under both Alternatives 2 and 3. Also, PDC would restrict use of clopyralid in areas with high water table and high soil permeability.

An analysis of soil characteristics using the Willamette National Forest Soil Resource Inventory (SRI) indicate that almost all Willamette National Forest soils are well graded / poorly sorted.

This means they contain a wide range of soil particle sizes from gravels to sands to silts and clays. They also have relatively high organic matter content, have good infiltration capacity, and are slightly acidic. The smaller particles, the fine silts and clays, as well as the humus in the soil, are well suited to adsorbing and stabilizing possible contaminants. Good infiltration means that there is a low likelihood that overland flow would occur, and herbicides would be carried off-site. A potential exists for herbicides to be transported by infiltration into the ground water. This hazard can be considerably reduced by controlling the season of application as well as the specific weather conditions during application. Herbicides would not be applied to soils when saturated conditions are evident, or to sites with perennially high water tables. Under PDC, herbicide application is restricted to non-rainy periods (May-October). No herbicide application will occur if rain is predicted within 24 hours. All listed herbicides would be expected to have higher adsorption, and lower solubility and half- life than shown in Table 10 due to the inherent soil properties and ecological systems found within the Willamette National Forest.

Table 10: Relative Ranking of Herbicide Characteristics and Influencing Factors on Soil Properties. (from SERA Risk Assessments)

Herbicide	Soil Mobility	Factors Increasing Adsorption	Soil Persistence	Factors Decreasing Half-life	Solubility	Factors Decreasing Solubility
Glyphosate	Very Low	Metallic cations	Low		Moderate-High	Affected by form
Imazapyr	Low	Increasing organic matter and clay content, decreasing pH (<6.5) and moisture; and time	High	Increasing light	Moderate-High	
Sethoxydim	Low	Increasing organic matter	Low		Low-Moderate	Decreasing pH
Triclopyr	Moderate	Increasing organic matter and clay content	Low	Increasing moisture and temperature	Low	
Clopyralid	High		Low	Increasing moisture	Low	

Alternative 3 poses the highest leach risk strictly on an acreage treated basis because more acres are treated with chemicals than in Alternative 2. The risk is substantially reduced by following PDCs for application, operating in appropriate weather conditions, avoiding wet soil areas. The risk of leaching enough herbicide to actually have measurable contamination of a well or surface water body is extremely low, even for the highest leach risk chemical (clopyralid) due to dilution, precautionary application requirements, and simply the lack of concentrated multiple applications in a small area that would show up later once sufficient amounts had leached from an application area to a monitoring location.

Cumulative Effects

The past, present and future actions that are responsible for cumulative impacts on soil erosion and soil biology are mainly timber harvest and road construction and maintenance. The Forest has averaged 1454 acres of timber harvest and 126 miles of road reconstruction per year. The cumulative addition soil erosion from noxious weed treatment from any alternative would be so small it would be masked by these other soil-disturbing activities.

As for soil productivity, some of the herbicide treatments have the potential to adversely affect soil microbes on a very small and site, specific basis. Some herbicides are metabolized by soil bacteria, while others are toxic to soil microorganisms. Additional herbicides might be utilized on adjacent ownerships, but these account for only 6% of the land area within the Forest. The effect of road building and timber harvest where host trees and vegetation are completely removed from large areas of land would have a much larger effect on soil productivity than herbicide application.

The No Action Alternative proposes no herbicide use, so there will be no cumulative effects to leaching.

The past, present and future potential for leaching of herbicides within the watersheds proposed for treatments and be based on the historic and current use of herbicides on WNF. For the past 8 years WNF has used glyphosate and triclopyr (Garlon 3A) exclusively on up to 8000 acres. Glyphosate is a very low risk of soil mobility and triclopyr has a moderate risk of soil mobility but a low risk of solubility (Table 10). Neither of these herbicides is a high risk for leaching. These herbicides are proposed for use under Alternative 2. No cumulative effects are expected from this alternative.

Under Alternative 3, the Project Design Criteria reduce the potential for leaching. Chlopyralid, the herbicide identified as having the highest probability of leaching, is not allowed to be used within the 50 foot riparian buffer in any action alternative and is not available to be used areas with a high water table and highly permeable soils. There is very little probability that any herbicide will leach through the soil profile given these design criteria; thus cumulative effects will be minimal.

Water Quality

Existing Conditions

Potential treatment areas are located in all fifth (5^{th}) field watershed of the Willamette National Forest. The range of elevation of sites is from 500 to more than 6,000 feet. Annual precipitation for these sites ranges from 40 to 120 inches. Distance from treatment sites to streams ranges from 0 to greater than 2,000 feet.

Drinking Water Protection

Drinking water protection areas were delineated by the Oregon Department of Environmental Quality (DEQ) and Oregon Health Division (OHD) in response to source water assessments required by the 1996 Amendments to the federal Safe Drinking Water Act (SDWA). DEQ and OHD were required to delineate the groundwater and surface water source areas which supply public water systems, inventory each of those areas to determine potential sources of contamination, and determine the most susceptible areas at risk for contamination. Public water systems with greater than 15 hook-ups or serving more than 25 people, year-round are regulated by the requirements in the SDWA.

Watersheds originating on the Willamette National Forest supply high quality drinking water to many communities in Oregon. Table 11 displays a list of public water systems using surface water near the Willamette National Forest that utilize at least some water originating from national forest lands. A summary of total potential treatment acres by fifth field watershed can be found in Table 12. Additional information regarding the potential effect of proposed invasive plant treatments on drinking water is located in the Analysis of the Maximum Site-Specific Effects for the Willamette National Forest (see Table 13 for summary; analysis in Project Files).

Clean Water Act

Rivers, streams, and lakes within and downstream of the Willamette National Forest provide water for human consumption, aquatic biota, recreation, and other uses. The federal Clean Water Act (CWA) requires States to set water quality standards to support the beneficial uses of water. For Oregon, the Department of Environmental Quality (DEQ) is responsible for the development of water quality standards that protect beneficial uses of water. The CWA requires states to list water bodies that do not meet water quality standards and these water bodies are listed as "water quality limited" under Section 303(d) of the CWA (303(d) list). Portions of many streams on the Willamette National Forest do not meet Federally-approved state water quality standards (http://www.deq.state.or.us/wq/standards/wqstdshome.htm). Nearly all of the streams on the Willamette National Forest on the current 303(d) list do not meet the water quality standard for temperature. There are no numeric State water quality standards for any of the potential herbicides or adjuvants that may be used in either of the proposed action alternatives.

Table 11. Public water systems using surface water near the Willamette National Forest with completed Source Water Assessment Reports.

Public Water System	Source	Watershed
Eugene Water and Electric Board	McKenzie River	Lower McKenzie River
City of Westfir	North Fork of Willamette	North Fork of Middle Fork Willamette River
Detroit Water System	Breitenbush River (summer only)	North Fork Breitenbush River
City of Gates	North Santiam River	Middle North Santiam River
City of Jefferson	North Santiam River	Lower North Santiam River
Lyons Mehama Water District	North Santiam River	Lower North Santiam River
Mill City Water Department	North Santiam River	Middle North Santiam River
Salem Public Works	Santiam River & Infiltration Gallery	Lower North Santiam
Stayton Water Supply	North Santiam River	Lower North Santiam River
City of Lebanon	Santiam Canal (South Santiam)	Hamilton Creek/South Santiam River
City of Sweet Home	South Santiam River	Hamilton Creek/South Santiam River

In Oregon, the USDA Forest Service is the designated management agency responsible for completion of Water Quality Restoration Plans (WQRP) that provide information of how water quality standards will be met. The Willamette National Forest has prepared a WQRP for Blowout Creek and its tributaries in the North Santiam watershed, and a WQRP has been completed for Horse Creek in the Upper McKenzie River watershed. The purpose of a WQRP is to identify sources and causes of pollution, make recommendations for Best Management Practices (BMP) and restoration to reduce levels of potential pollutants, display monitoring that is pertinent to the 303(d) listing parameters and a proposed time-table for completing the restoration work. Because there are no numeric State water quality standards for any of the potential herbicides or adjuvant that may be used in either of the proposed action alternatives, the existing WQMPs do not address the chemicals proposed for use under either of the action alternatives. Actions associated with either of the proposed action alternatives would be consistent with all potential measures included in WQRPs.

Table 12: Acres of known invasive plant treatment sites within riparian reserves on the Forest by 5th Field Watershed

5th Field Number	5th Field Watershed Name	Total acres invasive sites in 5th Field Watershed	Acres of known invasive plant sites within 50 feet of streams and wetlands
1709000101	Upper Middle Fork Willamette River	9.40	1.86
1709000102	Hills Creek	14.04	4.8
1709000103	Salt Creek/Willamette River	855.63	291.25
1709000104	Salmon Creek	163.03	121.62
1709000105	Hills Creek Reservoir	177.29	202.15
1709000106	North Fork Middle Fork Willamette R.	103.00	68.50
1709000107	Middle Fork Willamette/Lookout Point	1529.05	592.38
1709000109	Fall Creek	47.62	25.56
1709000303	Calapooia River	19.36	4.56
1709000401	Upper McKenzie River	1906.41	374.18
1709000402	Horse Creek	520.41	29.51
1709000403	South Fork McKenzie River	360.65	113.29
1709000404	Blue River	120.83	31.97
	Lower McKenzie	7.33	
1709000405	McKenzie River/Quartz Creek	587.45	194.42
1709000501	Upper North Santiam	685.95	270.34
1709000502	North Fork Breitenbush River	1143.95	324.80
1709000503	Detroit Reservoir/Blowout Divide	775.04	210.54
1709000505	Little North Santiam River	82.06	26.82
1709000601	Middle Santiam River	9.10	8.19
1709000602	Quartzville Creek	144.44	106.24
1709000603	South Santiam River	453.00	172.52
Total		**9,715**	**3,232**

Groundwater

Groundwater is water that occurs in saturated zones below the soil surface. Groundwater depths vary considerably throughout the Willamette National Forest and range from near the surface to hundreds of feet below the surface. Geologic conditions, soil type and precipitation are a few factors that help determine groundwater characteristics. The direction and speed with which groundwater moves is controlled by the slope of the water table and aquifer permeability. Aquifer permeability is a measure of how easy it is for groundwater to move through the geologic material that makes up the aquifer. The steeper the slope of the water table and the higher the aquifer permeability, the faster groundwater could move through a geologic formation. Depending on conditions, it can take anywhere from several hours to many decades for groundwater to move through an aquifer and become surface water. Groundwater generally comes in contact with streams, lakes or ponds in the form of seeps or springs. These seeps or springs can be sources of high quality water due to their clean, cold condition.

Riparian Conditions

Native riparian vegetation plays a key role in forming aquatic habitat for fish and other aquatic species. Roots help stabilize stream banks, preventing accelerated bank erosion and can be an important habitat component providing cover for juvenile and adult fish. Riparian areas with native vegetation can supply large down trees to stream channels (large woody material). In turn, large woody material in streams influences channel morphology characteristics such as longitudinal profile; pool size, depth, and frequency; channel pattern; and channel geometry. Turbulence created by large wood increases dissolved oxygen in the water needed by fish, invertebrates and other biota. Large woody material in streams can also have a positive effect on the hyporheic zone adjacent to and under the stream surface. Invasive plants could slow down or prevent the establishment of native trees, decreasing or delaying the future supply of large woody material to stream channels.

Riparian forest canopy protects streams from solar radiation in summer, and could moderate minimum winter nighttime temperature, preventing the incidence of anchor ice or freeze-up in streams (Beschta et. al., 1987). Changes in water temperature regime could affect the survival and vigor of fish, and affect interspecies interactions (FEMAT, 1993).

Riparian areas are dynamic. Disturbances characteristic of uplands such as fire and wind throw, as well as disturbances associated with streams, such as channel migration, floods, sediment deposition by floods and debris flows, shape riparian areas (FEMAT, 1993). Frequently disturbed ground in riparian areas makes these areas especially vulnerable to plant invasion.

The rapid growth and propagation characteristics of many invasive plants allow them to out-compete native vegetation. This competitive advantage results in the loss of functional riparian communities, loss of rooting strength and protection against erosion, decreasing slope stability and increasing sediment introduction to streams, and impacts on water quality (Donaldson, 1997). Invasive plants are especially difficult to control in riparian areas since invasive plants thrive in the moist environment and treatment measures are sometimes limited.

Japanese knotweed is an example of an invasive plant with potential effects to riparian areas. Japanese knotweed leaves fall off in a short period in the fall, leaving soil beneath knotweed relatively unprotected from rain, leading to potential for some increased erosion and sediment delivery to streams. In addition, if a relatively large number of Japanese knotweed leaves are decomposing in a small stream at any one time, there could be a local increase in biological oxygen demand and a reduction in the amount of dissolved oxygen for other organisms in the stream (USDA Forest Service, 2005a). Several Japanese knotweed populations have been documented on the Willamette National Forest with the large known site within the riparian area of the Middle Fork of the Willamette River and its tributaries (5th field watersheds Middle Fork Willamette/Lookout Point and North Fork Middle Fork Willamette R.).

Effects Analysis & Methodology

This section will analyze the direct, indirect and cumulative effects of the action and no action alternatives on water temperature, turbidity, dissolved oxygen and nutrients, riparian structure and water chemistry. Effects on peak flows, low flows, and water yield were considered but not found to have effects in any of the alternatives. The water quality effects analysis utilizes research and relevant monitoring to provide a context for effects of each of the alternatives. In addition, herbicide concentrations derived from herbicide risk assessments completed by SERA (1999, 1999a, 2001, 2003, 2003a) and associated worksheets are used as a general indication of the potential delivery of herbicides to adjacent surface water (see Table 13 for synopsis of the Analysis of Maximum Site-Specific Effects). These concentrations were modified in the worksheets to reflect some specific site conditions for each of the treatment areas. Additional discussion of how this information was used in the aquatics analysis can be found in the Fisheries Section of this document.

Direct/Indirect and Cumulative Effects

Alternative 1 – No Action Alternative

Under this alternative management of invasive plants would be limited to manual and mechanical treatments. Weed populations would increase because the most effective methods would not be used. Additional populations would be expected to invade additional sites including streamside areas within riparian reserves. As the invasive plant populations become established over a larger portion of the streamside areas, there would be a corresponding adverse impact to riparian area condition and an increased risk of adverse effects to water quality. Table 12 displays the number of acres of known invasive plant sites by 5th field watershed and the acres of known sites within the 50-foot stream influence zone that could be treated under this alternative.

Water Temperature

Many invasive plants provide less stream-shading than native hardwoods and conifers. A decrease in shading vegetation can result in significant increases in stream temperature (USDA/USDI 2005). Increased water temperatures resulting from reduced shading due to invasive plants displacing native species are possible in streams that have the following conditions:

- Stream channel is moderately wide (10 feet to 20 feet);
- Stream channel has an east-west or south orientation;
- Limited groundwater input
- Riparian area has the potential for larger coniferous or hardwood streamside riparian vegetation; and
- Site has a large contiguous block of short invasive plants along the south edge of east-west oriented streams or either side of a southerly oriented stream.

The greater the area with conditions as indicated above at an infestation site, the higher the likelihood that the adjacent stream has some increased stream temperature resulting from shade loss. In reality, any stream temperature increase would likely be very localized and small due to the relatively small size of most of the infestations and the low probability that all of the conditions described above are found at any one site. It is anticipated that most of the manually-controlled infestation areas under this Alternative would have an insignificant effect on water temperature due to meeting very few of the above conditions.

Turbidity

Some invasive plants are less effective for stream bank stabilization than deeper rooted native species. On those areas that remain untreated or would become infested in the future, soil erosion could occur at rates greater than expected for the same site with adequate establishment of native vegetation.

Where invasive plants provide less effective ground cover and a shallow root system than native plants, there is a greater potential for a surface erosion, bank erosion and in-stream sediment delivery during high magnitude runoff events. This situation is similar to the stream temperature description above in that most of the sediment increase to adjacent surface water is anticipated to be insignificant, primarily due to the relatively small, localized infestation of invasive plants. Infestations do have the potential to introduce small quantities of sediment in areas that have highly erosive banks that are covered with a large (approximately 50 feet or more along the edge of the stream) contiguous block of shallow rooted invasive plants. Talmage (2004) found that if a shallower rooted invasive plant species such as Japanese knotweed completely occupies an unstable stream bank, the potential for stream bank instability during high flows is much greater than if the same site was occupied by deeper rooted native vegetation. Invasive plants also could complicate restoration by preventing the re-establishment of native vegetation that is more effective for providing stream shading, stream bank/soil stability, and ground cover.

Because only manual and mechanical treatments would be available, perennial invasives would resprout. This would be cause for repeated treatments over several successive years for invasive plant eradication, containment, and control. As treated vegetation dies there is the potential for surface erosion from exposed soil surfaces and loss of root holding strength.

Under this alternative, the localized effects of invasive plants out competing more beneficial native plants on key sites such as stream banks and other riparian areas would continue. Invasive plants are likely to spread in areas that do not have an active eradication, containment, and control program and the potential adverse effects to water quality and soil stability would continue to mount.

Direct effects to the aquatic environment would be minimal under Alternative 1 due to the small area disturbed at any one time within the streamside areas. In the long-term, indirect effects of this alternative compared to the action alternatives would be the continued spread of existing invasive plant infestations and establishment of new sites increasing the risk of soil erosion as the native plants are displaced.

Dissolved Oxygen and Nutrients

Under Alternative 1, manual and mechanical treatments have the potential to introduce vegetative material into the water where decomposition processes can result adverse effects to water quality including low levels of dissolved oxygen. Invasive plant treatments would occur at different times and in different places and efforts would be made to not place excessive amounts of vegetative material in surface water, so the odds of large amounts of plant material entering a water body in a short time is highly unlikely. In addition, riparian areas on the Forest naturally produce large amounts of organic matter including tree leaves and needles. Due to the natural high input of organic matter into streams and the small amount of invasive plant material entering the water, a negligible adverse effect on in-stream dissolved oxygen levels or nutrients would be anticipated. In addition, most streams on the Forest are relatively turbulent and cool resulting in conditions that favor relatively high concentrations of oxygen from the atmosphere dissolving in the surface water.

Riparian Structure

Treatment of invasive plants in riparian areas under Alternative 1 by manual and mechanical methods are intended to provide the opportunity for the eventual return of native vegetation and corresponding restoration of natural riparian structure and function. These treatment methods are not effective at eradicating most invasive species so implementation of this alternative would require multiple treatments of the same site. Due to the low extent of the area treatable under this alternative increases in invasive species would have an adverse effect on important riparian structural components. Over time it is anticipated there would be adverse effects to stream shading and bank stabilizing vegetation, as well as a reduction in large trees that contribute to in-stream habitat over the long-term.

Water Chemistry

Since Alternative 1 does not include the use of any herbicides, there would be no direct effect of this alternative on water chemistry by any proposed treatment method. Since the spread of invasive species would continue under this alternative, there would be the potential for some small localized effects on water chemistry or changes to nutrient cycling due to the leaching of some chemicals from the soil or the release of allelopathic or other compounds from invasive plants. It is anticipated that these effects would be small and in most cases not measurable, but these effects are not well studied at this time.

Cumulative Effects- Alternative 1

Under the No Action Alternative weed populations would be allowed to grow with little control. In riparian areas where invasive plants are currently restricting the ability of native vegetation to become established, these sites would likely continue to be dominated by noxious weeds and the extent of infestations would likely spread. Although treatment of these sites dominated by invasive plants under this alternative using manual and mechanical control methods may have some small localized adverse effects on water quality, the magnitude of the effect in comparison to the potential effect of other management activities would be negligible and on most sites not measurable. For example, any small localized increases in sediment or change in other water quality parameters would likely be insignificant compared to the potential effects of timber harvest and road reconstruction. On the Willamette NF from 1999 to 2005 a total of 8,293 acres of forest were commercially thinned and another 1.881 acres of regeneration harvest occurred. In addition, a total of 4.9 miles of road was constructed and 877 miles were reconstructed. Although best management practices are used to minimize the adverse effect to water quality including sediment production, the magnitude of the ground disturbance associated with these activities is far greater than what would occur under the No Action Alternative. No measurable adverse cumulative effects to water quality would be anticipated under this alternative.

Alternative 2 – Current Program: Direct and Indirect Effects

Alternative 2 (Revised Current Program) would implement invasive plant treatments on up to 9,700 acres of known invasive plant infestation sites within the Willamette National Forest. This alternative would treat a total of approximately 3,232 acres with non-herbicide methods and a total of up to 6,468 acres with herbicides (Glyphosate and Triclopyr). This alternative also includes treatment of up to 25 new invasive plant treatment sites per year with no cap on the number of acres treated on these new sites. However, under this alternative, no chemical treatments would be allowed within 50 feet of class 1-4 streams, ponds, or wetlands.

Table 12 shows the number of acres of known invasive plant treatment within streamside areas by 5th field watershed on the Forest including herbicide, manual, mechanical, and cultural treatment methods prescribed in this alternative.

Fifth field watersheds with the largest areas of invasive plants and potentially treated within the 50 foot streamside zone are Middle Fork Willamette/Lookout Point (592.38 ac.), the Upper McKenzie River (374.18 ac.), and the North Fork Breitenbush River (324.80 ac.) watersheds.

Water Temperature

The effects of Alternative 2 on water temperature would be similar to the effects of Alternative 1 (No Action). Since this alternative would not allow the use of herbicides within 50 feet of streams, treatment methods would be restricted to manual, hot foam, propane, and competitive planting within streamside zones. Although these methods can be effective at controlling invasive plant species, the number of acres treated over time would not be sufficient to control the spread of the invasive species. In the short-term there could be small localized effects on water temperature as a result of treatments near streams however these effects would be small and not likely to persist more than one growing season. In the long-term, as invasive species spread through more riparian areas, adverse effects to stream shading vegetation and water temperature are likely to occur particularly on those more susceptible stream reaches as described under Alternative 1.

Turbidity

The effects of Alternative 2 on soil disturbance, leading to entrainment and delivery of fine sediment to streams, producing increased turbidity would be similar to the No Action Alternative. Invasive plant eradication has the potential to temporarily leave treatment areas with reduced ground cover which in turn has the potential for increased erosion and resulting sedimentation but these areas would be small and localized. Equipment used in plant treatment has the potential to disturb or displace soil, making the soil more vulnerable to erosion. PDC #34 states that ground-based mechanized equipment will not be allowed within 25 feet of streams, ponds, or wetlands, so this would reduce the probability of erosion from equipment. As stated in the Soils Section of this document, there should be a net reduction in soil erosion risk with this alternative when compared to Alternative 1, because desirable native plants that provide long-term soil stability and proper function would eventually reoccupy the treated sites. Short-term erosion would be mitigated by creation of a restoration plan that would identify specific measures to ensure protection against erosion and resulting sedimentation. These measures would be implemented as part of the project implementation. A reduction in associated sedimentation is also expected from the reduction in erosion risk since the two are strongly related.

Dissolved Oxygen and Nutrients

The herbicide, manual, mechanical, and cultural treatments proposed would not result in large amounts of plant material or nutrients entering streams or other water bodies sufficient to reduce dissolved oxygen concentration. Similar to the No Action Alternative, invasive plant treatments in the aquatic influence zone would occur at different times and in different places, and efforts would be made to not place excessive quantities of vegetative material in surface water at one location. As a result, the odds of large amounts of plant material entering surface water in amount that could cause adverse effects are highly unlikely. As previously stated, riparian areas on the Forest naturally input large amounts of organic matter including tree leaves and needles into streams. Due to the natural high input of organic matter into streams and the small amount of invasive plant material entering the water at any one time, a negligible adverse effect on in-stream dissolved oxygen levels or nutrients would be anticipated.

Riparian Structure

Invasive plant treatment and removal in riparian areas would provide the opportunity for the eventual return of native vegetation and corresponding restoration of natural riparian structure and function. On sites where invasive plants occupying riparian areas are eradicated, the length of time before suitable native vegetation naturally becomes established on the site (passive restoration) would vary across the Forest due to site specific factors including soil type and elevation. On invasive plant treatment areas where native vegetation would be planted (active restoration) riparian function would return more rapidly. In general, improved long-term riparian structure and function due to invasive plant treatment would benefit water quality and listed aquatic species, due to long-term improvements in stream shading, vegetative stream bank stabilization, and in-channel large wood inputs. Since Alternative 2 would restrict the use of herbicides within the aquatic influence zone, overall the effects on riparian area structure would be similar to the No Action Alternative.

Water Chemistry

Herbicides used to control terrestrial invasive plants under Alternative 2 could enter water through spray drift, surface water runoff, percolation and groundwater contamination. This has the potential to reduce water quality due to introduction of herbicides and associated adjuvant and impurities. Some of these adjuvants may also alter water quality characteristics such as pH (Bakke, 2003a). The primary pathway for potential herbicide introduction into surface water depends on a variety of factors including: application method, timing and amount, herbicide properties, soil properties, site conditions and management practices. Once on the ground or plant surface, herbicide fate is controlled by numerous biological, physical and chemical processes including: ingestion by animals, insects, worms or microorganisms in the soil; movement downward in the soil and either adhered to soil particles or dissolved in water; degraded into less (or more) toxic compounds; carried away in runoff water on the soil surface or transported while attached to eroding sediment. Thus, herbicide delivery and fate is a very complex situation.

Detailed discussions about herbicide delivery and fate are contained in the herbicide risk assessments completed by SERA (1999, 1999a, 2001, 2003, 2003a).

Soil type and chemical stability, solubility, and toxicity could determine the extent to which an herbicide would migrate and impact surface waters and groundwater. Some herbicides such as glyphosate strongly adsorb to soil particles, which prevents it from excessive leaching. Other herbicides such as Triclopyr are more mobile in soil.

Water runoff during rain events could transport herbicides to waterways, and convey them to aquatic species habitat directly adjacent and downstream of the treatment site. The mixing zone size needed to reduce or dilute downstream herbicide levels below any threshold effect concentration is a critical parameter. Mixing zone size can vary greatly and can depend upon the volume of herbicide input, the volume of the water body, the entry point (e.g., gravel bar inundation or drift deposition), and turbulence, which is generally greater for small but steep headwater streams. Hydrologically complex waterways with meanders, pools, riffles, and eddies that accelerate mixing and dilution are more likely to disperse contaminants than simplified waterways with consistent channel velocities that allow contaminants to maintain a more consolidated profile (Jobson, 1996). Streams on the Forest generally have high channel complexity (wood, pools, boulders), so it is expected that mixing of chemicals would occur rapidly and there would be a rapid decrease of concentration with time. Mixing distances are also usually shorter in smaller streams (Heard et. al., 2001: as cited in USDC NOAA, 2003).

Project Design Criteria (PDC) are utilized to reduce or eliminate negative effects of management activities on resources. Under this alternative the amount of herbicide reaching surface water by spray drift would be minimal considering the restrictions of no broadcast boom spraying and no hand spraying within 50 feet of water or when wind speeds are greater then 10 miles per hour. In addition, when spray equipment would be used, applicators would use a coarse spray and low nozzle pressure spray heads. Herbicides entering surface water through surface runoff would also be expected to be minimal, since herbicide would not be applied within 50 feet of surface water, and application of herbicides would be restricted if rainfall is expected within 24 hours after application. This would minimize the amount of herbicide potentially reaching the ground surface as well as minimize the potential for herbicide drift (see Appendix F: Herbicide Hazards and Project Design Criteria Designed to Mitigate Hazards).

The low risk of significant quantities of herbicide to enter surface or ground water as described above should result in insignificant short term and long term direct or indirect effects to water quality. As indicated by the mixing and dilution studies cited in the paragraphs above, any trace amount of herbicide that may reach surface water would be quickly diluted.

Due to the PDC that would be employed under Alternative 2, there would be a low risk of exposure to humans of herbicides in a concentration that would result in adverse health effects.

Cumulative Effects – Alternative 2

Similar to the discussion under the No Action Alternative, the past, present and future effects of other land management practices including commercial timber harvest and road construction and reconstruction would be far greater than the potential adverse effects on water quality under Alternative 2. This alternative would have a small beneficial effect on water temperature, turbidity, dissolved oxygen and nutrients, and riparian structure as noxious weed infestations would be replaced with native vegetation over the long-term. The magnitude of the effect would likely be small however and may not be measurable or would only be measurable at the site specific scale.

As indicated in the previous section Ownership Patterns, within the boundaries of the Willamette NF the ownership is predominantly National Forest System lands (94%). Most proposed invasive plants treatment areas on the Forest are upstream of other sources of herbicides and sediment on both non-federal and federal lands. Where streams migrate and flow downstream through other land ownerships (BLM, Federal, State, Tribal, or private), the potential exists for herbicides or sediments originating from invasive plant treatment sites on the Forest to mix with those originating from sites being treated off-National Forest System lands (see section Ownership Patterns for additional information). There is also the potential for herbicides and sediments from invasive plant treatment sites adjacent to the Forest watersheds to mix together at some point downstream if simultaneous treatment occurs. As described in Section 4.1.1 of the Invasive Plant FEIS (USDA Forest Service, 2005a), the effects could be additive or synergistic in nature.

The total area potentially treated in any stream influence zone on Willamette National Forest lands by 5th field watershed would be a small percentage of the entire watershed area. Even if the invasive plant treatments are occurring at the same time on both Federal and non-federal lands, the potential for sediment or chemical related cumulative effects is very low considering the negligible amount of sediment or chemicals expected to reach perennial or intermittent streams from any of the proposed treatment methods and considering the dilution factor for any herbicide. Forest streams listed on the 303(d) list for temperature with infestations of invasive plant species in the long-term would likely cool to a small extent as native vegetation becomes established in the aquatic influence zone.

The potential for adverse cumulative effects to water quality is negligible considering the small amount of herbicide or sediment expected to reach surface water due to implementation of PDC that would minimize the amount and type of herbicides that actually reach surface water, the distance between potential treatment areas, and dilution over time and space by mixing and additional inflow from downstream tributaries and groundwater entering streams.

Alternative 3 – Proposed Action: Direct and Indirect Effects

Alternative 3 would implement invasive plant treatments on up to 9,700 acres on known invasive plant infestation sites within the Willamette National Forest. Treatments would include herbicide, manual, mechanical, and cultural treatment methods. This alternative would treat a total of approximately 1,940 acres with non-herbicide methods and a total of approximately 7,760 acres with herbicides. This alternative would allow the use of two herbicides (Glyphosate and Imazapyr) within 50 feet of the edge of streams and other surface water. PDC for applying herbicides in the stream influence zone would limit application methods to spot spraying, stem injection, or wiping (injection and wiping only within 10 feet of surface water). In addition to these 9,700 acres, additional areas may be treated as part of the Early Detection Rapid Response (EDRR) strategy described in Chapters 1 and 2 of this document. Effects of this program on water quality are displayed in the EDRR portion of this analysis shown below.

Water Temperature

As described in Alternative 1, several factors including vegetative shade and physical features such as stream orientation, existing topographic shading and groundwater input play a part in determining whether a change in stream shading would result in water temperature changes. Since other alternatives would allow only manual and mechanical treatments within the stream influence zone, it is likely that reliance on these methods alone adjacent to streams would result in fewer acres being treated effectively within riparian areas. Since Alternative 3 would allow the use of herbicides adjacent to streams, it is likely that more acres could be treated effectively and this alternative would favor the establishment of native shade producing vegetation to a greater extent than the other alternatives.

Establishment of native vegetation on sites currently occupied by invasive species would be expected to have positive effects on stream bank stability and stream shading, and potential long-term reduction in water temperature.

The risk of adverse effects to shade-producing native vegetation is relatively low with direct hand/selective and spot spraying (e.g., backpack sprayer) techniques that would be used near surface water. Spot spraying, injection, or wiping enables the applicator to target specific invasive plants, thereby minimizing the potential for overspray to native plants.

In the short-term there could be small localized effects on water temperature as a result of treatments near streams after invasive plants are killed until native, shade-producing vegetation becomes established. However, these effects would be small, impacting limited areas of surface water and not likely to persist more than one growing season.

Turbidity

Although Alternative 3 would allow for herbicide treatments within the stream influence zone (Table 5) there is no indication that there would be an increased risk of localized soil disturbance, turbidity or fine sediment as a result of treatments over Alternatives 1 and 2. PDC would ensure that only minimal quantities of sediment would enter streams. Short-term erosion would be mitigated by creation of a restoration plan that would identify specific measures to ensure protection against erosion and resulting sedimentation. In the long-term, the establishment of native vegetation would favor stream bank stability and lower rates of sediment input into streams. Under Alternative 3, it would be expected that streams would meet turbidity standards.

Dissolved Oxygen and Nutrients

Under Alternative 3, the herbicide, manual, mechanical, and cultural treatments proposed would not result excessive quantities of plant material or nutrients entering streams resulting in degraded water quality. Invasive plant treatments would occur at different times and in different places, therefore large amounts of plant material entering surface water at one time and location is highly unlikely. In addition, streams on the Forest have naturally vegetated riparian areas that provide large amounts of organic matter including tree leaves and needles. Due to the natural high input of organic matter into streams and the small amount of invasive plant material entering the water and similar to Alternatives 1 and 2, a negligible adverse effect on in-stream dissolved oxygen or nutrients levels would be anticipated under this alternative.

Riparian Structure

As previously described, invasive plant treatment and removal in riparian areas would provide the opportunity for the eventual return of native vegetation and corresponding restoration of natural riparian structure and function. Restoration of riparian area structure and functions could be accelerated by active methods such as planting native vegetation adjacent to streams following eradication of invasive species. In general, improved long-term riparian structure and function due to invasive plant treatment would benefit water quality and listed aquatic species, due to long-term improvements in stream shading, vegetative stream bank stabilization, and in-channel large wood inputs. Alternative 3 would provide the greatest range of possible treatment options within the aquatic influence zone and would therefore likely result in the greatest long-term benefit to restoration of riparian structural components.

Water Chemistry

PDC are utilized to reduce or eliminate negative effects of management activities on resources. A list of PDC and how they would address specific effects from herbicide application is summarized in Appendix F. – Herbicide Hazards and Project Design Criteria Designed to Reduce

Hazards. As described under Alternative 2, the amount of herbicide reaching surface water by spray drift is expected to be minimal considering the restrictions of no broadcast boom spraying and no hand spraying when wind speeds are outside the prescribed range as well as using coarse spray, low nozzle pressure spray heads. Herbicides entering surface water through surface runoff are also expected to be minimal, since among other things, within 50 feet of water, targeted spot spraying could be used from 50 to within 10 feet of water and from 0 to 10 feet of water, only injection or wiping techniques would be allowed. Additionally, application of herbicides would be restricted if rainfall is expected within 24 hours after application.

Soil type and chemical stability, solubility, and toxicity could determine the extent to which any of the herbicide proposed for use under this alternative would migrate and impact surface waters and groundwater. The herbicide risk assessments completed by SERA (1999, 1999a, 2001, 2003, 2003a), and associated worksheets utilize modeling to predict potential concentrations reaching surface water take these physical characteristics into account. These concentrations were estimated from risk assessments completed by SERA. Information on site specific analysis for the Willamette National Forest related to the hazards to aquatic biota and water quality for human consumption are described in the Analysis of Maximum Site-Specific Effects (Appendix F) of this document. This analysis showed that for site specific conditions on the Willamette National Forest even under conditions where the maximum effects could occur on a site the concentration of herbicide chemicals in the water would be low and there would be a corresponding low level of risk to humans or aquatic biota.

The potential routes of herbicide entry described above should result in insignificant short-term and long-term direct or indirect effects to water quality. As described in Appendix F- Herbicide Hazards and Project Design Criteria designed to Reduce Hazards, PDC would be employed to minimize the potential for introduction of herbicides into surface water and groundwater. No aerial application of herbicides, only allowing selective application techniques within the aquatic influence zone and using coarse spray, low nozzle pressure spray heads would substantially reduce the likelihood of herbicide drift. Within 10 feet of surface water, only stem injection or wiping of herbicides would be allowed. PDC would not allow the use of more toxic and mobile herbicides and adjuvants next to water features. As indicated by the mixing and dilution studies cited in the paragraphs above, any trace amount of herbicide that may reach surface water would be quickly diluted.

Early Detection / Rapid Response

Early Detection/Rapid Response (EDRR) component of Alternative 3 refers to the approach taken so that new or currently unknown infestations may be treated with herbicides quickly, without additional NEPA decisions. Total treatment acres for the EDRR would not exceed a total of 3,000 additional acres treated with herbicide under Alternative 3 of this Environmental Assessment.

Within the 50 foot riparian influence zone adjacent to surface water, there would be a cap on the number of acres that could be treated with herbicides in each 6th field watershed each year; no greater than 10 contiguous acres and 1.5 miles along a river corridor could be treated annually.

New sites would be analyzed by an interdisciplinary team to ensure that proposed treatments are consistent with PDC and that no additional surveys or mitigation measures are needed. New sites would be published in the newspaper for public comment. Additionally, information on the new sites to be treated would be presented annually to the Wildlife and Fisheries Level 1 Teams as informational updates.

Any new areas identified and treated under EDRR would have the same physical characteristics that influence herbicide concentration and erosion on other treatment areas and the effects would be similar. The invasive plant review team would periodically review the proposed program of work to ensure, among other things, that new sites meet the conditions outlined in this document. In conjunction with the PDC and other mitigation, there are no additional effects under Alternative 3.

Cumulative Effects – Alternative 3

Similar to the discussion under the other alternatives, the past, present and future effects of land management practices including commercial timber harvest and road construction and reconstruction would be far greater than the potential adverse effects on water quality under Alternative 3. Due to the larger number of acres treated, Alternative 3 would have the greatest beneficial effect on water temperature, turbidity, dissolved oxygen and nutrients, and riparian structure as noxious weed infestations are replaced with native vegetation in the long-term. The result of replacing invasive species in riparian areas combined with other riparian area restoration projects would cumulatively result in an overall improved riparian condition on the Forest with beneficial effects on water quality. The magnitude of the effect from implementation of Alternative 3 alone would likely be small however and may not be measurable or similar to other alternatives would only be measurable at the site specific scale.

Detrimental effects to water quality from implementation of Alternative 3 would be expected to be insignificant due to PDC that employ measures to reduce or eliminate harmful effects to the aquatic environment (see Appendix F). These PDC were developed using modeling, research and other documents and field experience. Although Alternative 3 could result in the highest number of acres treated in any year, the total area treated would be a very small percentage of any 5th field watershed on the Forest. Currently there are 3,232 acres of known invasive plant sites on riparian adjacent lands (within 50 feet of streams) out of a total of approximately 80,000 acres of riparian adjacent lands on the Forest.

As described in the Water Chemistry section above, expected mixing and dilution of any trace amount of herbicide or adjuvants that may result from invasive plant treatment would occur quickly, making it highly unlikely that herbicide concentrations would be additive or synergistic with similar treatments at the watershed scale.

Forest streams listed on the 303(d) list for temperature with infestations of invasive plant species in the long-term would likely cool to a small extent as native vegetation becomes established in the aquatic influence zone.

As indicated in the previous section Ownership Patterns, within the boundaries of the Willamette NF the ownership is predominantly National Forest System lands (94%). Under Alternative 3, the potential for cumulative effects is negligible considering the insignificant amount of herbicide or sediment expected to reach surface water due to implementation of PDC that would minimize the amount and type of herbicides that have the potential to reach surface water, the distance between potential treatment areas, and dilution over time and space by mixing and additional inflow from downstream tributaries and ground-water entering streams. These factors result in a low risk of adverse cumulative effects to other downstream ownerships where herbicides may be applied.

Aquatic Conservation Strategy Objectives

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).

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 all action alternatives at the fifth-field scale.

Wildlife

Existing Condition

Invasive Plants and Wildlife Habitat

Some wildlife species utilize invasive plants for food or cover. For example, it has been reported that elk, deer and rodents eat rosettes and seed heads of spotted knapweed. However, the few uses that an invasive plant may provide do not outweigh the adverse impacts to an entire ecosystem (Zavaleta, 2000). More detailed information on the effects of invasive plants to wildlife is reported in the R6 2005 FEIS (USDA, 2005a).

Habitats that become dominated by invasive plants are often not used, or used much less, by native and rare wildlife species. Oregon Department of Fish and Wildlife (2006) identified invasive plants, such as Himalayan blackberry, false brome, reed canarygrass, scotch broom, and Japanese knotweed, as threats to upland and riparian habitats. Species restricted to very specific habitats, for example pond-dwelling amphibians, are more susceptible to adverse effects of invasive plants.

Federally Listed Species

Several species listed as "threatened" under the Endangered Species Act of 1973 (as amended) (ESA), are found on Willamette National Forest system lands. In addition, the U.S. Fish and Wildlife Service (FWS) maintain a list of "candidate" species. Candidate species are those taxa that the FWS has on file sufficient information on biological vulnerability and threats to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions (USDI Fish and Wildlife Service 1996). Listed and candidate species found on Willamette National Forest system lands are included in Table 13.

The two candidate species found or suspected on Willamette National Forest system lands are also included in the Regional Forester's Sensitive Species List and are discussed in the section titled "Forest Service Sensitive Species."

Table 13. Federally Listed Species on Willamette National Forest

Common Name	Scientific Name	Status	Critical Habitat
Birds			
Northern Bald eagle	*Haliaeetus leucocephalus*	Threatened	None
Northern spotted owl	*Strix occidentalis caurina*	Threatened	Designated
Mammals	**Mammals**	**Mammals**	**Mammals**
Pacific fisher	Pacific fisher	Pacific fisher	Pacific fisher
Mardon Skipper	Mardon Skipper	Mardon Skipper	Mardon Skipper

Brief general descriptions of the species' life history, threats, conservation measures, and their occurrence are in the Wildlife Report.

Forest Service Sensitive Species

Terrestrial wildlife species found on the Willamette National Forest systems lands that are included in the Region's "Special Status/Sensitive Species Program" are listed in Table 14. The primary objectives of the Sensitive Species program are to ensure species viability throughout their geographic ranges and to preclude trends toward endangerment that would result in a need for federal listing.

Baird's and Pacific shrew habitat can very briefly be described as conifer/mixed conifer forest stands, and other moist wooded or shaded riparian areas with numerous fallen decaying logs and brushy vegetation (Nature Serve 2006, Verts and Carraway 1998). Based on limited information, this type of habitat offers year-round life support for these species that includes a breeding season thought to extend from March through August (O'Neil et al. 2001). Both species are believed capable of a similar elevation range from approximately sea level to 5,000', and they are each identified as functional specialists in habitat where they occur as they tend to be insectivores.

Both shrew species have been documented on the Willamette National Forest in habitat similar to that associated with natural and older managed stands. There were 38 specimens of *S. bairdi* collected from sites in Lane County; most of the locations were on or near the Willamette National Forest (Verts and Carraway 1998). There also were 65 specimens of *S. pacificus* collected from sites in Lane County, most from locations on or near the Willamette National Forest, including one location on the Middle Fork Ranger District (Verts and Carraway 1998). The Forest has conducted limited surveys for these species in the invasive plant treatment project area, even though more potential habitat exists across the Forest. It is for this reason that species presence is assumed in the areas where surveys have not been done.

In the Pacific Northwest, the Pacific fringe-tailed as a whole is considered a forest-dwelling bat while this variant has been described in association with a diversity of mixed-conifer forests that have relatively dry moisture regimes in the Coast Range and southern Cascade Range of Oregon.

Table 14. Regional Forester Sensitive Terrestrial Wildlife Species

Common Name	Scientific Name	Occurrence on National Forest System Lands*
Mammals		
Baird's shrew	*Sorex bardi*	Documented
Pacific shrew	*Sorex pacificus*	Documented
Pacific fringed-tailed bat	*Myotis thysanodes vespertinus*	Documented
California wolverine	*Gulo gulo*	Historically Documented
Pacific fisher	*Martes pennanti*	Historically Documented
Birds		
Least bittern	*Iobrychus exilis*	Suspected
Bufflehead	*Bucephala albeola*	Documented
Harlequin duck	*Histrionicus histronicus*	Documented
American peregrine falcon	*Falco peregrinus anatum*	Documented
Black swift	*Cypseloides niger*	Documented
Yellow rail	*Coturnicops noveboracensis*	Suspected
Amphibians		
Oregon slender salamander	*Batrachoseps wrightorium*	Documented
Cascade torrent salamander	*Rhyacotrition cascadae*	Documented
Foothill yellow-legged frog	*Rana boylii*	Documented
Oregon spotted frog	*Rana pretiosa*	Documented
Northwestern pond turtle	*Clemmys marmorata marmorata*	Documented
Terrestrial Invertebrates (also Northwest Forest Plan Survey and Manage Species)		
Mardon skipper	*Polites mardon*	Suspected
Crater lake tightcoil	*Pristiloma arcticum crateris*	Documented

***Documented/Suspected**: Documented means that an organism that has been verified to occur in or reside on an administrative unit. Suspected means that an organism that is thought to occur, or that may have suitable habitat, on Forest Service land or a particular administrative unit, but presence or occupation has not been verified.

(Nature Serve, 2006; Weller and Zabel, 2001; O'Neil et al., 2001; Verts and Carraway, 1998). In summer, fringed myotis typically day roosts in large snags and rock crevices and forages in forest habitat including riparian habitats (Weller and Zabel, 2001; Hayes, 2003). Additionally, this species uses bridges as summer night roosts (Adam and Hayes, 2000). Little is known about winter use, although there are a few records in the Pacific Northwest of the species hibernating in caves and mines (P. C. Ormsbee pers comm.).

The bufflehead is an uncommon local breeder in the central and southern Cascade Mountains. It has been found nesting at a number of lakes at the higher elevations of Linn, Deschutes, Klamath, and Douglas Counties. The bufflehead is also a common transient and winter migrant through the state (Gilligan et al. 1994). This species typically summers on wooded lakes and rivers, winters on lakes and coastal waters.

The Harlequin duck is a fairly common transient and winter visitor along the coast and a rare summer resident on swift mountain streams in the Cascade Mountains. After the survey push in 1993 for this species by the Oregon Department of fish and wildlife, they were able to confirm breeding in the Hood, Deschutes, Sandy, Clackamas, Molalla, North Santiam, McKenzie and upper Willamette River drainages (Gilligan et al. 1994).

There is some documented breeding and foraging along portions of the North and Middle Forks Willamette River, as well as Salmon, Salt, and Hills Creeks on the Middle Fork RD. Other records of sightings include pairs, singles, and females with young in adjacent or nearby watersheds such as Santiam and South Santiam River, Salmon Creek, Salt Creek, Portland Creek, Blowout Creek, South Fork Breitenbush and Breitenbush Creek, Hills Creek, Lower Middle Fork, South Windberry Creek, Fall Creek, South Fork of the McKenzie River, McKenzie River, Blue River, French Pete Creek, Lookout Creek, Middle Fork of the Willamette River, Lost Creek, Big Lake, Walls Creek, and Deer Creek.

The Oregon Slender salamander (OSS) has been documented on the forest; however, our knowledge about the distribution of this species across its range, and on the Forest, is not complete. Within Oregon, 76% of the sites have been found in Matrix lands, and roughly 18% in the LSR (USDA 2006). One cautionary note is a sampling bias towards more activity generated surveys completed in matrix than in LSRs.

There are 13 documented locations (mostly on the Middle Fork RD) of Cascade torrent salamander on Forest. Although this species has a very limited range, it is mostly found in small very cold, clear springs, seeps, headwater streams, and waterfall splash zones. This species typically forages in moist forests adjacent to these areas. It is not very likely that any treatment areas occur in Cascade torrent salamander habitat.

The northwestern pond turtle (NWPT) is found throughout western Washington and Oregon. This species inhabits marshes, sloughs, and moderately deep ponds, slow moving portions of creeks and rivers. The NWPT has been observed in altered habitats, including reservoirs, abandoned gravel pits, stock ponds, and sewage treatment plants. Sparse vegetation, usually short grasses or forbs characterize most nesting areas.

On the Forest, populations of northwestern pond turtle occur along and between Lookout Point and Hills Creek Reservoirs on the Middle Fork Willamette River, as well as at one location in the Staley Creek watershed on Middle Fork RD. Elsewhere on the Forest pond turtles have been documented in the McKenzie River, and South and North Santiam River (Adamus 2003).

The Crater Lake tightcoil is associated with perennially wet environments in mature conifer forests and meadows among rushes, mosses and other surface vegetation or under rocks and woody debris within 30 feet of open water in wetlands, springs, seeps and riparian areas vegetation or under rocks and woody debris throughout the Oregon Cascades. The current range of this species is from the Mt Hood National Forest south to the Winema National Forest.

The Pacific fisher and the California wolverine do not currently occur on Willamette National Forest system lands. Oregon spotted frog are only known from a few locations on the Willamette NF. None of the sites are near weed treatment sites. The Foothill yellow-legged frog is only known from sightings that have occurred on or close to private land. There are no invasive plant treatments being analyzed in this document near known sites. The Pacific fisher, California wolverine, Oregon spotted frog, Foothill yellow-legged frog, Mardon skipper, least bittern, yellow-rail, will not be discussed further in this analysis.

Survey and Manage Species

Species that were covered under Survey and Manage as of March 21, 2004 (prior to the 2004 ROD) are once again included in the Survey and Manage program. The inclusion of some of these species in the Region's Special Status/Sensitive Species Program remains in effect. For the Willamette National Forest, one mollusk, the red tree vole and great gray owl are the only fauna included in the Survey and Manage program. The Survey and Manage mollusk, *Pristiloma arcticum crateris* is also included in the Special Status/Sensitive Species Program and is listed above.

The great gray owl is most common in coniferous forests adjacent to meadows. Surveys to determine occupancy are required in habitat that is above 3000 feet in elevation, within mature stands with greater than 60% canopy cover and within 1000 feet of meadows larger than 10 acres if the activity is considered ground-disturbing. Invasive plant treatments do not require survey.

The red tree vole is endemic to moist coniferous forests of Western Oregon and extreme northern California. Old growth forest conditions with Douglas fir as dominant tree species seems to be the preferred or optimal habitat. Surveys are required in the northern part of the WNF if activities are ground-disturbing; invasive plant treatments do not require survey.

Management Indicator Species

Management Indicator Species (MIS) are selected species whose welfare is believed to be an indicator of the welfare of other species using the same habitat or a species whose condition can be used to assess the impacts of management actions on a particular area (Thomas 1979). Table 15 includes those species that were identified as MIS for the Willamette National Forest (USDA 1990).

Species identified as MIS for the Willamette National Forest, with the exception of the Roosevelt elk and Columbian black-tailed deer, represent a suite of species that are dependent on mature and old-growth forest habitat. The black-tailed deer and elk represent wildlife associations that require a mix of vegetative age classes.

Table 15. Management Indicator Species

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"	see below
Columbian black-tailed deer	*Odocoileus hemionus columbianus*
Roosevelt elk	*Cervus canadensis roosevelti*
American pine marten	*Martes americana*

MIS are discussed below. The bald eagle is sensitive to management in riparian areas. The northern spotted owl represents wildlife species associated with mature and older coniferous forests. The bald eagle and northern spotted owl are discussed under the section titled "Federally Listed Species."

Pileated woodpecker

The pileated woodpecker represents species that inhabit mature coniferous forest habitats. The pileated woodpecker is the largest woodpecker species in the western United States and nests in cavities of large trees or snags. It is an inhabitant of mature forests, relying on dead and decaying trees for foraging and nesting. Pileated woodpeckers can act as a keystone habitat modifier by excavating large numbers of cavities that are depended upon by several other species, and by influencing ecosystem processes such as decay and nutrient cycling (Aubry and Raley 2002). Pileated woodpeckers will return to areas after timber harvesting (Ehrlich 1988), however, past management in the Pacific Northwest has lead to relatively few snags and down logs, especially of large diameters, remaining in many watersheds. Previous timber harvest, as opposed to wildfire events, has had the greatest effect on the availability of large diameter standing dead trees in the Willamette National Forest.

Primary excavators

A large number of species rely on cavities in trees for shelter and nesting. Examples include the red-breasted nuthatch, northern flicker, woodpeckers and the red-breasted sapsucker. Willamette National Forest system lands have designated a group of species for this Management Indicator category.

This group of species represents snag-dependent cavity nesters. It includes animals dependent on dead or dying trees for nest sites. "Primary cavity excavators" comprise a broad group of species associated with standing dead trees or snags and down logs, and that excavate their own nests.

Roosevelt elk and black-tailed deer

These two species are known throughout the Willamette National Forest. There are a number of established herds of Roosevelt elk that reside on the Forest as year-round residents, as well as many that are migratory, for example, moving into the Mt Washington, Three Sisters and Waldo Lake wilderness during the summer. Deer occur throughout the forest, and both species use a combination of habitats comprised of cover and forage areas that are not too fragmented by road systems. Oregon Department of Fish and Wildlife (2003) reported that predation, winter mortality, legal harvest, and disease were the primary causes of elk mortality. As one might expect, a high density of roads, common throughout the Forest, would have a negative impact on elk with increased disturbance from legal hunting and poaching (ODFW 2003).

On the Willamette National Forest, winter range is typically defined as land below 3,000 feet in elevation on the northern end of the Forest; 3,500 feet in the central part of the Forest; and 4,000 feet on the southern end of the Forest. The Willamette Land and Resource Management Plan (USDA 1990) provides direction that in those areas managed for winter survival, habitat capability should be managed to provide for a potential populations of two elk per 100 acres of winter range. Winter range should also be managed to for provide 50% of the area in thermal and hiding cover. High quality forage should be provided throughout the winter range.

Pine marten

The American marten (*Martes americana*), also known as the "pine marten," represents species that inhabit mature coniferous forest habitats. Pine martens occur in forests containing snags and down logs, which provide suitable denning sites. The pine marten is most closely associated with heavily forested east and north-facing slopes that contain numerous windfalls (Maser 1991). They tend to avoid areas that lack overhead protection and the young are born in nests within hollow trees, stumps, or logs.

Past management has lead to relatively few snags and down logs, especially of large diameters. Historic fire and intensive forest stand management within the national forest has lead to relatively few large snags and down logs, resulting in lower densities relative to historic levels. Many of the past harvest areas on the Forest are in the 80-120 year old age class, which are generally interspersed with varying size patches of old growth.

The Willamette National Forest has documented pine marten occurring on the Forest through casual observation or when conducting surveys for fisher and wolverine. Invasive species and pine martin habitat generally do not overlap.

Birds of Conservation Concern

Willamette National Forest system lands are included in Bird Conservation Region Five (Northern Pacific Rain Forests). Within this region, Willamette National Forest system lands may provide significant habitat, based on range maps in Nature Serve Explorer (Nature Serve 2005) and forest survey information for five species listed by the United States Department of Interior Fish and Wildlife Service (FWS) as "Birds of Conservation Concern.. These species include northern goshawk (*Accipiter gentiles*), black swift (*Cypseloides niger*), rufous hummingbird (*Selasphorus rufus*), and olive-sided flycatcher (*Contopus cooperi*). Peregrine falcons (*Falco peregrinus*) are included in Bird Conservation Region Five and occur on the Willamette National Forest. The peregrine falcon, goshawk, black swift and olive-sided flycatcher are known to nest on Willamette National Forest system lands, based on recent surveys. Brief descriptions of these species' life history are found in Appendix A.

Landbirds

In 1999, Partners in Flight released a conservation strategy for landbirds in coniferous forests of western Oregon and Washington (Altman 2005). The strategy identifies a select group of focal species and their associated habitat attributes that can be used to identify desired forest landscapes. All of the focal species identified (Altman 2005, Table 2, p. 146) are found on the Willamette National Forest. The strategy is intended to help facilitate land management planning for healthy populations of native landbirds. The document focuses on landscape-scale forest management, with emphasis on habitat structure. The conservation options recommended in the strategy are not relevant to invasive plant treatments because the treatments proposed in this EA do not involve modifying forest habitat structure or any other modifications to native habitat.

Amphibian Decline

Many species of amphibians in many parts of the world have experienced alarming population declines in the past two decades. International task forces have been formed and scientists have researched causes. A number of studies have documented declines, even in relatively undisturbed habitats (Drost and Fellers 1996, Lips 1998), while other studies have found some populations to be stable (Pechmann et al. 1991). However, detecting actual population declines in amphibian populations is difficult due to the extreme annual variation in populations caused by environmental factors, such as drought (Pechmann et al. 1991, Reed and Blaustein 1995).

Potential causes of amphibian declines investigated include ultraviolet radiation (Starnes et al. 2000, Adams et al. 2001), pesticides (Bridges and Semlitsch 2000), global warming (Blaustein et al. 2001) habitat loss, non-native predators (e.g. Drost and Fellers 1996, Knapp and Matthews 2000), and disease (Muths et al. 2003), among others. Results of studies are variable and some populations are in decline while others are not.

Environmental Consequences

Introduction

Effects of invasive plant treatment methods to wildlife were evaluated and discussed in detail in the R6 2005 FEIS and its Appendix P, the corresponding Biological Assessment (USDA Forest Service 2005c), project files, and SERA risk assessments (2001, 2003, 2004). These documents indicate that disturbance from manual and mechanical treatment pose greater risks to terrestrial wildlife species of local interest than herbicide use.

Risk from herbicide exposure was determined using data and methods outlined in the SERA risk assessments. Tables 8 and 9 in the R6 EIS Biological Assessment (USDA Forest Service 2005c, pp. 138-140) list the toxicity indices used as the thresholds for potential adverse effects to mammals and birds (respectively) from each herbicide. A quantitative estimate of dose using a "worst case" scenario was compared to these toxicity indices. There is insufficient data on species-specific responses to herbicides for free-ranging wildlife, so wildlife species were placed into groups based on taxa type (e.g. bird, mammal), body size, and diet (e.g. insect eater, fish eater, and herbivore). Under "worst case" scenarios, mammals and birds that eat insects or grass may be harmed by some herbicides and surfactants. Amphibians also appear to be at higher risk of adverse effects due to their permeable skin and aquatic or semi-aquatic life history.

The limited spatial extent of infestations, which are limited primarily to disturbed roadsides and powerline corridors (see Environmental Consequences Section, Table 6), and the limits placed on herbicide applications will reduce exposure of wildlife to herbicides. Standards 19 and 20 adopted in the R6 2005 ROD require that adverse effects to wildlife species of local interest from invasive plant treatments be minimized or eliminated through project design and implementation. In addition, Treatment Restoration Standard 16 restricts broadcast use of triclopyr, which eliminates plausible exposure scenarios (USDA FEIS, 2005a; USDA 1990). All action alternatives must be designed to comply with these standards.

Direct and Indirect Effects on Federally Listed Species: Bald Eagles, and Spotted Owls

Bald eagles

No Action

The No Action Alternative allows for manual and mechanical treatments for invasive plants. Manual treatments are not expected to have any effect on bald eagles. Potential effects of invasive plant treatment methods on bald eagles are associated with disturbance that may occur during the nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people and vehicles. Human and vehicle presence can disturb bald eagles during the breeding season, causing the birds to leave nests, or stay away from the nest long enough to have detrimental effects to eggs or young (U.S. Fish and Wildlife Service, 1986). Effects from mechanical methods (e.g. tractors, bulldozers, chainsaws, or string trimmers) may be more likely to occur, and occur at greater distances from the project site, because machinery creates louder noise.

The critical period in Oregon and Washington when human activities could disturb occupied nests extends from January 1 to August 31 (Anthony and Isaacs, 1989). Bald eagles are sensitive to human disturbance during this time, particularly within sight distance of nest sites. Invasive plant treatments will avoid conducting projects that create noise or disturbance above ambient levels in proximity to an occupied nest during the nesting season, as required by PDC-31 and 33. This same PDC has been included in many Biological Opinions throughout the region and has been found to be effective at minimizing effects to bald eagles because it minimizes or eliminates the source of disturbance near nests.

Invasive plant treatments will not result in the removal of bald eagle nest or roost trees, or suitable habitat, because invasive plants do not provide habitat. Projects could occur within suitable habitat.

Two bald eagle nests (Weed site # DE-R2 and MF-35) occur within 0.25 and four others (MR-49 b, c, d and e) are within 0.50 miles of proposed mechanical treatment areas. Mechanical activities may occur within the line of sight of eagle nests ½ mile away. Because disturbance is a plausible occurrence, all alternatives may affect bald eagle. However, the PDC included in all alternatives would minimize to the extent the effects are discountable the likelihood that disturbance to nesting eagles would actually occur. Therefore, all alternatives “may affect, but are not likely to adversely affect” the bald eagle from disturbance.

Wintering bald eagles are not as restricted to one location and are not as sensitive to disturbance as nesting eagles. Disturbance near winter roost sites is not likely to occur in any alternative because invasive plant treatments generally do not occur during the winter.

Action Alternatives

In addition to manual and mechanical treatments (effects discussed under No Action alternative), herbicides may be used as a tool for treating invasive weeds under Alternatives 2 and 3. Herbicides and surfactants applied according to PDCs, pose no risk to bald eagles. Bald eagles are not likely to be directly sprayed, or encounter vegetation that has been directly sprayed, because no aerial application is proposed. No ground applications of herbicide would reach the upper canopies of mature trees where bald eagles nest.

The potential for the herbicides to adversely affect bald eagles was determined using quantitative estimates of exposure from worst-case scenarios. The dose estimates for fish-eating birds were calculated using herbicide or NPE concentrations in fish that have been contaminated by an accidental spill of 200 gallons into a small pond. Assumptions used include no dissipation of herbicide, bioconcentration is equilibrium with water, contaminant level in whole fish is used, and upper estimate assumes 15 percent of body weight eaten/day. For chronic exposures, we used a scenario where the bird consumes fish from water contaminated by an accidental spill over a lifetime. All estimated doses used in effects analysis were the upper levels reported in the Forest Service/SERA risk assessments.

The following interpretations of the exposure scenario results are made with the reservation that toxicity data was generated from laboratory animals, which may not accurately represent potential effects to free-ranging wildlife.

The results of these exposure scenarios indicate that no herbicide or NPE surfactant poses any plausible risk to birds from eating contaminated fish. All expected doses to fish-eating birds for all herbicides and NPE are well below any known No Observable Adverse Effect Level (NOAEL - see R6 2005 FEIS, Appendix B). The weight of evidence suggests that adverse effects to bald eagles from NPE or the herbicides included in the action alternatives are not plausible.

Therefore, noise from mechanical and manual methods to control invasive plants, including equipment used to spray roadside vegetation, and with the implementation of PDC-31 on two territories that have known nest sites within 0.25 miles of proposed mechanical treatment have been determined to be a "may affect but not likely to adversely effect" to bald eagles (Table 17).

Northern spotted owl

Alternative 1: No Action

Manual treatments are not expected to have any effects on spotted owls. Mechanical treatments may disturb spotted owls during the nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people, vehicles and equipment. The potential for visual disturbance to cause harassment of spotted owls is low. Noise-generating activities above ambient could potentially cause enough disturbance to result in harassment of northern spotted owls during the breeding season. Noise or visual stimuli may interrupt or preclude essential nesting and feeding behaviors, cause flushing from the nest or missed feedings of young (U.S. Fish and Wildlife Service, 2006).

Projects that generate noise or activity above ambient levels and occur within the 35 yards (for heavy equipment), or 65 yards (for chainsaws or motorized tools), from an active spotted owl nest may cause these harassment effects (U.S. Fish and Wildlife Service, 2006). Some equipment used to treat invasive plants could create noise above ambient levels, depending upon site-specific conditions. Engines used to pump herbicide and other liquids through nozzles for roadside spraying operations, normally in the back of a pick up truck, may generate noise levels that could disturb spotted owls. Because noise levels of this type of equipment were not known, two diesel pump engines used for roadside spraying were evaluated for noise level. Two separate readings of different pump engines using different decibel meters produced readings of 72-75 decibels within 10 yards, dropping to 64-67 decibels at 35 yards (observations in the project file). The threshold for noticeable noise is 70 decibels and the threshold for disturbance causing “injury” or “harassment” is 92 decibels (U.S. Fish and Wildlife Service 2006). Vehicles used to spray roadside vegetation with herbicides do not make noise above 92 dB, based on the measurements by Mt. Hood National Forest biologists, so no effect to the northern spotted owl from noise disturbance will occur. Within 10 yards of a nest or un-surveyed suitable habitat, roadside spraying could create a brief noise of notice to spotted owls (e.g. slightly above 70 dB), but not loud enough to create disturbance (U.S. Fish and Wildlife Service 2006, project file data).

On Willamette National Forest system lands, no spotted owl activity centers are within 65 yards of proposed mechanized treatment. However, sixty-two (62) sites have unsurveyed Northern Spotted Owl habitat within 65 yards of mechanized treatment (See Table in Appendix D) Mowing and brushing uses machinery that can create louder noise, so treatment areas with these methods was considered a potential disturbance effect for owls.

Treatment areas that may use brushing or mowing include 2,373 acres of suitable habitat for spotted owls. The mandatory PDC -27 for spotted owls from the 2006 Willamette Province biological opinion (U.S. Fish and Wildlife Service 2006) requires that these methods, or others that generate sufficient noise (greater than 92 dB), to be conducted farther away than 35 yards for heavy equipment or motorized hand tools, and 65 yards for chainsaws, or outside the breeding season. This PDC has been included in several Biological Opinions throughout the region and has been found to be effective at minimizing effects to spotted owls because it minimizes or eliminates the source of disturbance near nests or suitable habitat.

Therefore, noise from mechanical and manual methods to control invasive plants, including equipment used to spray roadside vegetation, “may effect, but is not likely to adversely affect” spotted owls (Table 17).

Action Alternatives

In addition to manual and mechanical treatments (Discussed under the No Action Alternative), herbicide treatments could occur under Alternatives 2 and 3. Exposure scenarios used to analyze potential effects from herbicides are discussed in 2005 R6 FEIS, Appendix B, p. 461. None of the herbicides proposed for use in this EIS nor NPE surfactants, applied at typical application rates, pose a risk to northern spotted owls.

Spotted owls are not likely to be directly sprayed, or encounter vegetation that has been directly sprayed, because no aerial applications are proposed. No ground applications of herbicide would reach the upper canopies of mature trees where the owls nest and forage.

Spotted owls within Douglas-fir/Hemlock forests prey on red tree voles and flying squirrels, which are nocturnal and chiefly arboreal. Voles feed on the needles of Douglas-fir trees and the flying squirrels feed primarily on fungi and lichen. It is not plausible for the arboreal owls or their prey to be exposed to herbicides used within their activity centers in this forest type. However, a worst-case exposure scenario for the spotted owl was conducted using consumption of prey that had been directly sprayed, and assuming 100 percent absorption of the herbicide.

The following interpretations of the exposure scenario results are made with the reservation that toxicity data was generated from laboratory animals which may not accurately represent potential effects to free-ranging wildlife.

At typical application rates, the estimated doses from the exposure scenarios are all less than the reported NOAELs (no-observable adverse effect level) for all herbicides and NPE. Therefore, there is no basis for asserting or predicting that adverse effects to spotted owls from NPE or the herbicides considered in this EIS are plausible.

Invasive plant treatments do not remove or modify any of the primary constituent elements that define critical habitat. The action alternatives will have "no effect" to critical habitat for the northern spotted owl.

Table 16. Effects Determinations on Federally Listed Species (All Action Alternatives)

Species	Status	Effects Determinations
Northern Bald eagle	Threatened	May Affect, Not Likely to Adversely Affect
Northern spotted owl	Threatened	May Affect, Not Likely to Adversely Affect

Direct and Indirect Effects on Regional Forester Sensitive Species

Under the No Action alternative, the primary effects on sensitive wildlife species are disturbance and trampling from machinery or people treating invasive plants. Effects to wildlife are going to be very small as most would shy away from people or machines. Under action alternatives, there may be additional risks from herbicide contact.

Sensitive species' habitat would be protected in all alternatives because invasive plant treatments do not remove suitable habitat for any species, and the majority of the treatments will occur along highly disturbed roadsides which do not provide suitable habitat in most cases. Some species on the Willamette National Forest may have suitable habitat along roads, although in small amounts relative to the amount of suitable habitat that is not within a road corridor.

Baird's and Pacific Shrew

Roadside herbicide spray treatments for noxious weeds consist of a hand wand nozzle spray attached to a pick-up truck, or a person with a backpack sprayer conducting spot sprays of plants during the day. Both treatment methods take a couple minutes to conduct, do not generate noise much beyond the background noise of the road use. Treatment occurs in scattered small patches over localized areas.

Effects to Baird's and Pacific shrew habitat are predicted to be minor. Although the areas treated are adjacent to suitable habitat for the shrew, the treatment areas themselves are not considered good habitat. The possibility for exposure to herbicides under any action alternative would be on habitat adjacent to or in mature forest that would be backpack sprayed. There is a reduced risk of herbicide exposure with Alternative 2, as only 2014 acres adjacent to old-growth habitat could be treated with herbicides, compared to 4277 acres in Alternative 3.

Although the effects analysis shows that there is potential, the risk to exposure is minor. Openings and roadside habitats where most of the invasive plant treatments would take place is not shrew habitat. The effects analysis (Wildlife Report) indicates a toxic level of exposure is possible for Baird's shrews with the following herbicides: clopyralid, triclopyr, and NPE surfactant. This would only occur if the animal were to consume contaminated insects. Triclopyr and clopyralid would only be applied through spot spraying so the plausibility of exposure is small.

A key component of habitat for this species is down logs. None of the alternative would impact existing logs that are currently in these stands. No change in the microclimate in the adjacent stands is anticipated. It is predicted that the Preferred Action would not degrade nor would it remove potential Baird or Pacific shrew habitat from the area.

No impacts from manual, mechanical or cultural treatment are expected. These methods would not affect shrews.

Pacific Fringe-tailed bat

Roadside herbicide spray treatments for noxious weeds will consist of a hand wand nozzle spray attached to a pick-up truck, or a person with a backpack sprayer conducting spot sprays of target weeds. Both treatment methods take a couple minutes to conduct, do not generate noise much beyond the background noise of the road and bridge use. Treatment occurs in scattered small patches over localized areas. No spraying occurs directly adjacent to or over water.

Because the bats roost inside recessed crevices in snags and rock features during the day, it is not plausible that they would be disturbed by the spraying activity nor directly exposed to spray of herbicides or NPE.

Because spraying occurs during the day, it would affect diurnal insects. Since the bats forage at night on nocturnal insects, no effect on bat prey is expected. Also, because the spraying is localized in the herbaceous layer away from water and bats aerially feed in the canopy or over water, covering relatively large areas, it is unlikely that the bats would forage within the localized treatment areas.

The likelihood of a chronic exposure (90 days) to sprayed vegetation or contaminated insects by the fringed myotis is remote; therefore, "no impact" to Pacific Fringe-tailed bats will occur for all action alternatives.

Bufflehead and Harlequin Duck

The herbicide effects analysis in the R6 EIS (Appendix P) determined that there were no toxic effects from any of the herbicides analyzed for bufflehead and harlequin ducks. There are six treatment sites on the Forest (Westfir and Oakridge) where Japanese Knotweed will be treated directly adjacent the stream and river systems. The Treatment Restoration standard #16 requires that certain measures be taken with respect to the various herbicides and PDCs require using a stem injection technique for knotweed. There is a low probability that the harlequin duck would be present in the treatment area during the herbicide application. Although nesting has been documented in the North and Middle Forks of the Willamette River for the harlequin duck, there is no evidence to suggest they are within any of the treatment sites.

The effects analysis in the Region 6 EIS indicates exposure is not likely for the bufflehead or harlequin duck with the following herbicides: imazapyr, clopyralid, glyphosate, triclopyr, and NPE surfactant. Triclopyr would only be applied through spot spraying away from the 50- foot riparian buffer so the effect of this herbicide on bufflehead or harlequin ducks is not likely. Invasive plant treatments planned to treat the six Japanese knotweed sites are designed to reduce the impact on aquatic species. With the use of stem injection or weed wiping application methods, no dose of herbicide or NPE exceeded toxicity indices, even in a "worst case" scenario. Even though the treatments may occur when harlequin duck are present, based on the worst case scenario, it is not plausible this species would be impacted.

It is anticipated that some harassment from the treatments could occur but the effects would be minor to these birds.

Therefore, there will be "no impact" to bufflehead or harlequin ducks from the proposed treatments, regardless of alternative chosen.

American Peregrine Falcon

Three nest sites (Site No. OE-32, OE-85 and OE-93) for peregrine falcons occur within 1.5 miles of three proposed treatment areas (DE-F1a, DE-R5 and DE-R5-1). The mandatory PDC will avoid disturbance, and no herbicide or NPE dose exceeded the toxicity indices for fish-eating birds even in a "worst case" scenario, so there would be "no impact" to peregrine falcons regardless of alternative chosen.

Oregon Slender and Cascade Torrent Salamander

Suitable habitat for these two salamanders exists on the forest; much of it has not been surveyed. Suitable habitat has not been mapped but can be considered to be most closely associated with riparian areas and mature forests. For purposes of this analysis, the Riparian Buffer Zone is used as an indicator of suitable Cascade torrent salamander habitat that has not been surveyed. This will greatly overestimate the actual suitable habitat for these rare salamanders, which have very specific habitat requirements. There is an estimated 3232 acres within the Riparian Buffer Zone that may be infested with invasive plants (see Table 5). This compares to an estimated 161,633 total acres of Riparian Buffer Zone on the Willamette National Forest. So, of the unsurveyed suitable salamander habitat on the Willamette National Forest, 2 percent is infested acres that may be treated and 98 percent are not likely to have invasive plant treatments.

Oregon slender salamanders are not found along roadsides, utility corridors, administrative sites or forest openings where a majority of the invasive plant treatments are slated to occur. However, there are 2014 acres in Alternative 2 and 4277 acres in Alternative 3 adjacent to old growth forest habitat where herbicides could be used.

Mechanical treatments near streams and springs can create ground disturbance that could introduce silt into salamander habitat, potentially clogging the gills of the salamanders and resulting in mortality. Little is known about the effects of herbicides other than the potential for some herbicides to cause mortality or result in malformations of amphibian larvae. Effects of herbicides to amphibians are discussed in the R6 EIS for Invasive Plants (Appendix P, pp. 28-31).

The aquatic and salamander Project Design Criteria (11, 13, 19, 20, 21, 22 23) limit broadcast application of herbicides would minimize exposure of salamanders to the herbicides most likely to have adverse effects under either action alternative. PDC-28 requires surveys within 100-feet of springs or seeps prior to any herbicide treatment, which should further reduce any potential impact to this species.

Backpack application of herbicides within riparian and wetland sites reduces the likelihood and amount of herbicide that could contaminate water, soil or rocks used by salamanders. In addition, there is little overlap between the habitat for these salamanders and locations of infestations to be treated, as suggested by the Riparian Buffer Zone acres described above. Most invasive plants occur in more open, drier, and previously disturbed sites. Because there is minimal overlap between actual treatment sites and salamander habitat, and project design features minimize exposure to herbicides, this project may adversely impact individuals, but is not likely to lead to a trend toward federal listing of these salamanders.

Northwestern Pond Turtle

Very little research has been done on the effects of herbicides to reptiles. It is assumed therefore that the effects would be similar to other aquatic organisms such as fish (See Aquatic Species section). The PDCs reduce the risk of toxic effects and sedimentation from mechanical and manual methods.

Cultural methods such as the use of goats to control invasive plants would have a minor detrimental effect on turtle reproduction since the goats could walk along the shoreline of a pond and crush the shallow buried turtle eggs. Reproductive failure due to egg predation is possibly the reason for the decline in the turtle population. Goats could add to this loss.

There is a negligible impact to turtles, their populations or their habitat. Restricting or regulating herbicide use within 50 feet of a body of water, will reduce the potential of herbicide exposure to the turtles. The run-off that occurs will not raise concentrations to a level that would have toxic effects on the turtles. Because there is minimal overlap between actual treatment sites and pond turtle habitat, and PDCs minimize exposure to herbicides, this project may adversely impact individuals, but is not likely to lead to a trend toward federal listing of these pond turtles.

Crater Lake Tightcoil Mollusk

The only know location of this mollusk on the Forest is from a 2005 record which is not located within any treatment areas. While there is potential habitat for this species on the Forest, this species has not been found. Since there is a low likelihood this species exists in any large numbers on the Forest, it is tied closely to riparian conditions and specific micro-climate/habitat associations, it is not within any treatment sites, has a PDC (28) that provide adequate protection, there would be "no impact" to this mollusk specie from any alternative. The Project Design Criteria further reduce the risk to this species from manual, mechanical, and herbicide treatments; therefore, all action alternatives will have a "No Impact" on this species.

Table 17. Impact Determinations for Sensitive Wildlife Species

Wildlife Common Name	Impact Determination
Baird's Shrew	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Pacific Shrew	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Pacific Fringe-Tailed Bat	No Impact
Bufflehead Duck	No Impact
Harlequin Duck	No Impact
American Peregrine Falcon	No Impact
Oregon Slender Salamander	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Northwestern Pond Turtle	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Crater Lake Tightcoil	No Impact

Direct and Indirect Effects on Survey and Manage Species

The red tree vole, great gray owl and mollusk Crater Lake tightcoil (addressed above under Regional Forester Sensitive Species) are the only wildlife species currently included in the Survey and Manage program that occur on the Willamette National Forest.

The 2001 Survey and Manage ROD (USDA and USDI 2001, p. 22) states, "The line officer should seek specialists' recommendations to help determine the need for a survey based on site-specific information. In making such determination, the line officer should consider the probability of the species being present on the project site, as well as the probability that the project would cause a significant negative effect on the species habitat or the persistence of the species at the site." It is the professional opinion of the Forest Wildlife Biologist that pre-project surveys for red tree vole and great gray owl are not required for the proposed invasive plant treatments along roadsides, regardless of alternative, because there is a low probability of these species occurring within the infestations to be treated. Invasive plant treatments are similar in scope and scale to routine maintenance such as pulling ditches and removing encroaching vegetation, which are not considered habitat-disturbing activities in the 2001 ROD (p. 22). Routine maintenance of currently used roads can occur without the need for surveys because populations in adjacent habitat are expected to persist.

Red tree vole is arboreal but feeds exclusively on conifer needles. It could encounter some contaminated soil or vegetation when it moved on the ground from one tree location to another, but it is highly unlikely that it would trap enough on its body in the treated patches to affect this species. Even if it fed exclusively on contaminated vegetation for an entire day, or on 20% contaminated vegetation over 90 days, it would not receive a dose that exceeded any toxicity indices for any herbicide proposed or NPE. Direct spray is not feasible due to the red tree vole's arboreal and nocturnal behavior. An herbicide dose of concern is not plausible. No action alternative would alter habitat for these species. No adverse effects are plausible to populations.

The great gray owl is an uncommon and rare inhabitant of forest adjacent to openings above 3,000 feet (Marshall, Hunter, Contreras, 2003). Although a small population has been located on the Forest it is not a very widespread species. The Forest currently tracks about 18 nest locations of great gray owls.

Manual and mechanical treatment has the potential to disturb this species if within ¼ mile of an active nest site. There are no treatment sites identified within that ¼ mile zone and none of the treatments would have an effect on the prey used by great gray owls. The worst-case exposure never exceeds toxicity index from ingesting prey that has been sprayed with any of the herbicides proposed for treatment. Therefore, worst-case exposure to herbicides is not plausible (USDA FEIS, 2005a, Appendix P).

Direct and Indirect Effects on Management Indicator Species

The invasive plant treatments proposed in all alternatives focus on treating the target non-native plants and avoid or minimize effects to non-target native vegetation. No treatments will remove native trees or alter native habitat structure. Proposed treatments will improve cover of native plants within treatment areas and could contribute to improved habitat conditions for deer and elk in some select sites. Habitat for pileated woodpecker, primary cavity excavators, and pine marten is not substantially affected by invasive plants, nor would it be affected by invasive plant treatments.

Pileated woodpecker and Primary Excavators

Invasive plant treatments under any alternative would not affect the pileated woodpecker, or the primary cavity excavator group. These birds nest in cavities in dead limbs and forage on trees and shrubs. Lewis' woodpecker, and Northern flicker may encounter contaminated insects due to their foraging habits.

The 2005 R6 FEIS (Appendix P) assessed risk of herbicides to insectivorous birds. The exposure scenarios for insectivorous birds indicate that only NPE doses would exceed a threshold of concern in acute exposures at typical application rates. In order to receive this dose, the birds would have to feed exclusively on contaminated insects for an entire day's feeding. The above-mentioned species forage in relatively large areas, sometimes several acres or more, and forage on a variety of plants and locations (e.g. tree limbs and boles, understory shrubs, bare ground, and bird feeders). Proposed backpack and hand wand broadcast application of herbicides is proposed only along roadsides, utility corridors, and administrative sites. Other application methods treat individual plants and are unlikely to contaminate significant amounts of forage insects or seed. The patchy nature of proposed invasive plant treatments would make it unlikely for a single bird to feed exclusively on insects from treated patches, even in roadsides treated with hand-wand broadcast applications. However, adverse effects on some individual birds cannot be ruled out, due to lack of data on occurrence and foraging area within treatment areas.

Data on chronic exposure of birds to contaminated insects is lacking. Very conservative assumptions regarding herbicide residue on insects would indicate that several herbicides could exceed a threshold of concern in a chronic exposure scenario. However, chronic exposure thresholds of concern were established by daily doses for 90 days or more in laboratory studies. It seems highly unlikely that wild birds would feed exclusively on insects from treated patches of invasive plants along a roadside for the length of time needed to acquire a chronic dose of concern.

The northern flicker regularly forages for ants on the ground and ants can be active during herbicide applications. However, even if a flicker ate contaminated ants, it would have to eat nothing but contaminated ants for an entire day's feeding to be exposed to enough NPE-based surfactant to be a concern. Given that the vast majority of proposed treatments are along roadsides, and that flickers would move among various foraging sites throughout the day, this scenario is not plausible. Given varied diet, foraging strategies, and movement of northern flicker and Lewis' woodpecker, actual doses exceeding level of concern are unlikely.

Roosevelt elk and Black-tailed deer

Invasive plant treatments will not reduce available habitat for deer or elk, but could contribute to improved habitat quality in the long term (see Rice et al. 1997, for example).

The grazing and browsing habits of elk and deer make it possible for them to consume vegetation that has been sprayed with herbicide. Quantitative estimates of risk using "worst-case" scenarios found that none of the herbicides considered for use, at typical application rates, would result in a dose that exceeds the toxicity indices in either acute or chronic scenarios. The dose for NPE surfactant exceeds the toxicity index only in an acute scenario. The deer or elk would have to consume an entire day's diet of contaminated grass in order to receive this dose. Deer and elk do not forage extensively on the invasive plants found on the Willamette National Forest. They are not likely to forage exclusively on the patches of invasive plants that have been treated with herbicide. Treated sites comprise a very small proportion of the available foraging area for these species. Backpack spot sprays would only contaminate very small amounts of forage, if any, because forage species are not the target of the applications. The "worst case" exposure scenario for NPE is not plausible for the treatments proposed in any of the alternatives. Therefore, no plausible adverse effects to deer or elk would result regardless of alternative chosen.

Pine Marten

On the Willamette National Forest, pine martens are most likely to occur in remote wilderness areas or contiguous mature or old-growth forest. Most treatment areas are on roadsides and are unlikely to disturb pine martens, do not alter suitable habitat, and are unlikely to expose their prey. Even if pine martens consumed for an entire day nothing but prey that had been directly sprayed, they would not receive a dose that exceeded the toxicity indices for any herbicides or NPE (USDA Forest Service 2005a, Appendix P). No plausible effects would result from any alternative.

Direct and Indirect Effects to Landbirds

Invasive plant treatments proposed on the Willamette National Forest will not remove habitat of the focal species for coniferous forests. No trees will be removed and forest structure will not be altered by proposed treatments. Only species that forage or nest near the ground are likely to be exposed to disturbance from treatments or herbicides. Of the coniferous forest focal species identified in Altman (2005), the following species are most likely to forage or nest near the ground: varied thrush, Wilson's warbler, winter wren, black-throated gray warbler, Hutton's vireo, olive-sided flycatcher, western bluebird, orange-crowned warbler, rufous hummingbird Altman 2005; Marshall et al. 2003). Because these species are not reported to nest in invasive plant species targeted for treatment, manual and mechanical treatments are not likely to disturb nests of these species.

As discussed above for Primary Cavity Excavators, analysis in the 2005 R6 FEIS (Appendix P) indicated that only NPE poses a risk to insectivorous birds at typical application rates for acute exposures. Exposures resulting in a dose of concern do not appear plausible for the proposed treatments, as detailed above for Primary Cavity Excavators, although risk to some individual birds cannot be ruled out.

In conclusion, invasive plant treatments will not alter habitat for focal species in the Partner's In Flight land bird conservation strategy. Manual and mechanical treatments are not likely to disturb nests of focal species. Some individuals of focal species could be exposed to herbicides by foraging on contaminated insects, but the likelihood of any dose of concern is remote.

Direct and Indirect Effects to Birds of Conservation Concern

For all species included in the Birds of Conservation Concern, invasive plant treatments proposed on the Willamette National Forest will not remove or degrade their habitat. Removal of invasive plants will likely contribute to the integrity of habitat areas, although no specific habitat elements for these species are currently being affected by invasive plants on the Willamette National Forest.

Northern goshawks prey on ground-dwelling birds or mammals. It is a secretive hawk that generally avoids people or areas with disturbance and nests in dense, often mature, forest. The predatory bird exposure scenario was used to assess risk to northern goshawk from herbicide. Goshawk prey is unlikely to be directly sprayed because they are larger and more mobile species that would avoid the disturbance of a treatment. Even if goshawk should consume prey that had been directly sprayed, which is unlikely, all exposures for herbicide and NPE at typical application rates were less than reported NOELs.

The black swift and olive-sided flycatchers are insectivorous birds. They do not nest in close proximity to the ground and are not sensitive to the short-term disturbance that most invasive plant treatments would create. The exposure scenarios for insectivorous birds indicate that only NPE doses would exceed a threshold of concern in acute exposures at typical application rates (see 2005 R6 FEIS, Appendix P). In order to receive this dose, the birds would have to feed exclusively on contaminated insects for an entire day's feeding. Black swifts feed primarily on flying aquatic insects like mayflies, stoneflies, and caddis flies, catching them high in the air. These insects are unlikely to be directly sprayed because backpack spray of herbicide is limited or prohibited in their habitats. Therefore, any exposure of concern for black swift is unlikely.

Olive-sided flycatchers also catch their flying insect prey high in the air, launching from a high perch in a snag or tree. Proposed broadcast spraying is along infested roadsides and the infestations occur in patches rather than long solid infestations. The patchy nature of proposed invasive plant treatments would make it unlikely for a single flycatcher to feed exclusively on insects from treated patches. While some of their insect prey may become contaminated by broadcast spraying, it seems unlikely that they would forage exclusively on contaminated insects. Chronic doses are even more unlikely, as described above in the effects to Landbirds. Therefore, negative effects to olive-sided flycatchers are unlikely.

The rufous hummingbird inhabits open areas and meadows, catching insects and sipping nectar. A small amount of exposure to herbicides or NPE could amount to a dose of concern because of the very small body size of the rufous hummingbird. These hummingbirds could forage in open areas where invasive plants have been treated and possibly glean contaminated insects. It is unlikely that they would forage exclusively within a patch of invasive plants. These hummingbirds are not known to heavily utilize invasive plants for a nectar source and they prefer tubular flowers where the nectar is deep inside the corolla. Native forage plants would not be treated so the nectar is unlikely to be contaminated with herbicide. Rufous hummingbirds breed from Alaska south to Oregon. The patchy nature of the invasive plant infestations and the multi-state breeding range for this bird indicate that while adverse effects to some individual birds cannot be ruled out, there is not likely to be any population-level effect to the species from proposed invasive plant treatments on the Willamette NF.

Herbicide Use and Amphibian Decline

Information on the effect of pesticides on amphibian populations is limited, and the studies that are available often focus on the most toxic compounds like insecticides (e.g. Taylor et al. 1999, Bridges and Semlitsch 2000, Boone and Semlitsch 2001, Relyea and Mills 2001, Relyea 2004). Some herbicides are known to have adverse effects on amphibians (e.g. Hayes et al. 2002, Wojtaszek et al. 2005). To date, atrazine is the only herbicide that has been implicated in overall amphibian declines (Hayes et al. 2002). The pesticides investigated (e.g. carbaryl, PCB's, atrazine) all have much higher propensity to accumulate in the fatty tissues than the herbicides proposed in this document. For example, Atrazine has a Kow of 481 while the highest Kow for any herbicide proposed is 45.1 for sethoxydim, and all the other herbicides have Kow ranging from 2.1 to much less than 1. There is a substantial data gap regarding effects of the herbicides included in this analysis and the potential for effects to amphibian populations, but current date on these herbicides does not suggest a risk to amphibian populations because they do not accumulate in animal tissues and are less persistent, less mobile, and less widely used than pesticides that have been implicated in amphibian declines.

Project Design Criteria have been proposed that respond to uncertainty about effects to amphibians from herbicide exposure. These Project Design Features (e.g. PDCs 11, 13, 19, 20, 21, 22, 28) prohibit broadcast spraying, specify selective application methods, and limit the herbicides that can be used within certain distances of amphibian habitat.

Cumulative Effects Analysis for All Alternatives

The Project Design Criteria common to all action alternatives are likely to effectively reduce risk of adverse effects to terrestrial wildlife because they minimize or eliminate disturbance and herbicide exposure scenarios of concern.

There will be no disturbance to nesting bald eagles or spotted owls due to Project Design Criteria 25, 26 and 27 that prescribe seasonal restrictions from mechanical and motorized equipment.

Herbicides were the other treatment method that was a risk to wildlife. Several Region 6 sensitive wildlife species- Baird's shrew, Pacific shrew, Oregon slender salamander and Northern pond turtle- could experience some adverse effects under Alternatives 2 and 3. The past, present and future use of herbicides is detailed in the Herbicide Use on Other Lands (p. 38). The use of herbicides in terrestrial habitats is extremely small in comparison to the number of acres being treated on private forestry, railroad, county and adjacent federal land, not to mention agricultural use downstream. The types of treatments application methods that are proposed, implemented according to Project Design Criteria, have a low likelihood of contributing to cumulative effects from other projects on and off the Willamette National Forest. Invasive plant treatments are likely to have an overall beneficial impact to wildlife to the extent that invasive plants are replaced with native vegetation.

All of the environmental standards, policies and laws related to wildlife would be met in all alternatives.

Botanical Species of Concern

Current Condition

Invasive plants present within the Forest and pose a threat to native plant communities and rare botanical species included on the Pacific Northwest Sensitive Species List (USDA Forest Service), Survey and Manage plant species (Northwest Forest Plan). No species listed as Threatened or Endangered by the Fish and Wildlife Service have known locations on the Willamette National Forest. In this document, all are referred to simply as botanical species of concern.

Invasive species have been documented on 9700 acres of Willamette National Forest. The majority of sites proposed for treatment are located in disturbed areas- along roads (site types 1 and 2), powerline corridors (site type 5), in timber sale units and landings (site type 2) and in recreational areas (site type 4). With the exception of some forested campgrounds, these areas are not high probability habitat for botanical species of concern. There are some habitats such as meadows (site type 7) and forested stands (site type 6) that do contain potential habitat for sensitive plants.

Seventy-two Regional Forester's Sensitive Plant species are either documented or suspected to occur on the Willamette National Forest (see Botanical Biological Evaluation for complete species list). This list includes bryophytes, lichens, fungi and vascular plants. A prefield review of weed sites and known sensitive plant populations reveals that several Region 6 Sensitive plant populations have potential habitat in areas with weed infestations. Sensitive plants are routinely surveyed for in ground-disturbing project areas and weed sites from these surveys have been documented and are included in the list of project areas in this Environmental Assessment; the list of sites where weeds coexist with botanical species of concern comes from known sites and these surveys.

The results of the prefield review and field surveys show that 11 weed sites are within 200 feet of sensitive plant populations (Table 18).

Polystichum californicum, California swordfern, is a fern that grows out of rock outcrops. There are 16 populations in the state of Oregon and only one on the Willamette National Forest. On the WNF it grows in a steep, south-facing grass-dominated hillside with an oak overstory. False brome is invading the grass understory and has come within 5 feet of the sensitive plants. The false brome at this site was treated with Rodeo for the first time in 2006. Due to current EA constraints, a 200 foot buffer was maintained around the population.

Romanzoffia thompsonii, Thompson's mistmaiden, is an ephemeral annual that lives in seasonally wet rock garden habitats. Over 50 populations of this plant occur on the WNF, but this is the epicenter of its range. It is a northwest Oregon western Cascades endemic. Spotted knapweed grows intermittently along the road shoulder below the rock outcrop this population inhabits along road 19. Knapweed has been treated with Rodeo along this road system since 1999; no knapweed had climbed the rock outcrop and the population of *Romanzoffia*, last surveyed in 2004, is stable. At the Beard Saddle site, the population is at risk from Scotch broom, blackberry and St. Johnswort. The Scotch broom was manually controlled along the road corridor leading to this population in 2006. St. Johnswort was manually controlled at the Tombstone Pass population of Romanzoffia in 2006. Spotted knapweed is spot sprayed along the highway 20 road corridor that is near the population.

Carex scirpoidea var. *stenochlaena* is a sedge that grows on basalt cliffs. Populations of this species are widely scattered within the state; two populations are known from WNF and others are in Wallowa County, in the northeastern part of the State. Spotted knapweed grows intermittently along the road system below the cliff face where this population is growing. This road system has been treated with Rodeo in backpack sprayers since 1999.

Ophioglossum pusillum, adder's tongue, is a member of the grape fern family. It grows in meadows, coastal deflation plains and adjacent to ephemeral ponds. There are 9 populations in Oregon, 5 of which are on the WNF. The population in question grows in a disturbed mesic meadow that has been grazed in the past. Canada thistle, reed canarygrass, and false brome, are found within the meadow. Manual control of these species was initiated in the summer of 2006.

Cimicifuga elata, tall bugbane, is a member of the buttercup family that lives in openings in mixed coniferous/deciduous (big leaf maple) forests with a swordfern understory. Hundreds of populations of tall bugbane are documented in Oregon; it is found on every Ranger District on WNF. Blackberry and tansy ragwort are located along roads adjacent to *Cimicifuga* populations. Tansy has been manually controlled along road shoulders for many years. Some manual control of blackberry was initiated in 2006.

Scheuchzeria palustris and *Scirpus subterminalis* are wetland species. Neither species has a large number of sites on the Forest but they are both widespread within the state and more common elsewhere. They grow in bogs or pond edges. The spot where these plants grow is about 100 feet from highway 22 where there are scattered populations of spotted knapweed. This corridor has been spot sprayed with Rodeo since 1999.

Pseudocyphellaria rainierensis is a foliose lichen that lives in the canopy of old-growth forests *Nephroma occultum* is another old-growth associated lichen that makes its home in the forest canopy. Both are classified both as Region 6 Sensitive and Survey and Manage. Dozens of sites

Table 18. Botanical Species of Concern at Risk from Invasive Plants

Species at Risk	Organism	Weed Invading	Site	District	Site No.
Polystichum californicum	Fern	False brome	Canyon Creek	Santiam River	SH-93
Romanzoffia thompsonii; Carex scirpoidea ssp. stenochlaena	Vascular plant; Sedge	Spotted knapweed	Road 19	McKenzie River	BR-02
Ophioglossum pusillum	Grape fern	False brome, thistles, reed canarygrass	Owl Creek	McKenzie River	MR-40
Cimicifuga elata (3 populations)	Vascular plant	Blackberry, tansy	Moose Mountain	Santiam River	SH-71
Cimicifuga elata	Vascular plant	False brome	Moose Mountain	Santiam River	SH-46,47,92
Cimicifuga elata	Vascular plant	Blackberry, reed canarygrass, false brome	Hwy 20, waste area	Santiam River	SH-72
Scirpus subterminalis; Scheuchzeria palustris; Pseudocyphellaria rainierensis; Nephroma occultum	Vascular plants; lichen	Spotted knapweed	Hwy 22	Santiam River	DE-05
Romanzoffia thompsonii	Vascular plant	Scotch broom, blackberry, St, Johnswort	Beard Saddle	Santiam River	DE-S2
Romanzoffia thompsonii	Vascular plant	Spotted knapweed	Tombstone Pass	Santiam River	SH-02
Usnea longissima	Lichen	False brome	Aufterheide	Middle Fork	MF-101
Montia howellii	Vascular plant	Spotted knapweed and sweetclover	Willamette Pass	Middle Fork	OA-1
Pseudocyphellaria rainierensis; Nephroma occultum	Lichen	Spotted knapweed	Hwy 20	Santiam River	SH-01
Usnea longissima	Lichen	Spotted knapweed	Hwy 126	McKenzie River	MC-03
Usnea longissima	Lichen	False brome; blackberry	Moose Creek	Santiam River	SH-56, 73,90,28, 94,25,128
Phaecollybia sipei; P attenuate	Fungus	False brome	Whiterock Creek	Santiam River	SH-25
Phaeocollybia sipei	Fungus	False brome	Moose Mt.	Santiam River	SH-28

are documented on the Willamette National Forest for *Pseudocyphellaria* while *Nephroma* is found a little less frequently. Both are widespread within the state. Spotted knapweed, Centaurea maculosa, grows intermittently along both Highways 22 and 20, corridors that lead from Bend/Sisters (an area of very high concentrations of this weed) to Salem and Sweet Home respectively. The highway corridors have been spot sprayed with Rodeo since 1999.

Usnea longissima is a fruiticose lichen found hanging from large trees in riparian corridors or fog zones where there is a lot of residual moisture in the air. *Usnea* is uncommon on the Willamette NF but is widespread in Oregon. False brome has moved into the Aufderheide road system along the North Fork of the Middle Fork of the Willamette at one site where *Usnea* is found. The second site has spotted knapweed growing intermittently along the highway 126 corridor. This corridor has been spot sprayed with Rodeo since 1999. The final site has Usnea growing along Moose Creek. Some populations of false brome are spot sprayed along the 2025 and its tributary roads.

Montia howellii is an ephemeral member of the carnation family. It is very small in stature and easily overlooked. It grows in waste places such as parking lots and highway pullouts where there is standing water. The *Montia* likes the puddles. Many populations of this species are documented in Oregon and on the Willamette. Spotted knapweed and yellow sweetclover are found sporadically along the road shoulders of highway 58. These species have been spot sprayed with Rodeo since 1999.

There are many sensitive fungi species on the Sensitive Species list for the Willamette National Forest. Two fungi have been documented from weed sites: *Phaeocollybia sipei* and *P. attenuata*. These fungi were located during Region 6 Strategic Surveys. Specific surveys for fungi in treatment areas has not occurred due to impracticality of single-visit survey protocols (USDA, 2004).

There are eighteen Survey and Manage Species suspected or documented to occur on the Willamette National Forest (See Botanical Survey and Manage Prefield Review for full species list). Survey and manage botanicals are old-growth-associated bryophytes, lichens, fungi and vascular plant species that are surveyed for and populations managed due to concerns over viability (see Wildlife discussion concerning Survey and Manage direction). Two survey and manage species were documented; *Pseudocyphellaria rainierensis* and *Nephroma occultum*. These species are also Regional Forester's Sensitive species and have been addressed in preceding paragraphs in this section. No Survey and Manage bryophytes or fungi are found within 200 feet of weed sites.

Direct and Indirect Effects

Alternative 1

In all cases, manual control would be the choice where botanical species of concern are found. If weed infestations are allowed to continue growing because manual control methods are unable to eradiate them, populations of botanical species of concern could be at risk of extirpation due to competition for habitat from invasive non-natives.

Direct effects would include unintentional trampling of flowers, fruits, or root systems of botanical species of concern. Indirect effects brought about by these direct effects could include microsite shifts such as reduction in productivity, reduction in soil moisture, disruption of mycorrhizal connections, and increase in soil temperature (USDA Forest Service, 2005a). Creation of open microsites could enable new weed species to come into the areas that are opened up by manual control. However, these sites would be revegetated after control, so the chance of weeds reinvading should be minimal.

Alternative 2

Under this Alternative, manual, mechanical and cultural methods are available for use where applicable. Additionally, spot spray of the chemicals glyphosate and triclopyr are allowed outside 50 foot riparian buffers.

Effects from manual and mechanical treatments will be similar to the no action alternative.

Several populations of botanical species of concern are found within 200 feet of weed populations and are thus deemed potentially at risk from herbicide treatments. As with non-target vegetation, the greatest risk to these species is effects from herbicide spray drift or leaching through the soil. Effects would be mitigated by a 200 foot buffer on all TES plant species.

This 200 foot buffer could put some species at risk from invasion. For example, false brome is less than 10 feet from the Polystichum californicum population. Because manual control is largely ineffective on large stands of false brome and manual controls could adversely affect the microsite (root system or mycorrhizal networks) of Polystichum, the inability to spray herbicides closer could compromise this species existence. The same thing can be said of all of the other vascular botanical species of concern if the weeds creep closer to populations.

The Region 6 Invasive Plant FEIS (R6 2005 FEIS, 4-130) concluded that some non-vascular plants and fungi would be negatively affected by at least two active ingredients (triclopyr and glyphosate).

Little information is available on how herbicides may affect non-vascular plants. Newmaster et al. (1999) analyzed the relationship between herbicide application rates and changes in bryophyte and lichen abundance and species richness after direct application of herbicides using spray bottles. They divided bryophytes and lichens into three ecologically-defined response groups: herbicide-tolerant colonizers, semi-tolerant long-term stayers from dry open forest, and sensitive forest mesophytes. They tested two herbicides used in Canada in silviculture treatments to control competing vegetation: triclopyr and glyphosate. Their research showed that bryophyte and lichen abundance and species richness decreased after herbicide treatments. They found that drought-tolerant species recover within one year but that others may take up to 4 years to recover. Some mesophytic species were eradicated. Hallbom and Bergman (1979) found that triclopyr had no effect on the nitrogen fixation in lichens. However, since lichens and bryophytes lack roots and instead obtain moisture and nutrients directly from the atmosphere, they are particularly sensitive and vulnerable to aerosols and contaminants in the atmosphere such as herbicide mist. Lichens would be especially sensitive to herbicides because they lack a waxy cuticle and so would easily absorb them (USDA, 2006- DES EIS).

Since surveys for fungi have not been completed because they are not surveyable, it is unknown whether any rare fungi are located in weed sites (see Botanical Biological Evaluation). Some species of fungi and their communities could be negatively affected by triclopyr and glyphosate (SERA, 2003a and 2003b; Estok et. al, 1989; Chakravarty and Sidhu, 1987). The FEIS stated that fungi could be negatively affected by herbicides known to affect soil mycorrhizae (glyphosate, triclopyr) but studies are laboratory based and results difficult to extrapolate to field situations. Also, effects seem to be concentration-dependant. NCAP (2000) notes that triclopyr inhibits the growth of mycorrhizal fungi and notes that the most sensitive species are affected by concentrations of .1 ppm. Charkravarty and Sidhu (1987) also found that mycorrhizal fungi were inhibited by glyphosate and triclopyr at >10 ppm. They noted that triclopyr is more toxic than glyphosate and that at low application rates glyphosate can act as a stimulant. Trappe et al. (1984) found that glyphosate and triclopyr either caused no reaction to a stimulating effect on mycorrhizal fungi. Cox (1995) notes that growth inhibition of mycorrhizal fungi occurs anywhere between 1 and 100 ppm. Chakravarty and Chatarpaul (1990) found effects of glyphosate to be dose-dependent. Although there was a short-term effect, the long term soil microbial population remained unchanged at rates of .54 and 3.23 kg active ingredient/hectare.

There should be no direct or indirect effect to *Pseudocyphellaria rainierensis*, *Nephroma occultum* or *Usnea longissima* populations from any control methods proposed as these are forest canopy species. Herbicide drift is not expected to reach the forest canopy with a 200 foot no-spray buffer and manual or mechanical controls will occur on the ground, well away from species' habitat.

There may be small-localized effects on fungal species of concern, as most are mycorrhizal.

However, the fungal species of concern are associated with late successional forest ecosystems, which are not usually of high susceptibility to invasion; the vast majority of our invasive plant sites occur along roads, in powerline corridors, waste areas, and other disturbed sites. Therefore, a call was made that treatments under this Alternative May Effect Individuals but are not likely to lead to a need for listing.

Early Detection-Rapid Response

Although no bryophytes or fungal botanical species of concern are found in known weed sites, additional weed sites could harbor these species. Under this Alternative, the Forest can add 25 new sites per year. To mitigate any potential effects on these species as well as any new vascular or lichen species of concern, there is a mitigation measure to survey all new weed sites with potential habitat (mostly site types 4, 6 and 7) for botanical species of concern prior to consideration for inclusion in the treatment program. If botanical species of concern are located, they will receive 200 foot buffers from herbicide treatment.

Alternative 3

Under this Alternative all control methods available in Alternative 2 would be available. In addition, 3 herbicides are proposed for use: sethoxydim, clopyralid and imazapyr. Glyphosate and imazapyr would be available for restricted use in riparian areas. All herbicides would be available for use in upland situations, depending on soil properties. There is no designated buffer from herbicide treatments for botanical species of concern under this Alternative.

The effects to rare botanical species would be similar to Alternative 2, except for the populations at risk from invasion of weeds that are uncontrollable by manual means. Some populations (Owl Creek, Canyon Creek) may require herbicides to treat the false brome that is invading the habitat. In these cases, Project Design Criteria denote that herbicide would be either hand-wicked or sensitive plants would be shielded from herbicides. Glyphosate, a non-leaching herbicide, would be used to treat plants. Other populations may require chemical treatment of blackberry, reed canarygrass or thistles if manual controls are deemed ineffective or weed species get too close to botanical species of concern for manual controls to be effective. Although there is a risk that some sensitive plants would be killed by herbicide application, the risk of total loss of the entire population through competition from a weed infestation would be worse.

No data could be found during literature searches for the effect of imazapyr on botanical species of concern. The Risk Assessment for clopyralid noted a couple of experiments on effects to fungi: one showed no effect on spore germination and another showed inhibition of growth of a fungus on winter wheat (SERA, 2004a). One paper on the effect of sethoxydim notes that effects were dose-dependent. At low concentrations fungi are stimulated; at high concentrations fungi are suppressed. Effects on fungi are still quantified as "may affect individuals" but not likely to cause listing.

Early Detection Rapid Response

EDDR would function in a similar way as Alternative 2 except that an unlimited number of new sites could be added. There is a requirement to survey all new weed sites with potential habitat (mostly site types 4, 6 and 7) for botanical species of concern prior to consideration for inclusion in the treatment program. (See Project Design Criteria). If Rare botanical species were encountered, Mitigation Measures would be used to ensure their survival.

Cumulative Effects

If the noxious weed populations that are putting sensitive plant species at risk are allowed to expand because adequate control methods are unavailable under the No Action alternative, populations could be extirpated. This would not lead to a need for listing any of these species under the Endangered Species Act, but it would affect the distribution of several species and biodiversity on the Forest. The *Polystichum californicum* site is the only one on the Forest and the most northern population of this species known in the Pacific Northwest. It probably contains a unique genetic component that would be lost with the population. The *Ophioglossum pusillum* site is one of 3 known from the McKenzie watershed, but it is the lowest in elevation and in a unique habitat. Only 9 populations are known from the Pacific Northwest, although the distribution of the species is circumboreal.

Under Alternative 2, at least two botanical species of concern, *Polystichum californicum* and *Ophioglossum pusillum,* remain at risk due to the ineffectiveness of available treatments. Even though populations could be extirpated, this would not lead to a need for listing these species under ESA.

Alternative 3 provides the best chance for survival of all botanical species of concern found in weed treatment areas because it allows for the fullest range of treatments available. No loss of populations is expected under this Alternative.

Fish and Aquatic Organisms

There are a variety of habitat types for aquatic species on the lands managed by the Willamette National Forest, from high elevation lakes, ponds, reservoirs, steep stream channels, and low gradient, meandering stream channels with side-channel habitat. These features provide habitat for a diverse array of aquatic-dependent species, including anadromous fish, resident fish and aquatic macroinvertebrates.

Lands managed by the Willamette National Forest provide important habitat for four fish species listed under the Endangered Species Act of 1973 (as amended) (ESA), one endangered and three threatened. None of the aquatic macroinvertebrates are listed under the Act.

The Land and Resource Management Plan for the Willamette National Forest identifies “Anadromous Fish” and “Resident Fish” as two Management Indicator Species (MIS) (actually general assemblages of fish). NFMA requires the Forest Service to plan the management of habitat to “maintain viable populations of existing native and desired non-native vertebrate species in the planning area.” NFMA further requires the Forest to establish objectives to maintain and improve the habitats of these indictor species.

The Regional Forester’s sensitive species list does not identify any additional aquatic species other than those listed under the ESA.

Invasive plant species have become established on the Willamette National Forest and continue to spread. Some of these invasive plants can reduce the quality of instream aquatic habitat, resulting in a negative effect to aquatic life, although these risks are minimal.

Methods used to control invasive plants have the potential to result in negative effects to individuals and their habitat.

The following analysis of effects to aquatic life focuses on the potential effects of treatment on ESA-listed endangered and threatened fish species, Management Indicator Species, and aquatic macroinvertebrates, to the extent where changes to their abundance or distribution may affect the food supply for fish.

Riparian areas provide vital habitat features for aquatic species. Near-stream vegetation shades the water surface, helping to regulate stream temperature, keeping streams cool during the summer, when fish are most susceptible to temperature related negative reactions. The roots of near-stream vegetation stabilize stream banks, and allow for the formation of undercut banks, an important habitat feature for juvenile and adult fish. The rapid growth and propagation of invasive plants allows them to out-compete many native plants. This competitive advantage results in the loss of functional riparian communities, loss of rooting strength and protection against erosion, decreased slope stability, and increased sediment delivery to streams, impacting water quality (Donaldson 1997), and potentially degrading habitat for aquatic organisms.

Where invasive plants provide less effective ground cover and a shallow root system than native plants, there is a greater potential for a surface erosion, bank erosion and in-stream sediment delivery during high intensity rainfall events. This situation is similar to the stream temperature description above, in that most of the sediment increase to adjacent surface water is anticipated to be insignificant, due to the localized infestation of invasive plants. Infestations do have the potential to introduce small, localized amounts of sediment in areas that have highly erosive banks that are covered with a large (approximately 50 feet or more along the edge of the stream) contiguous block of shallow rooted invasive plants. Talmage (2004) found that if a shallower rooted invasive plant species such as Japanese knotweed completely occupy an unstable stream bank, the potential for stream bank instability during high flows is much greater than if the same site was occupied by deeper rooted native vegetation. Invasive plants also could complicate restoration by preventing the re-establishment of native vegetation that is more effective for providing stream shading, stream bank/soil stability, and ground cover.

Himalayan blackberry has created a physical barrier and blocked salmonid migration upstream in one tributary on the Columbia River Gorge National Scenic Area (Chuti Fiedler, personal observation, 2005). Similar situations have not been observed on the Willamette N.F.

Endangered Species Act:

There are four fish species[2] listed under the ESA which utilize habitat on the Willamette National Forest. Oregon chub (*Oregonichthys crameri*) is listed as an endangered species, and Upper Willamette River (UWR) Chinook salmon (*Onchorhynchus tshawytcha*), UWR steelhead (*O. mykiss*), and Columbia Basin bull trout (*Salvelinus confluentus*) are listed as threatened. Distribution of these species on the Willamette National Forest is shown in Figures 1-3 (distribution maps for Oregon chub are not available for public disclosure).

More detailed information on fish species life histories, threats, and conservation measures can be found in the Biological Assessment prepared for the Regional Invasive Plant Program (USDA Forest Service 2005c), which is incorporated by reference.

Endangered Species Act - Critical Habitat:

Critical habitat has been designated for Chinook salmon, steelhead, and bull trout, but has not been designated for Oregon chub.

The National Marine Fisheries Service has designated critical habitat for UWR Chinook salmon and UWR steelhead (70 Federal Register 52630, September 2, 2005). Critical habitat for these two species includes most of the habitat currently utilized by these fish. The US Fish and Wildlife

[2] Specific geographically separated meta-populations of Chinook salmon, steelhead and bull trout were considered for listing under the ESA. These are referred to as a distinct population segment (DPS) or evolutionary significant unit (ESU) and do not necessarily include all of a given fish population.

Service has designated critical habitat for Columbia Basin bull trout (70 Federal Register 56233, September 26, 2005). This listing explicitly excluded Federal Lands managed under the NW Forest Plan from this designation; therefore there is no bull trout critical habitat on the Willamette National Forest.

Primary constituent elements for steelhead and Chinook salmon are sites and habitat components that support one or more life stages. The first three, listed below, refer to freshwater habitat components, whereas the last three relate to estuarine or marine habitat components. Nothing proposed in any alternative would have any affect on estuarine or marine habitat components, thus they are not discussed.

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development.
2. Freshwater rearing sites with:
   a. Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
   b. Water quality and forage supporting juvenile development; and
   c. Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
3. Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions, and natural cover, such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

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)).

Management Indicator Species – Aquatic Species

The Land and Resource Management Plan for the Willamette National Forest identifies "Anadromous Fish" and "Resident Fish" as two Management Indicator Species (MIS) (actually general assemblages of fish). Anadromous fish present on the Forest include spring Chinook salmon, winter steelhead, summer steelhead, and Pacific lamprey, and resident fish include rainbow trout, cutthroat trout, bull trout, brook trout, Oregon chub, sockeye salmon (naturalized), white and black crappie, largemouth bass, brown bullhead, pikeminnow, mountain whitefish, largescale sucker, chiselmouth, sculpins, redside shiner, brook lamprey, and dace.
NFMA requires the Forest Service to plan the management of habitat to "maintain viable populations of existing native and desired non-native vertebrate species in the planning area." NFMA further requires the Forest to establish objectives to maintain and improve the habitats of these indicator species.

Aquatic macroinvertebrates are an important resident of streams, lakes, and ponds located on the Willamette National Forest. Presence, abundance, and status of invertebrate species that reside in area water bodies are not well understood. Limited sampling of macroinvertebrates has shown robust populations with a range of species representing a wide variety of feeding groups (predators, grazers, leaf shredders) usually present, but definitive studies to characterize diversity, richness, and biomass are lacking. Macroinvertebrates are an important food source for many of the ESA-listed fish on the Forest.

Aquatic habitat conditions across the Forest vary depending on the location, past land management activities, and natural events such as floods, fire, and debris torrents. In general, streams that have experienced little to no land management are in good condition even though Forest Plan standards (pools per mile, pieces of wood per mile, etc.) are not always met. Some of these streams have been impacted by natural events and, indeed, were formed or maintained by such events.

Fish habitat conditions within watersheds where land management has occurred range from poor to good, depending on the type and scale of disturbance, proximity to streams, and duration of land management activities. Watersheds have been affected by logging, dams, road construction, and past flood control activities. Separately and cumulatively, these activities have resulted in some loss of connectivity, reduction of stream shading, alteration in riparian vegetation and function, increased sedimentation, reduced instream large woody debris, and loss of pools.

Actions proposed in all alternatives would not affect physical stream habitat parameters such as pool quantity and quality, large woody debris levels, channel geometry, stream flow, or the amount of spawning size gravel. Treatment of invasive plants would not target conifers or deciduous trees, thus impacts to these species and the benefits they provide as habitat elements would be negligible. As such, there will be no further discussion of these parameters, including describing existing conditions.

Instead, existing habitat conditions and subsequent analysis will focus on those habitat elements that could be affected by invasive plant treatment: water temperature, fine sediment levels, and water chemistry. The discussion below focuses on the relationship between these habitat elements and fish populations/habitat.

Water Temperature

Water temperatures across the Forest are generally cool and fall within preferred ranges for salmonids. Preferred temperatures vary by species and life stage, but generally range from 10-16 ºC for many salmonids, although spawning often occurs at lower temperatures (Bjornn and Reiser, 1991). Some streams near the forest boundary exceed 16 ºC in late summer and fall, but there are no known streams within the Forest where water temperatures approach lethal limits of 23-29 ºC. In terms of fish and other aquatic animal requirements, shade is most important in water temperature regulation. Primary shade producing elements within the Forest are coniferous and deciduous trees and, to some extent, topography. The amount of shade varies across the Forest, and in some cases shade has been reduced due to land management activities such as timber harvest and road construction.

Fine Sediment

Levels of fine sediment (defined here as sand or silt <1 mm in diameter) in spawning habitat or riffles within stream reaches across the Forest vary widely depending on a variety of factors, including parent soil type, stream size, gradient, flow regime, water source (e.g. glacial, spring-fed, snowmelt), and past land management activities. Many studies have taken place to try and determine the amount of fine sediment in spawning gravel that limits survival of salmonid embryos. Significant embryo mortality can be expected when fine sediment <0.8 mm approaches or exceeds 20% of the redd (Waters, 1995).

As mentioned above, there are segments of some streams with high amounts of fine sediment that may be detrimental to salmonid spawning and egg incubation, reduce insect production or survival, and may decrease available rearing habitat by filling pools or other slow water areas.

<u>Water Chemistry</u>
There are no known streams or stream reaches within the Forest that are impaired for water chemistry (in this context water chemistry refers to the presence of herbicides, pesticides, or other chemicals). Herbicide application to control invasive plants to date has been limited (see Water Chemistry section under Water Quality). Likewise, the use of pesticides and other chemicals agents within the Forest has not been a common occurrence. Mining utilizing cyanide leach methods has not occurred in this area. As such, surface waters do not contain large amounts of chemicals and there are no areas with long standing chemical sources leading to degraded conditions for aquatic organisms.

Direct, Indirect, and Cumulative Effects to Aquatic Organisms

Effects of invasive plant treatment methods to aquatic organisms were evaluated and discussed in detail in the R6 2005 FEIS and its Appendix P, the corresponding Biological Assessment (USDA Forest Service 2005c), project files, and SERA risk assessments (2001, 2003, 2004).
The "worst case" exposure scenarios do not account for factors such as timing and method of application, animal behavior and feeding strategies, seasonal presence or absence within a treatment area, and/or implementation of Project Design Criteria unique to this EA. Therefore, risk is overestimated when compared to the actual applications proposed in this EA.

The three alternatives developed in this EA are described in detail in the Willamette N.F. Integrated Weed Management EA. All three alternatives utilize the same set of allowable manual, mechanical, and cultural treatment methods; they differ in the allowable level of herbicide use. Alternative 1 would prohibit herbicide use, alternative 2 would allow herbicide use on sites at least 50 feet from water bodies, and at least 200 feet from ESA-listed fish habitat, and alternative 3 would allow the application of herbicides up to the water's edge. None of the alternatives allow for herbicide use on emergent vegetation.

Common to all alternatives is a comprehensive set of Project Design Criteria, designed to limit the probability and/or magnitude of adverse effects.

Analysis completed under the Soils and Water Quality sections of the Willamette N.F. Integrated Weed Management EA indicate that water chemistry, stream shading, and turbidity/fine sediment are the primary fish habitat related factors that have the highest potential for incurring a changed condition due to alternative implementation. The following analysis will focus on these effects, and draw some conclusions on the expected level of effect associated with each alternative.

Evaluation criteria used to differentiate between alternatives are:

1) Acres of riparian habitat[3] that will be treated with herbicide.

2) Acres of invasive plant sites that would be treated with herbicides that are adjacent (within 50 feet) to ESA-listed fish habitat.

A GIS query selected all known invasive plant sites on the Willamette N.F. that are near water bodies. The results are shown in Table 20. There are 184,842 total water body acres on lands administered by the Willamette N.F., with 657 miles of ESA fish habitat (~80,000 acres of riparian adjacent land).

Alternative 1

This alternative focuses on treating invasive plants using manual, mechanical and cultural treatment methods only; no herbicide use would be allowed. Treatment methods include hand-pulling, digging with hand-tools, covering with black plastic, mulching, and mowing, cutting with powered line or blade cutters, chainsaws, controlled grazing with goats, and competitive planting.

Table 20. Known invasive plant sites near water bodies.

Stream Category	Acres of Riparian Area with Invasive Plants	Acres of Riparian Area Potentially Treated with Herbicides, By Alternative		
		Alt 1	Alt 2	Alt 3
MIS (all fishbearing)	1,934	0	0	1,934
ESA	1,552	0	0	1,552
EFH	1,153	0	0	1,153
Riparian Habitat, All Water bodies	3,232 (1.8% of total Forest water body acreage)	0	0	3,232

Note: ESA = any stream or water body currently or potentially providing habitat for ESA-listed fish, including any designated critical habitat. EFH is only designated for Chinook salmon; therefore there are fewer adjacent acres when compared to the area near all combined ESA fish species. All water bodies includes all stream categories, lakes, reservoirs, ponds and wetlands. Riparian Area in this case is defined as the zone extending from water's edge out to 50' on either side of all water bodies.

Proximity/Probability: Invasive plant treatments may occur to a varying extent near MIS streams (includes all fishbearing stream reaches), streams occupied by ESA-listed fish/critical habitat, essential fish habitat (MSA), and the entire stream network as shown in Table 1. Streams are all protected in a like manner with this alternative. Manual, mechanical, and cultural treatment methods are allowed up to the water's edge, with the exception of the use of mechanized equipment that may result in soil disturbance. The use of ground-disturbing equipment is prohibited within 25 feet of any water body.

[3] Riparian habitat in this case is defined as the zone extending from water's edge out to 50' on either side of streams, or other waterbodies.

Effect due to manual and mechanical eradication activities: These activities have causal mechanisms that may change water quality, primarily stream temperature and instream sediment/turbidity levels.

Stream temperature: This alternative may result in a very slight change in stream shading due to vegetation removal on streambanks. Stream shading changes are expected to be very minor with this alternative, due to the small size of the treatment areas, wide distribution of changed conditions throughout treated watersheds, rapid reestablishment of new ground vegetation, and no change in existing mid-level and overstory vegetation. In no instances is it expected that treatment will result in a measurable, detectable, or otherwise evaluated change in stream temperature at any scale. Fish will not be affected.

Stream sediment/turbidity: This alternative may result in an increase in soil erosion and subsequent increase in the rate of sediment delivered to adjacent streams (see Water Quality section). Any potential increase in the rate of sediment delivered to streams is expected to be very minor. Some currently vegetated and protected soils will be exposed to erosion and transport of soil towards stream channels; however project design criteria have been designed to minimize the potential for measurable changes in this habitat feature. Erosion control measures (e.g., silt fence, native grass seeding) will be required where the removal of vegetation may result in delivery of sediment to adjacent surface water. Ground based mechanized equipment will not be allowed within 25 feet of streams, ponds, or wetlands, which will leave an intact soil layer between the water body and the slightly disturbed area, potentially stopping any overland soil transport before it enters the stream.

The small size of the treatment areas, wide distribution of changed conditions throughout treated watersheds, rapid reestablishment of new ground vegetation, and no change in existing mid-level and overstory vegetation will minimize the potential for effect.

Therefore, the probability that disturbed soils associated with the mechanical treatment will result in an increase in the sediment delivery rate to fish habitat is low, and the magnitude of any change is likely to be minimal. Fish occupying the affected stream reaches may be negatively affected, however, the expected low extent of stream reach length negatively affected, and the only slight magnitude of effect is likely to result in only very minor direct and indirect effects to fish. Habitat changes are not expected to be of the magnitude where there will be a measurable loss of channel substrate interstitial space, or no increase in substrate embeddedness. Therefore, spawning success will remain the same, juvenile fish inter-gravel habitat will remain available, food supplies will not be impacted, etc. Any negative effects to fish will be very minor, and discountable.

Water chemistry: This alternative does not utilize herbicides or their surfactants, so there will be a neutral effect to water quality and therefore to aquatic organisms. Fuel-powered equipment may be utilized near water bodies, but the probability of accidental fuel spillage is very low based on past monitoring of similar treatment activity. Project design criteria restrict refueling near water bodies. This alternative may affect water chemistry, but the probability of this occurring is very low and discountable. Therefore, the potential risk to fish is also very low.

Direct Effect to aquatic organisms: It is not expected that workers will be present in the wetted stream channel, so no physical impacts to aquatic organisms are expected. Invasive plant eradication may require work to occur on streambanks. This human presence and activity provides a causal mechanism for incurring direct effects to aquatic organisms, primarily fish. Workers on streambanks may alarm fish occupying adjacent stream habitat, typically resulting in a temporary displacement of these fish from their currently occupied habitat feature. Some examples of negative effects associated with displacement include an increased predation risk or non-obligatory use of energy stores. This negative effect is expected to be very short in duration, as the fish typically will quickly find a new habitat feature to occupy off-bank, or upstream/downstream from the work sites. Aquatic plants will not be affected by this alternative, therefore this feature of fish habitat will not change from its current condition. The vast majority of fishbearing streams will have no treatment, so the net effect to the fish populations will be extremely minor. The magnitude of effect is also minor, a few humans moving near their habitat for a day or two at most, compared to chronic effects such as recreational use near streams, or fishing effects.

Summary of Direct and Indirect Effects:
This alternative will result in only minor negative effects to aquatic organisms. There may be some minor short-term negative effect associated with disturbance, and very minor negative effects associated with habitat degradation due to a loss of stream shade and increased sediment delivery. All of these negative effects are expected to be short-term in duration, and of very low magnitude, and therefore negligible.

This alternative is not likely to adversely affect ESA-listed fish species, or their critical habitat. It will result in no adverse effects to EFH. Habitat for MIS fish species will be maintained to levels consistent with biological needs of these species.

Evaluation Criteria for Fish:

1) Acres of riparian habitat that will be treated with herbicide. None

2) Acres of invasive plant sites that would be treated with herbicides that are adjacent (within 50 feet) to ESA-listed fish habitat. None

Alternative 2

This alternative allows the use of manual, mechanical, and cultural treatment as described in Alternative 1. Additionally, two herbicides may be utilized as needed: glyphosate (Rodeo® formulation), and triclopyr (Garlon 3A® formulation). The application rate for glyphosate must not exceed 2.0 lbs/acre, and the application rate for triclopyr must not exceed 1.0 lbs/acre. No herbicide mixtures are allowed.

Adjuvants are mixed with herbicides to increase herbicide absorption through plant tissues and increase spray retention on vegetation surfaces. Adjuvants that may be utilized include Hasten® (an ethylated corn oil/non-ionic surfactant blend), methylated seed oil, or LI-700® (a non-ionic, low foam surfactant), although only LI-700 will be used within 50 feet of any water body due to its very low toxicity level to aquatic organisms. Herbicides may be applied using backpack or truck-mounted hand sprayers, by wick, or by injection.

The Early Detection/Rapid Response process allows for the application of herbicides to prioritized new weed sites- up to 25 new sites per year. This ability will allow for treatment and elimination of these new sites before they can expand their distribution and become more difficult to eradicate in the future; however, there are always more populations than can be treated. All project design criteria would be followed during EDRR treatment. The effect to aquatic organisms under the EDRR process is identical to the effect realized during the primary treatment process. There may be a slight increase in the magnitude of site scale effects due to the additive nature of expanded treatment area.

Proximity/Probability: The risk of exposing ESA-listed fish and critical habitat to applied herbicides is limited or essentially eliminated by buffering these habitats with a 200-foot wide no-spray zone adjacent to both sides of any occupied habitat. Other fishbearing streams are protected by a 50 foot no-spray buffer, as are all tributary stream channels, including streams with intermittent flow, ponds, and wetlands.

Effect due to manual, mechanical and cultural eradication activities: The effects associated with the implementation of the manual, mechanical, and cultural treatment methods are similar to those described for Alternative 1. Project design criteria are identical. The difference is that there will be fewer acres potentially treated with these techniques since herbicide use is allowed which will reduce the need to use non-herbicide treatment methods. Therefore, the effects to aquatic organisms are slightly less than those described for this category of treatment under Alternative 1, which were determined to be negligible.

Water Chemistry: Any application of herbicides and their surfactants has some potential for water contamination. Project design criteria were developed to minimize or eliminate this potential. Implementation of a 50-foot buffer on most streams (200-foot buffer on either side of streams occupied by ESA-listed fish) will likely eliminate herbicide drift as a contamination source. Allowable application techniques would rarely result in ground water contamination or contaminated surface runoff that may reach the stream network.

SERA risk assessments discussed below for Alternative 3 indicate that the application of glyphosate and triclopyr, with surfactants, will not result in herbicide water contamination that exceeds the most sensitive aquatic organism threshold. Since Alternative 2 buffers all water bodies by 50 or 200 feet, compared to Alternative 3 which allows treatment up to the water's edge, the expected herbicide contamination rate is considerably less than the already low risk associated with Alternative 3.

Fuel-powered equipment may be utilized near water bodies, but the probability of accidental fuel spillage is very low based on past monitoring of similar treatment activity. Project design criteria restrict refueling near water bodies.

Direct Effect to aquatic organisms: The direct effects associated with the implementation of this alternative are similar to those described for Alternative 1. Project design criteria are identical. Herbicide application allowed with this alternative will occur at least 50-200 feet from water bodies, so the potential for direct effect to aquatic organisms is extremely low. Therefore, the effects to aquatic organisms are equivalent to those described under Direct Effect for Alternative 1.

Summary of Direct and Indirect Effects: This alternative will result in only minor negative effects to aquatic organisms. There may be some minor short-term negative effect associated with disturbance, and very minor negative effects associated with habitat degradation due to a loss of stream shade and increased sediment delivery. All of these negative effects are expected to be short-term in duration, and of very low magnitude, and therefore negligible. Application of herbicide is not expected to result in any discernable level of herbicide entering water bodies. This alternative is not likely to adversely affect ESA-listed fish species, or their critical habitat. The primary constituent elements of critical habitat for Chinook salmon include protection of freshwater spawning, rearing, and migration habitat. There will be no degradation of these habitat features. This alternative will not cause any adverse effects to EFH. Habitat for MIS fish species will be maintained to levels consistent with biological needs of these species.

Evaluation Criteria for Fish:

1) Acres of riparian habitat that will be treated with herbicide. None

2) Acres of invasive plant sites that would be treated with herbicides that are adjacent (within 50 feet) to ESA-listed fish habitat. None

Alternative 3

Alternative 3 is similar to Alternative 2 with two primary differences:

1) Expands the herbicides available for use from two (glyphosate and triclopyr) to five (glyphosate, triclopyr, imazypyr, sethoxydim, and clopyralid),
2) Allows herbicide treatment nearer streams and other water bodies.

Near streams (within a zone 10-50 feet from all water bodies and stream channels), glyphosate (Rodeo® formulation) and imazypyr (Habitat® formulation) may be applied using a backpack sprayer. The maximum application rate of active ingredient for glyphosate is 2.0 lbs/acre and the maximum rate for imazypyr is 0.45 lbs/acre.

Immediately adjacent to streams (water's edge to 10 feet away), glyphosate and/or imazypyr may be applied using stem injection or wiping application methods. No herbicides will be applied to any water body, or to emergent or aquatic plants in the water.

Further than 50 feet from the stream or other water body, glyphosate (Rodeo® formulation) and triclopyr (Garlon 3A® formulation) will be applied as described in Alternative 2. Additionally, sethoxydim (Poast® formulation applied at a rate of 0.3 lbs active ingredient/acre), a grass-specific herbicide, and clopyralid (Transline® formulation, applied at a rate of 0.35 lbs active ingredient/acre), used to treat spotted knapweed, may be used outside of the 50 foot stream buffered area, if the treated site does not have a high water table with permeable soils. Herbicides may be applied using backpack or truck-mounted hand sprayers, by wick or injection. No herbicide mixtures are allowed.

The EDRR process allows for the application of herbicides to newly discovered invasive plant sites. This ability will allow for treatment and elimination of these new sites before they can expand their distribution and become more difficult to eradicate in the future. All project design criteria would be followed during EDRR treatment. The effect to aquatic organisms under the EDRR process is identical to the effect realized during the primary treatment process. There may be a slight increase in the magnitude of site scale effects due to the additive nature of expanded treatment area.

The maximum acreage implemented under the EDRR process across the Forest shall not exceed 3,000 acres (approximately 30% of the known acreage) over the ten-year life of this action. The maximum total treated area is approximately 12,700 acres. EDRR site scale treatments will not affect more than 10 contiguous acres or 1.5 miles adjacent to a water body in any given HUC 6 watershed.

Proximity/Probability: The risk of exposing aquatic organisms to applied herbicides is limited by buffering their habitat at least 10 feet when using spray application, although stem injection or wipe application is allowed up to the water's edge. No herbicide will be applied within the wetted area of any water body. Backpack spraying of herbicides has the potential to result in some herbicide entering the stream network, or other water bodies. Unexpected, intensive rainfall immediately following application may also result in some runoff of herbicides directly to streams, or potential groundwater contamination. Use of sethoxydim, clopyralid, and triclopyr are only allowed at sites greater than 50 feet from any water body, and when other project design criteria are applied, the probability that these herbicides will contaminate water is low and discountable.

Water Chemistry: This alternative has a causal mechanism which may result in a negative effect to aquatic organisms. The application of herbicides and their surfactants has some potential for water contamination, directly through unintentional drift of sprayed herbicides, or indirectly through surface runoff or percolation. Project design criteria were developed to minimize or eliminate this potential. The Rodeo® formulation of glyphosate and Habitat® formulation of imazypyr are both registered for use near or in water, with minimal risks to aquatic organisms.

An analysis of the potential herbicide concentration that may be delivered to a two site specific invasive plant treatment areas was conducted. One site was selected with a high density of invasive plants near a small stream, and another near a pond. Both sites were selected based on the fact that they have the potential for the highest concentration of herbicide water contamination, and thus represent the maximum impact that would be expected on any of the proposed treatment sites.

Site 1 is located near Whiterock Creek, a small stream (1.8 cfs mean summer flow), utilized by ESA-listed fish and other MIS fish species. Site 2 is located near the confluence of Buck Creek and the Middle Fork Willamette River, adjacent to a small floodplain pond Buckhead (0.25 acres in area, 1 meter deep) currently occupied by Oregon chub, and near a river occupied by spring Chinook salmon. It was assumed that a high rainfall event would wash herbicides into Whiterock Creek that could quickly rise from base low flow and under these conditions herbicides could also be washed into Buckhead Pond. The modeled soil parameter was set for sandy soil, as this predicts the highest rate of herbicide transport.

Herbicide concentrations potentially delivered to these water bodies were predicted using the Syracuse Environmental Research Associates, Inc (SERA) risk assessments for glyphosate and imazypyr. These risk assessments were prepared 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 by making the thresholds of concern substantially smaller than normally used for such assessments. Although the risk assessments have limitations, they represent the best science available.

In addition to the analysis of potential hazards to human health from every herbicide active ingredient, SERA Risk Assessments 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).

Site specific variables (soil type, annual precipitation rate, and maximum application concentration) were entered into the worksheets, and the predicted concentration of herbicide delivered to surface water is shown in Table 21. SERA risk assessments use hazard quotients for exposure risk to fish, and use the most sensitive fish and the lowest value available in the literature for determining the concern threshold. NOEC values are used when they are less than $1/20^{th}$ of the LC50 as they account for sub-lethal effects.

The worksheet predictions of the maximum site-specific effects application of these two herbicides and potential surfactants shows that exposure levels of concern for aquatic organisms will not be exceeded. Any trace amount of herbicide that may reach surface water would be quickly diluted, and there will not be any additive effects transmitted downstream.

The predicted maximum concentration values are likely much higher than the actual expected values at the treated sites on the Forest, due to project design criteria that were not accounted for in the SERA worksheets such as:

- Restriction on spraying during windy days
- No boom spraying allowed near streams
- Requirement to use coarse spray nozzles and low pressure spray heads.
- Minimum 10 foot no-spray buffer separating sprayed herbicide from water bodies.

- Herbicide application not allowed if rainfall is expected immediately following treatment.

The SERA model also assumes that herbicide will be broadcast sprayed up to the water's edge, which will not occur with this alternative where only spot spray application is allowed near water bodies, with a minimum 10 foot no spray buffer.

Table 21. Predicted maximum herbicide exposure rates compared to thresholds of concern for aquatic organisms**.**

Herbicide/Surfactant	Predicted Maximum Concentration (mg/l)		NOEC or Conservation Threshold (mg/l)	Hazard Quotient	
	Whiterock Creek	Buckhead Pond		Whiterock Creek	Buckhead Pond
Glyphosate	0.11 to 0.28	0.03 to 0.04	0.5	0.2 to 0.6	0.06 to 0.08
Imazypyr	0.0000 to 0.0001	0.0001 to 0.0002	5.0	0.00001 to 0.00003	0.00002 to 0.00004
Triclopyr*	0	0	0.26	0	0
Sethoxydim*	0	0	0.06	0	0
Chlopyralid*	0	0	5.0	0	0

Notes: 1 = Reported predicted maximum concentration values are reported as a range based on differing precipitation ranges (50-100").

* = These herbicides will not be applier nearer than 50 feet from any water body, therefore the probability that they will enter the stream network is near zero and the concentrations are immeasurable and/or discernible.

Hazard quotient is the predicted maximum concentration divided by the NOEC value. A HQ value greater than 1 would indicate that the conservation threshold would be exceeded

The SERA model assumes that all herbicide applied to a site will enter the adjacent water body in one point and the contamination rate is calculated at that highest concentration point. Actual application will more likely result in potential contamination at multiple points along a water body, which allows for some dilution of effect.

Effects to aquatic macroinvertebrates are also expected to be minor. Studies on herbicide effects to Daphnia showed a LC50 as low as 4 mg/l, corresponding to a 0.2 mg/l concern threshold. Expected contamination rates with this alternative are much lower than this concern threshold, therefore, only negligible negative effects are expected.

Fuel-powered equipment may be utilized near water bodies, but the probability of accidental fuel spillage is very low based on past monitoring of similar treatment activity. Project design criteria restrict refueling near water bodies.

Summary of Direct and Indirect Effects:
This alternative will result in only minor negative effects to aquatic organisms. There may be some minor short-term negative effect associated with disturbance, and very minor negative effects associated with habitat degradation due to a loss of stream shade and increased sediment delivery. Macroinvertebrates, a food source for some fish, may experience a slight negative effect; however this effect is not likely to reduce the overall availability of food for the fish populations. All of these negative effects are expected to be short-term in duration, and of very low magnitude, and therefore negligible. Application of herbicide is not expected to result in any discernable level of herbicide entering water bodies.

This alternative is not likely to adversely affect ESA-listed fish species, or their critical habitat. The primary constituent elements of critical habitat for Chinook salmon include protection of freshwater spawning, rearing, and migration habitat. There will be no degradation of these habitat features. This alternative will not cause any adverse effects to EFH. Habitat for MIS fish species will be maintained to levels consistent with biological needs of these species.

Evaluation Criteria for Fish:

1) Acres of riparian habitat that will be treated with herbicide. 3,232

2) Acres of invasive plant sites that would be treated with herbicides that are adjacent (within 50 feet) to ESA-listed fish habitat. 1,934

Cumulative Effect to Aquatic Organisms – All Alternatives:

The cumulative effects area used for this assessment is the combined watershed area within the Santiam, Calapooia, McKenzie, and Middle Fork Willamette River sub-basins. This area encompasses all proposed treatment areas, and includes non-federal lands in the lower portions of the sub-basins.

Cumulative effects result from the incremental effects of this action when added to other past, present, and future actions.

The analysis presented above concluded that the implementation of this project, with the Project Design Criteria in place to reduce risk, would result in a minor negative effect to water quality and fish habitat due to a slight loss of stream shade, slight increase in fine sediment delivery to streams, and a slight increase in fish harassment. None of these changed conditions are expected to result in measurable changes in habitat condition, even at the local or site specific scales. Once the scale of analysis is increased to the watershed scale, these effects are diluted to a point where they approach a neutral effect. Analyzing at the four subbasin scale, the effects due to this alternative are non-discernible from baseline condition.

Activity occurring in the project area and on other land areas not managed by the Forest are likely resulting in negative effects to stream shade, sediment delivery, and fish harassment. Agriculture and urban activity in the Willamette Valley likely effects habitat conditions to a degree many orders of magnitude higher than the effects associated with this activity. Fishing, poaching, recreational use, dam operation, and other uses result in levels of harassment far greater than the miniscule effect expected with this activity.

The limited spatial extent of invasive plant infestations, which are limited primarily to disturbed roadsides, and the limits placed on herbicide applications will reduce the potential for herbicide exposure to aquatic species. The herbicides considered in this EA are eliminated rapidly from the bodies of aquatic animals, and do not bio-accumulate up the food chain. It is not expected that the small magnitude of negative effect associated with this alternative will be transmitted to downstream reaches, and therefore the probability that this alternative will result in additive negative effects to downstream reaches is very unlikely.

Herbicide use is likely occurring at a much higher rate on agricultural and commercial timber lands in the analysis area. Our predictive model indicates that the level of herbicide contamination of water bodies is very low, below any observable effect thresholds for aquatic species. Once these contamination plumes enter the river system, the toxicity will rapidly dilute with the large volumes of fresh water coming from headwater streams, and be immeasurable almost immediately. Therefore, by the time there is an opportunity for mixing with other herbicide contamination plumes from non-Forest lands, there will not be a net increase in toxicity, as the Forest effect will have been diluted to the extent that there is only a neutral effect. No cumulative effects will be realized with any of the alternatives. All of the environmental standards, policies and laws related to aquatic organisms would be met in all alternatives.

This project is consistent with all rules, regulations, and laws regarding fisheries (e.g. the Willamette National Forest Land and Resource Management Plan (LRMP)(1990), as amended, the Northwest Forest Plan (1994) as amended, Aquatic Conservation Strategy (ACS) as amended in 2003, Best Management Practices (BMPs), the Endangered Species Act (ESA) of 1973 (as amended), the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 1996 as amended, Clean Water Act, Wild and Scenic Rivers Act, and Executive Order 12962, Recreational Fisheries (1995). Specific details on compliance are located in the Fisheries Report.

Aquatic Plants

Current Condition

Algae are primary producers in aquatic ecosystems and are vital to the maintenance of productivity of streams and wetlands within the Forest. They are necessary for completing the food web for TES and game fish. Aquatic macrophytes, submerged plants, are necessary cover for small fish and their decaying parts provide nutrients for the food chain.

Direct and Indirect Effects

Alternative 1

Alternative 1 should have no effect on aquatic plants. Manual treatments might drop a few plant parts in or near the water but effects will be small scale and localized. No motorized equipment is allowed within 25 feet of water bodies (PDC 29), so there should be no sedimentation as a result of mechanical use.

Alternative 2

The effects of Alternative 2 should be similar to Alternative 1. No herbicides are available for use within the 50 foot riparian buffer, Application outside this zone can occur but use of calibrated backpack spot sprays should result in no drift to aquatic areas.

Alternative 3

The effects on aquatic plants under Alternative 3 are different from the other alternatives because herbicide application may occur within the 50-foot riparian buffer. Potential effects of the herbicides that will be used in strictly terrestrial situations- clopyralid, sethoxydim and Triclopyr- should be completely mitigated by PDC as they will only be available for use 50 feet from water and method will be backpack or truck-mounted hand spray.

Glyphosate and imazapyr may be used near water. The formulation of glyphosate that will be used under this EA is Rodeo, a formulation approved for aquatic use. The SERA risk assessment for glyphosate states that glyphosate is equally toxic to algae and macrophytes and that it is more toxic to aquatic plants than animals. The NOEC for aquatic species is 3 mg/L. Neither the pond or stream site-specific scenarios (see Water Quality section) show concentrations of herbicide entering water that would adversely affect these species.

Imazapyr is the other herbicide that will be used near water. The formulation that will be used in the riparian buffer will be Habitat, a formulation approved for aquatic use. It may be wiped from 0-10 feet and may be spot sprayed with a backpack from 10-50 feet from water. Some herbicide could drift into water with this scenario. Sensitive algal species show acute effects at 0.02 mg/L and chronic effects at 0.20 mg/L. Some algal species are tolerant of glyphosate and are actually stimulated by low concentrations. Tolerant species are not adversely affected until concentrations of chemical reach 200 mg/L. Aquatic macrophytes show acute and chronic effects at .013 mg/L. Neither the site- specific modeling for imazapyr delivery to the pond nor stream would adversely affect algae or macrophytes.

Cumulative Effects

There should be no cumulative effects to aquatic plant species from any alternative because no method of treatment will cause an adverse effect on aquatic plant species.

Heritage Resources

Existing Conditions

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). Impacts from the use of "weed wrenches" is similar in scale and extent to impacts from shovels, and the use of this tool also falls within the definition of activities with no potential to affect heritage resources. Competitive planting of native species falls within the description of activities determined to have no potential to affect heritage resources. No heritage resource survey is required for any of these activities.

Mechanical methods such as mowing, brushing, weed-eating, and mulching to control vegetation within existing clearing limits of roads, trails, powerlines, etc., including invasive plant treatments, have also been determined within the agreement cited above to have no potential to affect historic properties. No cultural resource survey is required for these activities.

The use of goats as a biological or "cultural" control method for in invasive species, while not specifically addressed under the Programmatic Agreement, is a type of activity that does not have the potential to cause effects on historic priorities, so requires no further consideration under Section 106 of the NHPA (36 CFR 800.3[A][1]).

One traditional gathering area, Camas Prairie (site # SH-104), containing plants that have a cultural significance to Native American peoples within the proposed project areas were identified through Tribal consultation efforts. Other areas identified by Tribal Representatives as potential for gathering included meadows (with camas or other root foods) and wetlands (for basketry materials).

Culturally significant plants are collected and used as food, for medicine, or for ceremonies, and are important for American Indian lifestyles (Table 21). Especially important among the culturally significant plants are the camas and huckleberry for food and beargrass and hazelnut for basketry. The plant species targeted for treatment (Table 1) do not include any plants identified for traditional cultural uses. However, while the herbicides proposed for use are designed to target invasive plants, many have the potential to affect broadleaf varieties and grasses, including cultural plants (See discussions of effects to native plants, Section on Vegetation and Treatment Effectiveness).

Table 21: List of culturally significant plants with potential to be found in proposed treatment areas.

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*

Restoration of the treated areas is also proposed under each alternative. Restoration would consist of reseeding and/or planting. Reseeding would be accomplished using either hand spreaders or hydro-seeders. The ground surface would be scarified using a rake or other hand tool. Saplings or small foliage would be planted using shovels, hoedads, or other hand tools. Restoration using hand tools within previously disturbed ground falls within the description of activities determined to have little or no potential to affect heritage resources as determined within the 2004 Programmatic Agreement (PA). Seeding by hand or spray has also been determined within the agreement to have no effect on heritage resources. No heritage resource surveys are required for these activities.

Direct/Indirect Effects

Alternative 1 – No Action

Currently invasive plants treatments are limited to manual and mechanical treatments and were previously analyzed and approved activities under the amended Willamette LRMP. Under Alternative 1, no additional treatments for invasive plants are proposed beyond those activities. There would be **no effect** under Alternative 1 to heritage resources other than the natural processes that are already occurring. However, the lack of any additional treatments could result in the proliferation of invasive plant species, which may compete with culturally significant plants. An example of this would be the continuing spread of false brome at Camas Prairie. This is a site that has been restored with the help of the Siletz and Grand Ronde Tribes for the expressed purpose of harvesting camas for ceremonial purposes. The false brome infestation there is currently small in size but if it were to get larger, methods other than manual treatment might be needed. So, though no particular populations of interest have been identified, the potential exists for culturally significant plants to be adversely affected under Alternative 1.

Alternatives 2 and 3 – Current Program and Preferred Alternative

Under these alternatives, a combination of herbicide, mechanical (mowing and brushing), manual (hand tools), and cultural (goat grazing) treatments would be applied. These treatment methods are described in Table 2. As previously discussed, the application of herbicides, mowing and brushing, and the use of hand tools for the eradication of invasive plant species would have no effect on heritage resources.

Although the list of herbicides proposed for treating invasive plant species are not designed to target plants desirable to Native American peoples, many of the proposed herbicides have the potential to affect other broadleaf plants and grasses, including culturally significant plants. Spot spraying or selective/hand methods will be employed to limit unwanted spray drift. Project Design Criteria and label restrictions limiting nozzle pressure and spray, and restricting herbicide application during high winds or expected precipitation would also limit unwanted spray drift and spread.

The Confederated Tribes of Warm Springs (CTWS), the Confederated Tribes of the Siletz Indians, the Confederated Tribes of the Grand Ronde, and the Klamath Tribe were consulted with on the implementation of an invasive species plant treatment program and for concerns over potential effects to culturally significant plants. Tribal representatives from the CTWS, Grand Ronde and Siletz agreed that any effects would be short-term, and eradicating or controlling the spread of invasive plants could potentially benefit desirable plant species. The following mitigation measures were requested during briefing visits:

1. Do not use herbicides in areas where food plants will be harvested, particularly Camas Prairie and huckleberry harvest sites.
2. Sign the trailheads or parking lots leading to meadows or wetlands which harbor potential food plants or basketry materials.
3. Clearly mark roadsides where herbicides may be used.

Restoration of the treated areas is also proposed under both alternatives. Restoration would consist of reseeding and/or planting. As previously discussed, the use of hand tools for scarifying, planting and seeding within previously disturbed ground would have no effect on heritage resource.

Additional areas may be treated in the future as part of an Early Detection Rapid Response program (EDRR). The EDRR would be designed to identify areas of uninventoried invasive plant infestation and propose treatments for those areas. The application of mechanical, manual, or herbicide treatment methods as proposed under Alternatives 2 or 3 would have no potential to affect heritage resources. A cultural resource survey and consultation with the Oregon SHPO would not be required.

Cumulative Effects

The quantity and quality of culturally significant plants have been declining through the years, due to encroaching vegetation. This is primarily due to historic and current fire suppression and subsequent tree and brush invasion into mesic and dry meadow environments. Loss of historic and current fire has also affected huckleberry fields which produce better crops of berries following fire. Invasive plant species also contribute to the decline of these plants as they compete for sunlight, soil, nutrients and water.

Under the No Action Alternative, some invasive plant infestations would not be treated with the most effective tools available, potentially leading to increases in these plants. This could lead to a loss of additional culturally significant plants.

For the action alternatives, continued treatment and suppression of invasive plants would reduce competition for the available resources and provide an opportunity for culturally significant plants to develop and spread. While there may be short-term effects to culturally significant plants via small site-specific effects to non-target individuals, the long-term effects would be beneficial and restorative. The cumulative effect would be positive for culturally significant plants, especially if the most effective treatment methods are used on the sites.

Human Health Effects

This section focuses on the health effects to workers and the public if herbicides are used as proposed in the alternatives. The Invasive Plant FEIS (USDA Forest Service, 2005a) and its Appendix Q: Human Health Risk Assessment detailed the potential for health effects from the use of the herbicides proposed for this project. Herbicide active ingredients, metabolites, inert ingredients, and adjuvants and people with particular herbicide sensitivity were addressed. The Invasive Plant ROD (USDA Forest Service, 2005b) adopted standards to minimize herbicide exposures of concern to workers and the public based on the human health risk assessments. Herbicides are an important component of the integrated weed management methods needed to meet the purpose and need for this project.

The Invasive Plant FEIS (USDA Forest Service, 2005a) evaluated human health risks from herbicide and non-herbicide invasive plant treatment methods. Hazards normally encountered while working in the woods (strains, sprains, falls, etc) are possible during herbicide and non-herbicide invasive plant treatment operations. Such hazards are mitigated through worker compliance with occupational health and safety standards and, as such, are not analyzed again here.

Many people express concern about the effects of herbicides on human heath. Workers and the public may be exposed to herbicides used to treat invasive plants under all alternatives in this project; however, no exposures exceeding a threshold of concern are predicted. This conclusion is based on facts about chemistry of the herbicides considered for use and the mechanisms by which exposures of concern might occur. Scientific risk assessments do not indicate that any person would be adversely affected in any way by these herbicides used in the manner proposed for this project. This applies to all alternatives.

Direct and Indirect Effects

Worker Herbicide Exposure Analysis

Herbicide applicators are more likely than the general public to be exposed to herbicides. Worker exposure is influenced by the application rate selected for the herbicide; the number of hours worked per day; the acres treated per hour; and variability in human dermal absorption rates. Appendix Q: Human Health Risk Assessment in the Invasive Plant FEIS (USDA Forest Service, 2005a) displayed HQ values for typical and maximum label rates under a range of conditions. Four potential exposure levels were evaluated for workers, ranging from predicted average exposure (typical application rate-typical exposure variables) to probable maximum exposure (maximum application rate-maximum exposure variables).

In routine broadcast and spot applications, workers may contact and internalize herbicides mainly through exposed skin, but also through the mouth, nose or lungs. Contact with herbicide formulations may irritate eyes or skin.

The herbicides proposed for use under Alternatives 2 and 3, used at rates and methods consistent with PDC, have little potential to harm a human being. Appendix Q of the Invasive Plant FEIS (USDA Forest Service, 2005a) lists the HQ values for all herbicides considered for this project. In most cases, even when maximum rates and exposures are considered, HQ values were below the threshold of concern (HQ values ranged from 0.01 to 1).

Risk assessments indicate concern for worker exposure to triclopyr, especially the Garlon 4 formulation. This is one reason why broadcast application of triclopyr is not allowed under Invasive Plant ROD (USDA Forest Service, 2005b) Standard 16. The use of Garlon 4 is not proposed for use in this Integrated Weed Management Program.

For all other herbicides and surfactants, the amount of plausible worker exposure is below levels of concern for all application methods, including broadcast. PDC for all action alternatives reduce both the application rate and the quantity of drift if triclopyr and/or NPE are used.

Chronic (daily over a period of time) worker exposure also was considered in SERA Risk Assessments (2001b, 2003a, 2003b, 2003c, 2004a, 2004b, 2004c, 2004d, 2004e, 2004f). Chronic exposures do not amount to levels of concern because the herbicide ingredients are water-soluble and are not retained in the body (they are rapidly eliminated).

Public Herbicide Exposure Analysis – Direct Contact, Special Forest Products and Drinking Water

The general public would not be exposed to substantial levels of any herbicides used in the implementation of this project. Appendix Q of the Invasive Plant FEIS (USDA Forest Service, 2005a) considered plausible direct, acute and chronic exposures from herbicide ingredients. Few plausible scenarios exist that exceed even the most conservative threshold of concern for public health and safety. Appendix Q shows Risk Assessment results assuming a human being contacts sprayed vegetation or herbicide or consumes sprayed vegetation, contaminated water, and/or fish.

Direct Contact*:* There is virtually no chance of a person being directly sprayed given spot and hand/select methods considered for this project. Because treatment sites will be posted and campgrounds and trailheads would be cordoned off during treatment, there is very little chance that a person could brush up against sprayed vegetation soon after herbicide is applied.

Eating Contaminated Special Forest Products*:* The public may be exposed to herbicide if they eat contaminated fish, berries or mushrooms, etc. Non-target, native berries or mushrooms may be affected by drift or runoff. Several exposure scenarios for recreational and subsistence fish consumption were considered in the SERA Risk Assessments; none are near any herbicide exposure level of concern.

People who both harvest and consume special forest products may be exposed both through handling contaminated plant material and chewing or eating it. Chewing and eating contaminated plant material cause different exposure and dose patterns. Such doses would be additive, but are unlikely to exceed a threshold of concern (see cumulative effects discussion below).

Drinking Contaminated Water*:* Acute exposures and longer-term or chronic exposures from direct contact or consumption of water, fruit or fish following herbicide application were evaluated in the Invasive Plant FEIS (USDA Forest Service, 2005a). Risks from two hypothetical drinking water sources were evaluated: 1) a stream, into which herbicide residues have contaminated by runoff or leaching from an adjacent herbicide application; and 2) a pond, into which the contents of a 200-gallon tanker truck that contains herbicide solution is spilled.

Table 22: Project Design Criteria to Minimize Exposures of Concern

	Project Design Criteria to Minimize Exposures of Concern
Workers	Typical application rates of herbicides (PDC 1); Wearing personal protective equipment (PDC 3.).
Public	Typical application rates of herbicides (PDC 1). Signing treatment sites (PDC13, 21). Notification of treatments in newspaper (PDC 20). These limitations reduce risks to the general public, even considering multiple exposures.
Special Forest Projects	Typical application rates of herbicides (PDC 1); posting areas (PDC 13, 21.). Detectable impacts are implausible except in the event of an unpredictable exposure. Even multiple exposures (eating contaminated fish, drinking contaminated water, skin irritation) would not result in exposure levels of concern.
Drinking Water	Typical application rates of herbicides (1); Transportation and Handling Safety Plan and Spill Plan (PDC 8.). Detectable impacts are implausible except in the event of a spill.

The only herbicide scenarios of concern would involve a person drinking from a pond contaminated by a spill of a large tank of herbicide solution. The risk of a major accidental spill is not linked in a cause-and-effect relationship to how much treatment of invasive plants is projected for a particular herbicide; a spill is a random event. A spill could happen whenever a tank truck involved in an herbicide operation passes a body of water. The potential risk of human health effects from large herbicide spills into drinking water are mitigated by PDC that require an Herbicide Transportation and Handling Plan be developed as part of all project safety planning, with detailed spill prevention and remediation measures to be adopted.

Comparison of Risks of Human Health Effects among Alternatives Considered In Detail

No Action

There would be little risk to human health under no action because the use of herbicides is not proposed. Manual and mechanical treatment methods would be those normally encountered in manual labor (sprains, strains, and falls) or with machines (malfunction, sliding off the road shoulder). Personal protective gear and safety training should mitigate most effects.

Alternatives 2

No individual worker or public exposures of concern are predicted in Alternative 2 (Table 22). Under this Alternative, 410 acres of sites designated as receiving high human use such as campgrounds and trailhead parking lots or dispersed campsites, would be exempt from herbicide use. PDC, including using the lowest effective application rates, requirements for use of personal protective equipment eliminate plausible exposures of concern (PDC 1), signing treatment sites (PDC13, 21)and notification of public concerning upcoming treatments in newspaper (PDC 20) eliminate public exposure of concern. No adverse effects to public drinking water supplies or health and safety are predicted because no herbicides will be applied near water and application methods (spot spray) will reduce the potential for herbicides to drift to water (see Water Quality discussion 64-65). The only possible scenario that exceeds the Hazard Quotient of 1 for humans and drinking water is in the case of an accidental spill of glyphosate in a pond. PDC call for carrying of only the amount of chemicals needed for the day and require mixing Transportation and Handling and Spill Plan (PDC 8) which would call for posting that contaminated water is not drinkable.

Alternative 3

Effects to humans are similar to those discussed in Alternative 2 except 410 additional acres of areas which receive high human use may be treated with herbicide and that herbicides may be used within the 3232 acres of riparian corridor (see Table 5). Using herbicides around areas of high human use is not expected to put anyone at risk of exposure given the PDC 15 for marking posting and/or closing administrative sites and campgrounds in advance of and after herbicide application to ensure that there is no inadvertent public contact with herbicide.

The application of herbicides close to water was identified as an issue during scoping because of the potential for herbicides to drift into drinking water sources. A model was run to show the maximum potential exposures from use of glyphosate and imazapyr to human drinking water (Appendix E, Table E-1) in areas treated near a pond and a stream. Although the model only allows for broadcast spray (which would tend to overestimate the amount of herbicide that reaches the streams as the Willamette is only proposing spot spray), it allows us to quantify the effects on water quality. Toxic effects for glyphosate on humans are 2 mg/kg (SERA, 2003a). The model predicts the range .005-.03 mg/kg from the maximum effects scenario. Toxic effects of imazapyr occur at 2.5 mg/kg (SERA, 2004b). The model predicts a concentration of .000020-.000006 mg/kg for maximum effects. None of the thresholds are close to being toxic.

Cumulative Effects

While workers, and the public, may be exposed to herbicides within and outside the Forest, multiple exposures do not necessarily equate to cumulative adverse effects. The herbicides proposed for use are water-soluble, are rapidly eliminated from humans and do not concentrate in fatty tissues and do not significantly bioaccumulate (USDA Forest Service, 2005a). Further, the PDC limit the mechanisms by which workers and the public may be exposed to herbicides. The PDC were developed considering the risks and properties of the herbicides proposed for use. The PDC ensure that chronic (long-term) and acute (short-term) herbicide exposures would not exceed thresholds of concern and sufficiently minimize risks to compensate for uncertainty about the impacts of herbicide use on neighboring lands.

Cumulative effects were analyzed in the Invasive Plant FEIS (USDA Forest Service, 2005a) and are briefly summarized below.

A person could be exposed to herbicide repeatedly over the course of their lifetime and exposure may occur any place that herbicides are used. Appendix Q (USDA Forest Service, 2005a) evaluated chronic exposure scenarios, including repeated drinking of contaminated water, repeated consumption of contaminated berries, and repeated consumption of contaminated fish over a 90 day period. The HQ values for chronic exposures of all herbicides considered for this project are below 1.

A person could be exposed to herbicides by more than one scenario, for instance, a person handling, and then consuming sprayed berries. The cumulative impact of such cases may be quantitatively characterized by adding the HQ values for each individual exposure scenario. An example of this scenario was considered for this cumulative effects analysis: the scenario assumes glyphosate contacts a person's bare skin (HQ for dermal exposure is less than 0.01)[4], and that person immediately eats contaminated berries and fish (HQ values for oral exposure are less than 0.01). Even if these three exposures occurred simultaneously, the combined HQ values are still far below a threshold of concern (HQ < 1).

Some of the herbicides considered for use in this project have HQ values greater than glyphosate;

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[4] See Appendix Q of the Invasive Plant FEIS (USDA Forest Service, 2005a) for details about each scenario.

however, the combined HQ values for dermal and oral exposure are still likely to be very low. The body would metabolize some of the initial dose before receiving the second dose, thus reducing the cumulative dose. The risk of adverse effects to human health is low because the herbicides proposed for this project are water-soluble, are quickly eliminated from the body, and do not bioaccumulate. All alternatives comply with standards, policies and laws aimed at protecting worker safety and public health.

Specifically Required Disclosures

Adverse Environmental Effects that Cannot be Avoided

Implementation of any 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 Chapter 3 and the purpose of this section is to fully disclose these effects. Table 27 below summarizes the unavoidable potential adverse effects to the environment associated with the invasive plant treatment alternatives considered in this EIS.

Table 27: Adverse Effects that Cannot be Avoided for Site-Specific Invasive Plant Treatments proposed on WNF

Adverse Effect	Reference	Effects without Project Design Criteria	USDA Forest Service Intended Response and Rationale
Effects of invasive plant treatments on non-target plants, including culturally significant plants	Vegetation and Botanical Species of Concern	There is some risk that native plants, including special status species and culturally significant species, may be injured and/or killed by herbicides. Herbicides may impact plants through overspray or drift from herbicide applications, root translocation or surface runoff. Also, manual, mechanical and cultural treatments entail some risk to native plants and plant communities. Any species along roadsides or where activities occur that disturb native plant communities would be threatened by not only invasive plants, but by invasive plant treatments. Adverse effects would most likely be localized and short-term. Without treatment, however, invasive plant infestations would increase and spread, displacing native plants and plant communities.	Short-term adverse effects to non-target plants would be largely offset by long-term benefits of treatment. The adverse effects would be minimized by properly implementing the Invasive Plant ROD standards (USDA Forest Service, 2005b) and PDC. PDC focus on botanical resources, including botanical species of concern, requiring surveys prior to treatment and specific application methods. PDC also address effects on culturally significant species in requiring no herbicides where food plants are collected and signing treatment areas where other materials might be collected.
Herbicide effects on water quality	Hydrology, Fisheries	Herbicides used to treat invasive plants for the Proposed Action can enter water through spray drift, surface water runoff, percolation, groundwater contamination, and direct application. The potential routes of herbicide entry may result in indirect effects to aquatic organisms, their habitat, and water quality. Water runoff during rain events could transport herbicides to waterways and convey them to aquatic species habitat. Soil type and chemical stability, solubility, and toxicity can determine the extent to which an herbicide would migrate and impact surface waters and groundwater. Some herbicides such as glyphosate strongly adsorb to soil particles, which prevents it from excessive leaching. Other herbicides such as clopyralid are highly soluble in water and more mobile.	The amount of herbicide reaching surface water by spray drift is expected to be minimal considering the restrictions of no spraying within 10 feet of surface water and when wind speeds are greater than 10 mph. Also, herbicides entering surface water through surface runoff are expected to be minimal, since targeted spot spraying techniques would be used to apply herbicide within 10-50 feet of surface water. This would minimize the amount of herbicide reaching the ground surface. The potential for direct application of herbicide to surface water is very low, since hand/selective and spot spraying herbicide techniques would be used to apply herbicides directly to plants.

Adverse Effect	Reference	Effects without Project Design Criteria	USDA Forest Service Intended Response and Rationale
Herbicide effects on terrestrial wildlife species, including shrew, salamander, pond turtle	Wildlife	All of the action alternatives are associated with plausible scenarios where herbicides that may adversely affect individuals. The number of acres treated at one time within one project area is likely to influence the likelihood of exposure to herbicides for wildlife. Indirect mortality is possible from sub-lethal effects that could increase susceptibility to predation. Indirect effects to wildlife from cumulative herbicide exposure are also possible. For example, if a sub-lethal exposure affects an internal organ and the effect is not quickly reversed, then subsequent exposure could cause cumulative damage.	Short-term adverse effects to terrestrial species would be largely offset by long-term benefits to the habitat resulting from treatment. All the herbicides in this EIS are excreted rapidly (often within 24 to 48 hours), and do not accumulate up the food chain. This reduces, but does not eliminate, the potential for these types of cumulative effects. The herbicides with greatest potential for harm birds and mammals, in decreasing severity are triclopyr, glyphosate, and clopyralid. By properly implementing the Invasive Plant ROD standards (USDA Forest Service, 2005b) and PDC, these effects largely should be avoided.
Herbicide effects on soil organisms (e.g., invertebrates, fungi, actinomycetes, bacteria)	Soils	Effect of an herbicide treatment on the soil depends on the particular characteristics of the herbicide used, how it is applied, and soil physical, chemical and biological conditions. Factors that determine the fate of herbicides in soil include mobility and degradation. Herbicide degradation over time is a result of physical and chemical processes in soil and water. Herbicide fate in soil is determined by herbicide characteristics such as adsorption, solubility, degradation, and volatility. Soil characteristics such as organic matter, pH, temperature, moisture content, clay content, and microbial degradation are important in the fate of herbicides. Degradation rates generally decrease with increasing soil depth and decreasing temperatures.	Short-term adverse effects to soil properties would be largely offset by long-term benefits of treatment. Invasive plants can have negative effects on soil properties. Invasive plants may increase the proportion of bare ground, increase or decrease the amount of organic matter in the soil, deplete the soil of nutrients or enrich the soil with certain nutrients, change fire frequency, and produce toxic herbicides that affect soil organisms. Some of these changes may be difficult to reverse and can lead to long-term soil degradation and difficulty in reestablishing native vegetation. By properly implementing the Invasive Plant ROD standards (USDA Forest Service, 2005b) and PDC, the effects of herbicides should largely be avoided.

Short-term Uses and Maintenance of Long-term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by the Congress, this included using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

The continued expansion of invasive plants within the Forest and Scenic Area would result in serious, long-term adverse effects on a broad range of resources, reducing the long-term productivity of the National Forest System lands. Invasive plants create a host of environmental and other effects, most of which are harmful to healthy, native ecosystem processes, including: displacement of native plants; reduction in functionality of habitat and forage for wildlife and livestock; increased soil erosion and reduced water quality; alteration of physical and biological properties of soil; loss of long-term riparian area function; loss of habitat for culturally significant plants; high cost (dollars spent) of controlling invasive plants; increased cost to maintaining transportation systems; and loss of recreational opportunities. Neighboring private and other public lands would also be affected. Invasive plants spread across landscapes, unimpeded by ownership boundaries. All land ownerships (private, corporate, tribal, and government) in the Pacific Northwest are affected by invasive plants, and have the potential to spread to neighboring lands. A sustainable solution to the problem would require cooperation and a long-term commitment from all landowners.

The relationship between uses and long-term productivity as it relates to invasive plant management is described throughout this EIS, primarily in each of the resource areas discussed in the Effects sections which discuss the relationship between land management activities and invasive plants, as well as describes the effects of the proposed invasive plant treatments on the resources.

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 or Restricted Herbicide Use alternatives would not produce irreversible or irretrievable commitment of resources. The invasive plant treatment proposed through these actions 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 described in Chapter 3 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 and the alternatives in this analysis 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 alternative 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 the following sections for discussions regarding these laws:

- Hydrology – Safe Drinking Water and Clean Water Acts;
- Wildlife and Fisheries – Endangered Species Act;
- Fisheries – Magnuson-Stevens Fishery Conservation and Management Act;
- Heritage – National Historic Preservation Act.
- Wilderness Act- The fact that there will be no use of motor vehicles in Wilderness under all Alternatives will allow the Forest to preserve the character as a recreational, scenic, scientific, educational, conservation and historic resource. Wild and Scenic River Act- No treatments proposed in this document under any Alternative would create impoundments or change shorelines from primitive or undeveloped status. All treatments along wild and Scenic corridors would need to occur on foot as no motorized vehicles are

available for use. Ground-based mechanized equipment will not be allowed within 25 feet of streams, ponds, or wetlands (PDC 23).

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.

Additionally, in accordance with USDA Forest Service policy, contracting procedures would ensure that project same available to contractors through projects made available to contractors through this project would be advertised and awarded in a manner that give proper consideration to minority and women-owned business groups.

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 invasive plant treatments within riparian areas are discussed in Hydrology and Fisheries sections.

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 invasive plant 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:

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Appendix A: Desired Future Condition, Goals and Objectives and Standards Amending the Willamette LRMP from Region 6 2005 EIS

Desired Future Conditions, Goals and Objectives

The following Desired Future Condition (DFC), goals and objectives were added to the already existing sets of DFCs, goals and objectives in Forest Plans across USFS Region 6 by the Record of Decision for the Pacific Northwest Region Invasive Plant Program Preventing and Managing Invasive Plants Final Environmental Impact Statement (April, 2005):

Desired Future Condition - In National Forest lands across Region Six, healthy native plant communities remain diverse and resilient, and damaged ecosystems are being restored. High quality habitat is provided for native organisms throughout the region. Invasive plants do not jeopardize the ability of the National Forests to provide goods and services communities expect. The need for invasive plant treatment is reduced due to the effectiveness and habitual nature of preventative actions, and the success of restoration efforts.

Goal 1 - Protect ecosystems from the impacts of invasive plants through an integrated approach that emphasizes prevention, early detection, and early treatment. All employees and users of the National Forest recognize that they play an important role in preventing and detecting invasive plants.

> Objective 1.1 - Implement appropriate invasive plant prevention practices to help reduce the introduction, establishment and spread of invasive plants associated with management actions and land use activities.
> Objective 1.2 - Educate the workforce and the public to help identify, report, and prevent invasive plants.
> Objective 1.3 - Detect new infestations of invasive plants promptly by creating and maintaining complete, up-to-date inventories of infested areas, and proactively identifying and inspecting susceptible areas not infested with invasive plants.
> Objective 1.4 - Use an integrated approach to treating areas infested with invasive plants. Utilize a combination of available tools including manual, cultural, mechanical, herbicides, biological control.
> Objective 1.5 - Control new invasive plant infestations promptly, suppress or contain expansion of infestations where control is not practical, conduct follow up inspection of treated sites to prevent reestablishment.

Goal 2 - Minimize the creation of conditions that favor invasive plant introduction, establishment and spread during land management actions and land use activities. Continually review and adjust land management practices to help reduce the creation of conditions that favor invasive plant communities.

> Objective 2.1 - Reduce soil disturbance while achieving project objectives through timber harvest, fuel treatments, and other activities that potentially produce large amounts of bare ground.
> Objective 2.2 – Retain native vegetation consistent with site capability and integrated resource management objectives to suppress invasive plants and prevent their establishment and growth.

Objective 2.3 - Reduce the introduction, establishment and spread of invasive plants during fire suppression and fire rehabilitation activities by minimizing the conditions that promote invasive plant germination and establishment.
Objective 2.4 - Incorporate invasive plant prevention as an important consideration in all recreational land use and access decisions. Use Forest-level Access and Travel Management planning to manage both on-highway and off-highway travel and travel routes to reduce the introduction, establishment and spread of invasive plants.
Objective 2.5 - Place greater emphasis on managing previously "unmanaged recreation" (OHVs, dispersed recreation, etc.) to help reduce creation of soil conditions that favor invasive plants, and reduce transport of invasive plant seeds and propagules.

Goal 3 - Protect the health of people who work, visit, or live in or near National Forests, while effectively treating invasive plants. Identify, avoid, or mitigate potential human health effects from invasive plants and treatments.

Objective 3.1 - Avoid or minimize public exposure to herbicides, fertilizer, and smoke.
Objective 3.2 – Reduce reliance on herbicide use over time in Region Six

Goal 4 – Implement invasive plant treatment strategies that protect sensitive ecosystem components, and maintain biological diversity and function within ecosystems. Reduce loss or degradation of native habitat from invasive plants while minimizing adverse effects from treatment projects.

Objective 4.1 – Maintain water quality while implementing invasive plant treatments.
Objective 4.2 - Protect non-target plants and animals from negative effects of both invasive plants and applied herbicides. Where herbicide treatment of invasive plants is necessary within the riparian zone, select treatment methods and chemicals so that herbicide application is consistent with riparian management direction, contained in Pacfish, Infish, and the Aquatic Conservation Strategies of the Northwest Forest Plan.
Objective 4.3 - Protect threatened, endangered, and sensitive species habitat threatened by invasive plants. Design treatment projects to protect threatened, endangered, and sensitive species and maintain species viability.

Goal 5 – Expand collaborative efforts between the Forest Service, our partners, and the public to share learning experiences regarding the prevention and control of invasive plants, and the protection and restoration of native plant communities.

Objective 5.1 - Use an adaptive management approach to invasive plant management that emphasizes monitoring, learning, and adjusting management techniques. Evaluate treatment effectiveness and adjust future treatment actions based on the results of these evaluations.
Objective 5.2 - Collaborate with tribal, other federal, state, local and private land managers to increase availability and use of appropriate native plants for all land ownerships.
Objective 5.3 - Work effectively with neighbors in all aspects of invasive plant management: share information and resources, support cooperative weed management, and work together to reduce the inappropriate use of invasive plants (landscaping, erosion control, etc.).

Appendix B: Willamette National Forest Noxious Weed Prevention Guidelines

Introduction

Forest Service Chief Dale Bosworth discussed four threats to the Nation's Forests and Grasslands (Bosworth, 2004); the second of these threats was the spread of invasive species that could have an unparalleled adverse effect on the lands the Forest Service is charged with managing for public good. Closely following this speech, Forest Service unveiled a National Strategy and Implementation Plan for Invasive Species Management (Ries et al., 2004) to combat this threat. This Strategy has four program elements. The first and most important of these elements is prevention.

Prevention has proven to be the most effective and cheapest means of managing invasive species. The Willamette National Forest's Environmental Assessment for Integrated Weed Management (USDA, 1999), the Pacific Northwest Region's draft Environmental Impact Statement for Preventing and Managing Invasive Plants (USDA, 2004) and the USDA Forest Service Guide to Noxious Weed Prevention Practices (USDA, 2001) can be used to help shape a prevention program for the Forest. In an effort to simplify incorporation of these practices into our program of work, enclosed is a list of prevention practices each project manager should evaluate for appropriateness to incorporate.

Guidelines

Education and Public Awareness

Noxious weed awareness by both the public and Forest Service personnel can reduce the number of practices that might otherwise move invasive plants onto the Forest. It will also help to identify infestations before they become well-established. Coordination with State, County, private, and other Federal Agencies is critical to addressing noxious weed issues.

1. Provide annual noxious weed identification training for Forest personnel at District meetings in the early summer, particularly targeting field-going personnel.
2. Develop displays for front desk areas so that visitors might learn about noxious weeds.
3. Present invasive plant programs and educational materials (pamphlets, brochures) to interested groups and organizations.
4. Post noxious weed educational posters at recreation sites such as trailheads and boat launches where there are particular weed concerns.
5. Explain noxious weed issues with contractors and special-use permitees, especially when permits come up for renewal.
6. Coordinate with State, County, private, and other Federal Agencies to identify new and encroaching noxious weeds.
7. Work with appropriate Cooperative Weed Management Area members (Upper Willamette and Central Willamette) sharing educational materials and coordinating information exchange.
8. Develop cleaning stations at all four Ranger District Offices so that FS vehicles operating in infested areas can be cleaned. Use these as a way to engage District personnel in their responsibility to help limit weed spread. Ensure not only vehicles but clothing is inspected. Allow permittees and contractors to use cleaning stations.

Inventory

Inventories for noxious weeds should not only identify where noxious weeds have already become established but should also identify areas that are at risk of weed invasion. Inventory should be part of the standard survey completed by Botanists for all projects and funded by benefiting function (i.e. if the project is a timber sale, inventory of weeds along road corridors should be part of the survey completed by the Botanist and funded by timber dollars), so that appropriate prevention measures can be incorporated into project design. (See regional direction for this in 8/28/02 direction on Invasive Plan Contract Provisions.)

1. Inventory proposed project areas as well as associated project sites such as quarries and travel routes.
2. Maintain regular inventory of high risk weed areas such as actively used rock or soil stockpile sites, trailheads, unpaved parking areas at recreation sites in a GIS layer that project planners and Botanists can access. Make a database available to link to GIS layer so that attributes such as species and population size are available for analysis.
3. To the degree practicable, inventory potential fire camp locations, helipads, pump chances, major staging areas and drop points prior to fire emergency situations and apply appropriate weed management measures or find alternative locations.
4. Develop an inventory of sites where it is appropriate to clean vehicles after they have been working in infested areas.
5. Where weeds are of a high concern for multiple owners, work with Cooperative Weed Management Area partners to get grant funds to survey road systems in a more efficient and cost-effective manner.
6. Inventory all lands considered for acquisition. Consider weed status when making land adjustment decisions.

Implementation of All Ground-Disturbing Projects

Many or most proposed activities will have some potential for introducing or spreading noxious weeds if not suitably addressed. In most cases, the risk of worsening the Forest noxious weed problem can be minimized through proper inventory and project design. Environmental analysis for ground-disturbing activities will assess invasive plant populations in the project area, will analyze the potential risks to introduction,… and include prevention practices and follow-up inspections into project design" (Regional Forester Regional Policy for Prevention letter dated 10/1/04).

Most noxious weeds are shade-intolerant so canopy closure can be particularly effective at minimizing weed establishment. Forest and Regional (USDA, 2004) policy recommends revegetation of disturbed sites with native species from *local genetic stock*. In some highly disturbed areas where recovery to a natural community is not an option, it may be necessary to establish a non-native plant community to discourage weed invasion or meet other resource goals. Such circumstances are expected to be rare exceptions.

1. Employ practices and technology that minimize disturbance to soil and desirable vegetation
2. Retain barriers of undisturbed vegetation between weed infested areas and project areas.
3. Treat existing infestations prior to project implementation to minimize seed spread.
4. Clean equipment prior to coming on to the Forest and potentially between projects or sites, depending on the occupancy of weeds at the affected areas. Use appropriate clauses

to ensure contractors whose vehicles operate off the road surface are cleaning vehicles appropriately. See Appendix 1 for contract clauses (WO-C6.36 & WO-CT6.36).

5. Work in weed-free areas prior to moving to weed-infested areas.
6. Avoid putting landings, yarding stations, staging and equipment storage areas, in weed infested areas. Provide timber and other contractors with a map of infestations in the prework process. Weed infestations will be identified on the sale map.
7. Use weed-free staging areas. Avoid or minimize all types of travel through weed-infested areas, or restrict to those periods when spread of seed or propagules is least likely.
8. Evaluate options, including closure to regulate the flow of traffic, in infested sites or in revegetation sites.
9. Use only Oregon noxious weed-free certified straw, mulch, seed, and transplant stock for revegetation/restoration projects.
10. Do not use soil, rock or gravel from weed-infested stockpiles or quarries. Inspect material sources on site and ensure they are weed-free before use and transport. This includes both gravel and dirt. Use the clause developed by the Engineering group for weed free material in road construction contracts
11. Develop a restoration plan for disturbed sites. Consider both short-term vegetation and soil stabilization needs at a site as well as the desired long-term plant community recovery objectives at the site. Make sure that short-term practices don't preclude or unnecessarily delay the ultimate site restoration objectives. Provide adequate lead time for seed collection and grow-out of appropriate stock.
12. Revegetate site as soon as possible (during the appropriate planting or seeding window) following disturbance. Revegetation may include topsoil replacement, site prep such as ripping, planting, seeding, fertilizing and weed-fee mulching as necessary. Monitor sites and reseed or replant as necessary.

<u>Road Maintenance Activities</u>

Because the vast majority of the Forest's noxious weed infestations occur along road shoulders, road maintenance activities represent a particular risk for inadvertently spreading weeds. Movement of maintenance equipment across the Forest introduces a risk of spread of high priority noxious weeds from one watershed to another. Activities such as grading, brushing and mowing, culvert upgrades, and ditch cleaning can contribute to the spread of noxious weeds along road corridors by transporting seeds from infested sites to uninfested areas. Consequently, coordination between the road manager and the District noxious weed coordinator is essential. By working together, the road manager and noxious weed specialist can identify areas of concern and develop strategies to prevent weed spread.

1. Train road maintenance personnel in weed identification and reporting.
2. Clean road maintenance equipment after working in high priority noxious weed infested areas (Appendix B). If contractors are employed for road maintenance, require vehicle cleaning in contracts where appropriate. These areas will be marked on maps associated with the contract. A list of appropriate cleaning sites for each high priority road system will be developed by the District Botanist. Follow-up monitoring of washing station areas is imperative to determine whether viable weed seed has been deposited and has germinated. If so, District Botanists will ensure sites are treated in a timely fashion.
3. Where possible, begin project operations in non-infested areas before moving to weed infested areas.
4. Avoid road maintenance activities when plants are seeding as this will result in movement of seed up and down the road corridor. Provide data on where maintenance

activities will occur the next summer to District Botanists in winter and they will help develop specifications on appropriate timing.

5. Maintain stockpiled material in a weed-free condition. Monitor stockpiles and eradicate new weeds prior to seed production. Consider covering stockpile sites to prevent weed establishment.
6. Inspect materials at the source to ensure that they are weed-free before transport and use. Do not use soil, rock or gravel from weed-infested stockpiles or quarries. If sources of sand, gravel, and fill are infested, eradicate the weeds, then strip and stockpile the contaminated material for several years, if possible, to further deplete the soil seed bank. Check regularly for weed re-emergence.
7. Limit road clearing and brushing widths as much as is permissible.

Fire

1. Train firefighters in weed awareness and prevention.
2. Include weed prevention in Resource Advisor duties. Weed locations and weed prevention measures should be communicated. Maps of infestations will be available on GIS and in an associated database.
3. Placement and size of dozer lines adjacent to weed areas should be minimized to the degree practicable.
4. Burned areas and areas affected by fire suppression activities should be inventoried following wildfires. Burned area emergency rehabilitation (BAER) funds may be collected for weed inventory of burned areas for up to three years.
5. To the degree practicable, inventory potential fire camp locations, helipads, pump chances, major staging areas and drop points prior to fire emergency situations and apply appropriate weed management measures or find alternative locations.
6. Weed cleaning stations should be established at fire camps. Vehicles assigned to the fire should be thoroughly cleaned at initial chack-in for the fire (this does not apply to vehicles involved in initial attack). Require contracted equipment to be cleaned before reporting to fire camp. The principle areas of concern are the tires, tracks, undercarriage, and blade, bucket or other parts involved in earth movement or transport. Inspect and treat infestations following fire.
7. Identify noxious weed infested water sources and treat prior to use as a drafting site.
8. Consider the potential for noxious weed invasion and spread when planning prescribed fire or other fuel treatments.

Special Uses and Administrative Sites

1. Require use of only weed-free feed for stock in wilderness areas and wilderness trailheads. This can include oats or pelletized feed. Recommend that stock be fed weed-free forage 3 days prior to coming onto Forest Service land to ensure the digestive tract is clean of weeds.
2. Include noxious weed prevention measures in special-use permits, easements, and leases as appropriate. Use reauthorization of permits to require weed removal and site restoration.
3. Use native species for restoration, focusing on genetically local, weed free seed and native shrubs appropriate for the landscape.
4. Set a good example and treat weed infestations at Ranger District offices.
5. Use specifications in special use permits as evidenced in Appendix C.

Recreation

1. Provide educational materials at boat launches and where weed sites are documented (e.g. Waldo Lake), consider developing cleaning stations.
2. Educate the public, via trail head signs, that hikers, stock, and ATV's can inadvertently move noxious weed seed from one place to another.
3. Inventory ATV use areas for noxious weed infestations and place a high priority on treatment due to the ease of spread on these vehicles.
4. Train recreation staff to identify weed species so they may inspect campgrounds, trailheads and recreation areas for new infestations and report back to District Botanists.
5. Train Wilderness Rangers to identify weed species so they may look for noxious weed infestations during their routine work. This is especially important because there are limited treatment opportunities in Wilderness and it is critical to detect and treat infestations early.
6. In areas susceptible to infestation, consider limiting vehicle access to designated, maintained travel routes.

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: List of Weed sites on Willamette National Forest

Site ID	Weed Species	Site Type	Restrictions	Prescription Alt B	Prescription Alt C
BR-001a	CEMA4	2,3	TES fish	c	c
BR-001b	CEMA4	2,3	TES fish	c	c
BR-002a	CEMA4	1,2		c	c
BR-002b	CEMA4	1,2,3	TES fish; TES plant	c	c
BR-002c	CEMA4	1,2,3	TES fish; TES plant	c	c
BR-003	CEMA4	2,3	TES fish	c	c
BR-004	CEMA4	2,3	TES fish	c	c
BR-005a	CEMA4	1,2		c	c
BR-005b	CEMA4	1		m	m
BR-005c	CEMA4	4	Boat Launch	m	c
BR-005d	CEMA4	1,2		m	m
BR-006a	CEMA4	1		m	c
BR-008	CEMA4	1		c	c
BR-010	CEMA4	1,3		c	c
BR-010a	CEMA4	1		c	c
BR-013a	CEMA4	1		c	c
BR-013b	CEMA4	1		m	m
BR-013c	CEMA4	1		m	m
BR-014	CEMA4	1		m	m
BR-014b	MEAL2	1		c	c
BR-015	CEMA4	1		c	c
BR-017	CEMA4	4	Dispersed rec	m	c
BR-020	RUDI2	1,3		c	c
BR-021	RUDI2	1		c	c
BR-021b	RULA	1		c	c
BR-022	RUDI2	1		c	c
BR-023	RUDI2	1		c	c
BR-024	RUDI2	1,3		c	c
BR-025	RUDI2	1		m	c
BR-026	RUDI2	1		c	c
BR-027	RUDI2	1		c	c
BR-028	RUDI2	1		c	c
BR-029	RUDI2	4	Lookout	m	c
BR-031	RUDI2	1		c	c
BR-032	RUDI2	1		c	c
BR-033	CYSC4	5	Powerline corridor; TES bird	e	e,c
BR-033b	CEMA4	5	Powerline corridor; TES bird	e,c	e,c
BR-033c	RUDI2	5	Powerline corridor; TES bird	e	e,c
BR-033d	RULA	5	Powerline corridor; TES bird	e	e,c
BR-034	CEMA4	1		m	m
BR-035	CEMA4	1		c	c
BR-036	CEMA4	1		m	m

BR-037	CEMA4	1		m	m
BR-038	PHAR3	3,4	Campground; TES fish	m	m,c
BR-039	PHAR3	2		m	c
BR-040	PHAR3	4	Campground	m	m,c
BR-041	PHAR3	4	Campground	m	m,c
DE-001	CEMA4	4	Park	m	m
DE-001b	MEAL2	2		m	m
DE-002	CEMA4	2		c	c
DE-002b	MEAL2	2		c	c
DE-003	CEMA4	1,3	TES fish	c	c
DE-003a	CEMA4	1,3	TES fish	c	c
DE-005	CEMA4	1,3		c	c
DE-005a	CEMA4	1,3	TES fish; TES/S&M botanicals	c	c
DE-009	CEMA4	1		m	c
DE-011	CEMA4	1		m	c
DE-011b	MEAL2	1		m	c
DE-012	CEsp.	6		c	c
DE-014	LIVU2	2,3	TES fish	c	c
DE-016	RUDI2	1		c	c
DE-018a	RULA	1		c	c
DE-018b	RULA	1		c	c
DE-019	RULA	1		c	c
DE-020	RULA	1		c	c
DE-021	RUDI2	1,3,4	Dispersed rec; TES fish	m	c
DE-022	RULA	1		c	c
DE-023	RUDI2	1		c	c
DE-023b	RUDI2	1		c	c
DE-023c	RULA	1		c	c
DE-023d	RULA	1		c	c
DE-023e	RULA	1		c	c
DE-023f	RUDI2	1		c	c
DE-023g	RULA	1		c	c
DE-024	RUDI2	1		c	c
DE-024b	RULA	1		c	c
DE-025	RULA	1		c	c
DE-026	RULA	1		c	c
DE-026b	RUDI2	1		c	c
DE-027	RULA	1		c	c
DE-028	RULA	1		c	c
DE-029	RUDI2	1		c	c
DE-030	RULA	1		c	c
DE-030b	RUDI2	1		c	c
DE-030c	RULA	1		c	c
DE-030d	RUDI2	1		c	c
DE-031	RULA	4	Ranger District	e,c	e,c
DE-031b	RUDI2	4	Ranger District	e,c	e,c
DE-031c	CYSC	4	Ranger District	m	m
DE-032	CEMA4	1		m	m
DE-033	CEMA4	1		m	m
DE-034	CEMA4	3,4	Trailhead	m	m
DE-034b	CEPR2	3,4	Trailhead	m	m
DE-035	MEAL2	2		m	m

DE-036	POSA4	1		m	c
DE-037	POSA4	2		m	c
DE-039	CEMA4	2		c	c
DE-040	CEMA4	4	Dispersed rec	c	c
DE-043	CEDI3	1		m	m
DE-044	CEDI3	4	Dispersed rec	m	m
DE-045	PHAR3	2		c	c
DE-046	PHAR3	1,4	Trailhead	m	c
DE-047	PHAR3	2, 4	Dispersed Rec	m	c
DE-048a	RULA	2		c	c
DE-048b	RULA	2		c	c
DE-048c	RUDI2	2		c	c
DE-048d	RULA	2		c	c
DE-049	RUDI2	2		c	c
DE-050	CEMA4	2		c	c
DE-051a	RULA	2		c	c
DE-051b	RULA	2		c	c
DE-052	RULA	2		c	c
DE-053	RUDI2	2		c	c
DE-054	BRSY	2		c	c
DE-055	HEHE	4	Hot springs	m	m
DE-056	RUDI2	1		c	c
DE-F1a	CYSC4/CIAR4/CIVU	3,5	TES fish; TES bird	e	e,m,c
DE-F1b	CYSC4/CIAR4/CIVU	5		e	e,m,c
DE-F2a	CYSC4/HYPE/CIAR4/CIVU	2	TES bird	e	e,m,c
DE-F2b	CYSC4/HYPE/CIAR4/CIVU	2	TES bird	e	e,m,c
DE-F2c	CYSC4/HYPE/CIAR4/CIVU	2,3	TES bird	e	e,m,c
DE-F2d	CYSC4/HYPE/CIAR4/CIVU	2	TES bird	e	e,m,c
DE-F2e	CYSC4/HYPE/CIAR4/CIVU	2,3	TES bird	e	e,m,c
DE-F2f	CYSC4/HYPE/CIAR4/CIVU	2,3	TES bird w/in 1/4 mi	e	e,m,c
DE-F2g	CYSC4/HYPE/CIAR4/CIVU	2		e	e,m,c
DE-F2h	CYSC4/HYPE/CIAR4/CIVU	2	TES bird	e	e,m,c
DE-R1	CYSC4/HYPE/SEJA/CIAR4 etc	1,2	TES bird	e	e,m,c
DE-R10	CYSC4/HYPE	1,2	TES bird	e	e,m,c

DE-R11	RUDI2/CYSC4/HYPE/PHAR3	4		e	e,m,c
DE-R12	RUDI2/RULA/CYSC4	4		e	e,m,c
DE-R1-I	CYSC4	2		e	e,m,c
DE-R2a	CYSC4/RUDI2/RULA	1,3	TES bird	e	e,m,c
DE-R3	PHAR3/HYPE/CYSC/RUDI2etc	2	TES bird	e	e,m,c
DE-R4	CYSC4/HYPE	1,3	TES fish; TES bird	e	e,m,c
DE-R4-I	CYSC4	2	TES bird	e	e,m,c
DE-R5	CYSC4/HYPE/RUDI2/RULA	1,2,3	TES bird	e	e,m,c
DE-R5-I	HYPE	2	TES bird	e	e,m,c
DE-R6	HYPE/CIVU/CYSC4	1,2	TES bird	e	e,m,c
DE-R6-I	HYPE	1,2		e	e,m,c
DE-R7	CYSC4/CIVU/HYPE/RUDI2	2,3	TES bird	e	e,m,c
DE-R8	CYSC4	1,2	TES bird	e	e,m,c
DE-R9	CYSC4	1,2,3	TES bird	e	e,m,c
DE-S1	CYSC4/HYPE	1,2,3	TES bird	e	e,m,c
DE-S2	CYSC4/RULA/HYPE	2,3	TES plant; TES bird	e	e,m,c
DE-S3	CYSC4/HYPE	1,2	TES bird	e	e,m,c
DE-S4	CYSC4/HYPE	1,3	TES bird; TES fish	e	e,m,c
DE-W1	HYPE/CIVU/CIAR4	4	TES bird	e	e,m,c
DE-W2	HYPE/CYSC4/CIVU	3,4	TES bird	e	e,m,c
DE-W3	CYSC4/HYPE/CIAR4/CIVU	4	TES bird	e	e,m,c
DE-W4	HYPE/SEJA/CEMA4	3,4	TES bird	e	e,m,c
DE-W5	HYPE/SEJA/CEMA4/PHAR3	4	TES bird	e	e,m,c
EWEB-01	BRSY/CEMA4/CEPR2/LALA4etc	2,3,5	TES bird;TES fish	e	e,m,c
EWEB-02	CEMA4/CEDI3	3,4	Reservoir/CG; TES fish; TES bird	e	e,m,c
EWEB-03	CEMA4/CYSC4/MEAL2/RUDI2	2,3	TES bird	c	m,c

EWEB-04	CEMA4/MEAL2/PHAR3/CYSC4	2,3,4	Reservoir; TES bird	m	m,c
EWEB-05	CEMA4/HEHE/PHAR3/RUDI2	1,4	Reservoir	e	e,m,c
LO-001	CEMA4	2,3	TES fish	c	c
LO-001b	MEAL2	2,3	TES fish	c	c
LO-002	CEMA4	1		c	c
LO-005	CEPR2	1		c	c
LO-006	CEPR2	2		c	c
LO-007	CEMA4	1		m	m
LO-009a	BRSY	1		c	c
LO-009b	BRSY	1,3		c	c
LO-010	BRSY	1		c	c
MC-001	CEMA4	2,3	TES fish	c	c
MC-002	CEMA4	1,3	TES fish	c	c
MC-003	CEMA4	1,3	S&M botanical	m	c
MC-005	CEMA4	1,2,3	TES fish	c	c
MC-006	CEMA4	2		c	c
MC-007	CEMA4	1,3	TES fish	c	c
MC-008	CEMA4	1		c	c
MC-009	CEMA4	1		m	m
MC-009b	CEPR2	1		m	m
MC-011	CEMA4	1		m	c
MC-014	CEMA4	1		m	m
MC-015	CEMA4	1,3	TES fish	c	c
MC-016	CEMA4	1		m	m
MC-017	CEMA4	1		m	m
MC-019	CEMA4	1		m	m
MC-022	CEPR2	1		m	c
MC-025	RUDI2	1		m	c
MC-026	RUDI2	2		c	c
MC-027	CYSC4	4	Ranger District Office	m	m,c
MC-027b	BRSY	4	RangerDistrict Office	c	c
MC-028	RUDI2	1		c	c
MC-029	RUDI2	1		c	c
MC-033	RUDI2	1		c	c
MC-034	CEMA4	1		c	c
MC-035	CEMA4	1		m	m
MC-037	CEMA4	1		m	m
MC-038	CEMA4	1		c	c
MC-039	RUDI2	1		m	m
MC-040	RUDI2	1		c	c
MC-043	CEMA4	2		m	m
MC-045	RUDI2	1		c	c
MC-046	RUDI2	1		c	c
MC-048	RUDI2	1		c	c
MC-049	PHAR3	4	campground/boat launch	m	m,c
MC-050	PHAR3	4	campground	m	m,c
MC-051	CEMA4	4	campground	m	m,c
MC-052	PHAR3	4	campground	m	m,c

MC-059	CEMA4	4	Boat launch	m	m,c
MC-059b	PHAR3	4	Boat launch	m	m,c
MF-001	BRSY	2		c	c
MF-004	CYOF	1,2,3	TES fish	m	c
MF-005	PHAR3	6		m	c
MF-006	PHAR3	7		m	c
MF-007a	POSA4/HEHE	2	TES bird	m	m,c
MF-007b	CYSC4/HEHE	2	TES bird	m	m,c
MF-007c	RULA	2	TES bird	m	m,c
MF-008	LYSA2	7	pond	m	m
MF-009	HYPE	4,7	Lookout	m	m
MF-010	PHAR3	3,7	lake; Wilderness	m	m, c
MF-010b	PHAR3	3	lake, wilderness	m	m, c
MF-011	CEMA4	2		m	c
MF-011b	CEMA4	2		m	c
MF-012b	CYSC4	1		m	m
MF-013	CEPR2	4	Rigdon Work Center	c	c
MF-014a	DIPU	2		m	m
MF-014b	DIPU	2		m	m
MF-014c	DIPU	2		m	m
MF-015	LIVU2	2		c	c
MF-016	LALA4	1,3		m	c
MF-017	CYSC4	2		m	m
MF-018	POCU6	2		m	c
MF-020	RUDI2	1		c	c
MF-020b	RUDI2	1,3	TES fish	c	c
MF-022	RUDI2	1		c	c
MF-023	PHAR3	2		c	c
MF-024	PHAR3	2		c	c
MF-025	CEMA4	1		c	c
MF-026	BRSY	1, 3,4	TES fish; Trailhead	m	c
MF-028	PHAR3	2, 4	Trailhead	m	c
MF-031a	RUDI2	1		m	c
MF-031b	RUDI2	1		m	c
MF-032	LALA4	2		m	c
MF-033	LALA4	2		m	c
MF-034	LALA4	2		m	c
MF-035	POCU6	3,5,6,7	TES wildlife, TES fish, TES bird	m, e, c	m,e,c
MF-036	RUDI2	7	TES bird	c	c
MF-037	RUDI2	7	TES bird	c	c
MF-038a	CEPR2	2		c	c
MF-038b	CEPR2	2		m	m
MF-039	LALA4	2		c	c
MF-040	CEMA4	2		c	c
MF-041a	BRSY	2,3		c	c
MF-041b	BRSY	2		c	c
MF-041c	BRSY	2		c	c
MF-041d	BRSY	2		c	c
MF-041e	BRSY	2		c	c
MF-041f	BRSY	2		c	c
MF-041g	BRSY	2		c	c
MF-042	BRSY	2		c	c

MF-043	BRSY	2		c	c
MF-044a	BRSY	2		c	c
MF-044b	BRSY	2		c	c
MF-044c	BRSY	2		c	c
MF-044d	BRSY	2		c	c
MF-044e	BRSY	2		c	c
MF-045	BRSY	2,3		m	c
MF-046a	LALA4	2		m	c
MF-046b	LALA4	2		c	c
MF-059	RULA	2		c	c
MF-060	RULA	2		c	c
MF-061	RULA	2		c	c
MF-062	RULA	2,3		c	c
MF-063	RULA	2		c	c
MF-064	RULA	2		c	c
MF-065	RULA	2		c	c
MF-066	RULA	2		c	c
MF-068	RULA	2		c	c
MF-069	RULA	2		c	c
MF-070	RULA	2		c	c
MF-071	RULA	2		c	c
MF-072	RULA	2		c	c
MF-073	RULA	2		c	c
MF-074	RULA	2		c	c
MF-075	RUDI2	2		c	c
MF-076	RULA	2		m	c
MF-077	RULA	2		c	c
MF-078	RUDI2	2		c	c
MF-079	RULA	2		c	c
MF-080	RULA	2		c	c
MF-081a	BRSY	1		c	c
MF-081b	BRSY	2	close to stream	m,c	c
MF-082	RUDI2	1		c	c
MF-083	BRSY	2		c	c
MF-084	CEMA4	1, 2,3		c	c
MF-085	HEHE	1		c	m
MF-086	RUDI2	2		c	c
MF-087	RUDI2	1		c	c
MF-088	RUDI2	2		c	c
MF-100	RUDI2	2,3		c	c
MF-101	BRSY	1,3	TES fish; TES plant	m	c
MF-102	BUDA2	2,3		m	c
MF-103	CEMA4	2		c	c
MF-104	CEMA4	3,6	TES fish	c	c
MF-105	POCU6	4		m	c
MF-106	BUDA2	2		c	c
MF-107	CEMA4	2		c	c
MF-108	CEMA4	2		m	c
MF-109	RUDI2	2		c	c
MF-110	RUDI2	2		c	c
MF-111	RUDI2	2		c	c
MF-112	RUDI2/RULA	2		c	c
MF-113	BRSY	2		c	c
MR-002	RUDI2	1		c	c
MR-003	CEMA4	1		m	m
MR-005a	RUDI2	2,4	campground	m	m
MR-005b	RUDI2	2,4	campground	m	m

MR-005c	RUDI2	4	campground	m	m
MR-005d	RUDI2	4	campground	m	m
MR-006a	RUDI2	1		m	m
MR-006b	RUDI2	1		m	m
MR-006c	RUDI2	1		m	m
MR-006d	RUDI2	1		m	m
MR-006e	RUDI2	1		m	m
MR-006f	RUDI2	1		m	m
MR-008	RUDI2	1		c	c
MR-009	RUDI2	1		c	c
MR-009b	RUDI2	1		c	c
MR-010	RUDI2	1		c	c
MR-011	RUDI2	1		c	c
MR-012	RUDI2	1		c	c
MR-013	RUDI2	1		c	c
MR-013b	RUDI2	1		c	c
MR-014	RUDI2	1		c	c
MR-015	RUDI2	1,3		c	c
MR-015b	RUDI2	1,3		c	c
MR-016	RUDI2	1		c	c
MR-016b	RUDI2	1		c	c
MR-017	RUDI2	1		c	c
MR-018	RUDI2	1		c	c
MR-019	RUDI2	1		c	c
MR-020	RUDI2	1		c	c
MR-021	RUDI2	1		c	c
MR-022	RUDI2	1		c	c
MR-023	RUDI2	1		c	c
MR-024	RUDI2	1		c	c
MR-025	CEMA4	1		m	m
MR-026a	CEMA4	1		m	m
MR-026b	CEMA4	1		m	m
MR-026c	CEMA4	1		m	m
MR-027	CEMA4	1		m	m
MR-028	CEDI3	2		c	c
MR-029	CEDI3	5		m	m
MR-030	BRSY	1		c	c
MR-031	PHAR3	4	SnoPark	m	c
MR-032	RUDI2	1		c	c
MR-033	RUDI2	4	trailhead	m	c
MR-034	CEMA4	4	trailhead	m	c
MR-035	CEMA4	2,6		c	c
MR-036	CEMA4	1		m	m
MR-037	PHAR3	3,4,6	reservoir; TES fish	m	m,c
MR-037b	PHAR3	1,4	reservoir	m	m,c
MR-038	BRSY	4	campground	m	c
MR-039	BRSY	7		c	c
MR-040	RULA	3,7	TES plant	m	m,c
MR-041	BRSY	2,3,6		c	c
MR-042A	RUDI2	2		c	c
MR-042B	RUDI2	2		c	c
MR-043A	RUDI2/RULA	2		c	c
MR-043B	RUDI2/RULA	2		c	c
MR-044A	RULA	1		m	c
MR-044B	RULA	1		c	c
MR-045A	RUDI2	1,2		e	e,m,c
MR-045B	RUDI2	1,2		e	e,m,c

MR-045C	RUDI2	1,2		e	e,m,c
MR-045D	RUDI2	1,2	TES bird	e	e,m,c
MR-047a	RUDI2/RULA	1,2,4	Reservoir; TES bird	e	e,m,c
MR-047b	RUDI2/RULA	1,2,3,4	Reservoir; TES bird	e	e,m,c
MR-047c	RUDI2/RULA	1,2,4	Reservoir; TES bird	e	e,m,c
MR-047d	RUDI2/RULA	1,2,4	Reservoir	e	e,m,c
MR-048a	RUDI2/RULA	1,2,4	Reservoir	e	e,m,c
MR-048b	RUDI2/RULA	1,2,4	Reservoir	e	e,m,c
MR-048c	RUDI2/RULA	1,2,4	Reservoir; TES bird	e	e,m,c
MR-048d	RUDI2/RULA	1,2,4	Reservoir; TES bird	e	e,m,c
MR-048e	RUDI2/RULA	1,2,4	Reservoir	e	e,m,c
MR-048f	RUDI2/RULA	1,2,4	Reservoir	e	e,m,c
MR-048g	RUDI2/RULA	1,2,4	Reservoir; TES bird	e	e,m,c
MR-048h	RUDI2/RULA	1,2,4	Reservoir; TES bird	e	e,m,c
MR-048i	RUDI2/RULA	1,2,4	Reservoir; TES bird	e	e,m,c
MR-048j	RUDI2/RULA	1,2,4	Reservoir; TES bird	e	e,m,c
MR-049a	RUDI2	2		e	e,m,c
MR-049b	RUDI2	2		e	e,m,c
MR-049c	RUDI2	2		e	e,m,c
MR-049d	RUDI2	2		e	e,m,c
MR-049e	RUDI2	2		e	e,m,c
MR-049f	RUDI2	2		e	e,m,c
MR-049g	RUDI2	2		e	e,m,c
MR-050a	RUDI2	1,2,3	TES bird	e	e,m,c
MR-050b	RUDI2	1,2,3	TES bird	e	e,m,c
MR-051	RUDI2	2		e	e,m,c
MR-052	BRSY	2		c	c
MR-053	BRSY	2		c	c
MR-054	BRSY	2		c	c
MR-055	BRSY	2		c	c
MR-056	BRSY	2		c	c
MR-057	BRSY	2		c	c
MR-060a	MEAL2	1		m	m
MR-060b	MEAL2	1		m	m
MR-061	RUDI2	2		c	c
MR-062	RULA	2		c	c
MR-063	RUDI2	2		c	c
MR-064	RUDI2	2		c	c
MR-065a	RUDI2	1,2		c	c
MR-065b	RUDI2	1,2		c	c
MR-065c	RUDI2	1,2		c	c
MR-070	RULA	2		c	c
MR-080a	MEAL2	1		m	m
MR-080b	MEAL2	1,3		m	m
MR-080c	MEAL2	1		m	m
MR-080d	MEAL2	1,3		m	m

MR-080e	MEAL2	1		m	m
MR-081	CEMA4	1		c	c
MR-082	BRSY	1		c	c
MR-083	RUDI2	6		c	c
MR-084	BRSY	1		c	c
MR-085	RUDI2	2,3		c	c
MR-086	RUDI2	1		c	c
MR-087	LALA4	1		m	c
MR-088	CEMA4	1		m	m
MR-090	BRSY	2		c	c
MR-091	BRSY	2		c	c
MR-092	BRSY	1		c	c
MR-093	DIPU	1		m	m
MR-094	LALA4	2		m	c
MR-095	BRSY	2, 6		c	c
MR-096	BRSY	2		c	c
MR-097	BRSY	1		c	c
MR-098	BRSY	1,2		m,c	c
MR-099	CEMA4	2		c	c
MR-100	RUDI2	1		c	c
MR-101	CEMA4	1		m	c
MR-102	BRSY	1,3		c	c
MR-103	BRSY	1		c	c
MR-104	BRSY	1,3		c	c
MR-105	BRSY	4		c	c
MR-106	PHAR3	1		c	c
MR-107	PHAR3	1		c	c
MR-108	BRSY	2		m	c
MR-109	BRSY	1		c	c
MR-110	BRSY	1		c	c
MR-111	BRSY	1		c	c
MR-112	BRSY	1		c	c
MR-113	BRSY	1		m	c
MR-114	BRSY	1		c	c
MR-115	BRSY	1	stream	m	c
MR-116	BRSY	1		c	c
MR-117	BRSY	1		c	c
MR-118	BRSY	1,3		m	c
MR-119	BRSY	1		c	c
MR-120	BRSY	1		c	c
MR-121	BRSY	1,3		c	c
MR-122	BRSY	2		c	c
MR-123	BRSY	1		c	c
MR-124	BRSY	1		m	c
MR-125	BRSY	1		c	c
MR-126	BRSY	2		c	c
MR-127	BRSY	1		c	c
MR-128	BRSY	1		c	c
MR-129	BRSY	1		c	c
MR-130	BRSY	1		c	c
MR-131	BRSY	1,3		m	c
MR-132	CEMA4	1		c	c
MR-133	BRSY	1		c	c
MR-134	BRSY	1		c	c
MR-135	CEMA4	1		c	c
MR-136	BRSY	2		c	c
MR-137	RUDI2	1,3		c	c
MR-138	CYSC4/RULA	1,2,4	City dump	e,m	e,m,c
MR-139	POCU6	4	EWEB home	m	c
MR-140	CEMA4	1		c	c
MR-141	CEMA4	1		c	c

MR-142	BRSY	1, 4	Horse Cr. Work Center	c	c
MR-143	RUDI2	1		c	c
MR-144	RUDI2	1		c	c
MR-145	RUDI2	1		c	c
MR-146	RUDI2	1		c	c
MR-147a	RUDI2	1		c	c
MR-147b	RUDI2	1		c	c
MR-148	BRSY	1		c	c
MR-149	CEMA4	1		c	c
MR-150	BRSY	1		c	c
MR-151a	BRSY	4	Trail	c	c
MR-151b	BRSY	4	Trail	c	c
MR-152	BRSY	2		c	c
MR-153	BRSY	1		c	c
MR-154	BRSY	2		m	c
MR-155	CEMA4	1		c	c
MR-156	CEMA4	2,3		c	c
MR-159	BRSY	2		c	c
OA-001	CEMA4	1,3	TES plant	m	c
OA-001b	MEAL2	1,3	TES fish; TES plant	m	m
OA-002	CEMA4	1		m	c
OA-007	CEMA4	1		c	c
OA-008	CEMA4	1		m	c
OA-009	CEDI3	1		c	c
OA-010	POSA4	2		m	m
OA-013	CEMA4	1		c	c
OA-014	RUDI2	2		c	c
OA-015	RULA	1		m	c
OA-016	RUDI2	2		c	c
OA-019	RULA	2		c	c
OA-020	RULA	2		c	c
OA-022	RUDI2	4	Ranger District Office;TES bird	e,m,c	e,m,c
OA-022b	RUDI2	4	Ranger District Office;TES bird	e,m,c	e,m,c
OA-024	PHAR3	2		m	m,c
OA-025	PHAR3	2		m	m,c
OA-026	PHAR3	1		m	m,c
OA-027	PHAR3	3,7	Waldo Wilderness	m	m,c
OA-028	PHAR3	3,4	Waldo Lake	m	m,c
OA-029	PHAR3	7	TES fish	m	m,c
RI-001	CEMA4	1,2, 4	Dispersed rec	m	c
RI-002	CEMA4	2		c	c
RI-003	CEMA4	1,2		m	m
RI-007	CEMA4	2		m	m
RI-013	CEMA4	4	Dispersed rec	m	c
RI-014	CEPR2	2		m	m
RI-015	POSA4	2		m	c
RI-020	CEPR2	1		m	m
RI-020b	CEPR2	1		m	m
RI-021	CEPR2	1		c	c
RI-022	CEPR2	1		m	m

RI-023	CEPR2	1		m	m
RI-025	CEMA4	4	Trailhead	m	m
RI-027	RUDI2	4	Ranger District Office;TES bird	e,m,c	e,m,c
RI-027b	RUDI2	4	Ranger District Office	e,m,c	e,m,c
RI-027c	RUDI2	4	Ranger District Office; TES bird	e,m,c	e,m,c
RI-028	RUDI2	1		c	c
RI-029	RUDI2	1		c	c
RI-030	RUDI2	1		m	c
RI-031	RUDI2	2		m	c
RI-032	RUDI2	1		m	c
RI-033	RUDI2	1		m	c
RI-034	CEMA4	1		c	c
RI-035	CEPR2	1,4	Trailhead	m	c
RI-036	PHAR3	2,3,7		m	c
SH-001	CEMA4	1,3	TES fish; TES/S&M botanical	m	c
SH-001b	PHAR3	1,3	TES fish; S&M lichens	m	m
SH-002	CEMA4	1,3	TES plant	c	c
SH-003	CEMA4	1,3		c	c
SH-003b	PHAR3	1,3		m	c
SH-006	LIVU2	2		c	c
SH-007	CEMA4	2,3	TES fish	c	c
SH-007b	CEPR2	2,3	TES fish	c	c
SH-008	CEMA4	1		m	c
SH-009	POSA4	2		m	c
SH-011	CEMA4	1		m	c
SH-012a	PHAR3	2		m	m,c
SH-012b	PHAR3	2,3	TES fish	m	m,c
SH-012c	PHAR3	2,3	TES fish	m	m.c
SH-012d	PHAR3	2,3	TES fish	m	m,c
SH-012e	PHAR3	2		m	m,c
SH-012f	CEPR2	1,3		c	c
SH-012g	CEPR2	1,3	TES fish	c	c
SH-012h	CEPR2	1,3	TES fish	c	c
SH-012i	CEPR2	1,3	TES fish	c	c
SH-012j	CEPR2	1		c	c
SH-014	CEMA4	1		c	c
SH-014b	CEPR2	1		c	c
SH-015	CEMA4	1		c	c
SH-016	CEPR2	2		c	c
SH-017	CEPR2	2		m	c
SH-018	CEPR2	1		c	c
SH-019	RUDI2	1		c	c
SH-019b	RULA	1		c	c
SH-021	RULA	1		c	c
SH-022	RUDI2	1		c	c
SH-024	BRSY	2		c	c
SH-024b	BRSY	2		c	c
SH-025	BRSY	2	S&M botanical	c	c
SH-026	BRSY	2		c	c

SH-027	BRSY	1		m	c
SH-028	BRSY	2	S&M botanical	m	c
SH-029	RUDI2	1		m	c
SH-030	RUDI2	1		c	c
SH-031	RUDI2	1		c	c
SH-032	RUDI2	1		m	c
SH-032b	RUDI2	1		m	c
SH-033a	RUDI2/RULA	4	Ranger District Office	e,m,c	e,m,c
SH-033b	RUDI2/RULA	4	Ranger District Office	e,m,c	e,m,c
SH-033c	RUDI2/RULA	4	Ranger District Office	e,m,c	e,m,c
SH-035	CEPR2	1		m	c
SH-036a	CEMA4	1,3		m	m
SH-036b	CEMA4	1,3		m	m
SH-037	PHAR3	3	TES plant	m	c
SH-038	PHAR3	1		m,c	c
SH-039a	PHAR3	1		c	c
SH-039b	PHAR3	1		c	c
SH-039c	PHAR3	1		c	c
SH-039d	PHAR3	1		c	c
SH-039e	PHAR3	1		c	c
SH-039f	PHAR3	1		c	c
SH-040	CEMA4	1		c	c
SH-041	CEMA4	4	Dispersed rec	m	c
SH-042a	PHAR3	1		m	c
SH-042b	PHAR3	1		m	c
SH-042c	PHAR3	1		m	c
SH-042d	PHAR3	1		m	c
SH-042e	PHAR3	1		m	c
SH-043	BRSY	1,6		c	c
SH-043b	BRSY	1,6		c	c
SH-044	BRSY	1,6		c	c
SH-045a	BRSY	1		c	c
SH-045b	BRSY	1		c	c
SH-045c	BRSY	1		c	c
SH-046	BRSY	1	TES Plant	m	c
SH-046b	BRSY	1		m	c
SH-046c	BRSY	1		m	c
SH-047	BRSY	1	TES Plant	c	c
SH-048	BRSY	2,6		c	c
SH-049	BRSY	2		c	c
SH-049b	BRSY	2		c	c
SH-049c	BRSY	2		c	c
SH-050	BRSY/RUDI2	2,3		c	c
SH-051	BRSY	2,3		c	c
SH-052	RUDI2	2		c	c
SH-052b	RUDI2	2		c	c
SH-052c	RUDI2	2		c	c
SH-052d	RUDI2	2		c	c
SH-052e	RUDI2	2		c	c
SH-052f	RUDI2	2		c	c
SH-053	RULA	2		c	c
SH-054	SODU	7	POND	m	c
SH-055	SODU	2	Wetland	m	c

SH-055b	RUDI2	2	Wetland	m	c
SH-055c	RULA	2	Wetland	m	c
SH-055d	BRSY	2	Wetland	m	c
SH-055e	RULA	2	Wetland	m	c
SH-056	SODU	2,3	lake; S&M botanical	m	c
SH-057	COAR4	3	wilderness	m	m
SH-058	RUDI2	2		c	c
SH-058b	RUDI2	2		c	c
SH-058c	RUDI2	2		c	c
SH-058d	RUDI2	2		c	c
SH-059	RUDI2	2		c	c
SH-059b	RUDI2	2		c	c
SH-059c	RUDI2	2		c	c
SH-059d	RUDI2	2		c	c
SH-059e	RUDI2	2		c	c
SH-059f	RUDI2	2		c	c
SH-061	RUDI2	2		c	c
SH-061b	RUDI2	2		c	c
SH-062	BRSY	1		c	c
SH-063	RUDI2	2		c	c
SH-064	MEAL2	2		m	m
SH-065	CEMA4	4	Dispersed rec	m	m
SH-066	BRSY	2		c	c
SH-067	CEMA4	4	Dispersed rec	m	c
SH-068	BRSY	2		c	c
SH-069	MEAL2	1		m	m
SH-070	RUDI2	1		c	c
SH-071	RUDI2	2,3	TES plant	c	c
SH-072	RUDI2	1,3,6	TES bird; TES plant	e,m,c	e,m,c
SH-072b	PHAR3	1,3,6		m,c	m,c
SH-072c	MEAL2	1,3,6		m	m
SH-072d	BRSY	1,3,6		c	c
SH-073	BRSY	2	S&M botanical	c	c
SH-074	HIPR	1,2		c	c
SH-075	RUDI2	2		c	c
SH-076	RUDI2	1		c	c
SH-077	RUDI2	1		c	c
SH-078	HYPE	4	Trailhead	m	m
SH-079	RULA	2		c	c
SH-080	RUDI2	2		c	c
SH-081	RUDI2	2		c	c
SH-082	RULA	2		c	c
SH-083a	PHAR3	2,7		m	m,c
SH-083b	PHAR3	2,7		m	m,c
SH-084	BRSY	2		c	c
SH-085	BRSY	2		c	c
SH-086	RUDI2	2		c	c
SH-087	PHAR3	7		m	m,c
SH-088	PHAR3	7		m	m,c
SH-089	CIAR4	7	TES bird	e,m	e,m,c
SH-090	PHAR3	2	S&M botanical	c	c
SH-091	BRSY	2		c	c
SH-092	BRSY	1	TES plant	c	c
SH-092b	BRSY	1		c	c
SH-093	BRSY	1,3	TES plant	c	c
SH-093b	BRSY	1		c	c

SH-094	BRSY	1	S&M botanical	c	c
SH-095	CEMA4	1		c	c
SH-096	CEPR2	1		c	c
SH-096b	LALA4	1		c	c
SH-096c	RUDI2	1		c	c
SH-096d	RULA	1		c	c
SH-096e	BRSY	1		c	c
SH-097	LALA4	1,3		c	c
SH-098	RULA	1		c	c
SH-099	RUDI2	2		c	c
SH-100	RUDI2	2		c	c
SH-100b	RUDI2	2		c	c
SH-100c	RUDI2	2		c	c
SH-100d	RULA	2		c	c
SH-100e	RULA	2		c	c
SH-100f	RULA	2		c	c
SH-101	RUDI2	4		c	c
SH-102	BRSY	2,4	Trailhead	m	c
SH-103	RULA	1		c	c
SH-104a	BRSY	2		c	c
SH-104b	RUDI2	2		c	c
SH-105	BRSY	2		c	c
SH-106	RULA	2	Tes bird	e,m	e,m,c
SH-107a	RUDI2	2		c	c
SH-107b	RUDI2	2		c	c
SH-108a	RULA	2		c	c
SH-108b	BRSY	2		c	c
SH-109	CEMA4	2		c	c
SH-110	PHAR3	6		c	c
SH-111	BRSY	3,4	Wilderness; trailhead	m	m
SH-112	BRSY	2		c	c
SH-113	BRSY	2		c	c
SH-114	BRSY	1		c	c
SH-115	BRSY	1		c	c
SH-116	BRSY	2		c	c
SH-117	BRSY	1		c	c
SH-118	BRSY	2		c	c
SH-119	BRSY	1		c	c
SH-120	BRSY	1		c	c
SH-121	BRSY	2		c	c
SH-122	BRSY/RUDI2	1		c	c
SH-123	BRSY	7	Native American gathering	m	m
SH-124	BRSY	2		c	c
SH-125	BRSY	2		c	c
SH-126	BRSY	2		c	c
SH-127	BRSY	2		c	c
SH-128	BRSY	1	S&M botanical	c	c
SH-129a	RULA	2		c	c
SH-129b	RULA	2		c	c
SH-130	RUDI2	2		m	c
SH-131	RULA	1		c	c
SH-132	RULA	2		c	c
SH-133	RULA	2		c	c
SH-134	RULA	2		c	c
SH-135	RUDI2	2		c	c
SH-136	RUDI2	2		c	c
SH-137	RULA	2		c	c

SH-138	RUDI2	1		c	c
SH-139	RUDI2	1		c	c
SH-140	RUDI2	2		c	c
SH-141	RUDI2	2		c	c
SH-142	RUDI2	2		c	c
SH-143	RUDI2	2		c	c
SH-144	CEMA4	1		c	c
SH-145	CEMA4	2		c	c
SH-146	CEMA4	2		c	c
SH-147	RUDI2	1		c	c
SH-148	RUDI2	2,3		c	c
SH-36a2	PHAR3	1		m	m,c
SH-36b2	PHAR3	1		m	m,c

Appendix E: Analysis of Maximum Site-Specific Effects on Water Quality

Because many significant issues revolve around riparian habitats and aquatic species, Risk Assessments were completed for herbicides proposed for use within the 50-foot riparian buffer to quantify the maximum site-specific effects that could happen to water. It was assumed that PDC would mitigate effects of herbicides used in upland habitats. Analyses of maximum site-specific effects were conducted at two locations (Buckhead Pond and Whiterock Creek) on the Willamette National Forest for the herbicides proposed to be used in the 50-foot stream buffer under Alternative 3 (Glyphosate and Imazapyr).

Risk Assessment Worksheets (SERA EXWS 05-43-28-08a and SERA EXWS 05-43-23-11a) were used for this analysis. These scenarios were developed to determine if herbicide concentrations could exceed a level of concern for fish and other aquatic organisms or consumption of water by humans (two of the significant issues identified during scoping).

The maximum site-specific effects for streams were analyzed under conditions where glyphosate and imazapyr were broadcast near Whiterock Creek (South Santiam 5th field watershed) and along road ditches during summer. For the purposes of this analysis, flow in Whiterock Creek was considered to be 1.8 cfs and the herbicide applied to sandy soil. The Whiterock Creek area has an infestation of false brome.

Maximum site-specific effects for ponds were analyzed under conditions where glyphosate and imazapyr were broadcast near Buckhead Pond (Middle Fork Willamette/Lookout Point 5th field watershed). Buckhead Pond was analyzed for a size of 0.25 acres and 1 meter deep with herbicides applied to sandy soil. The Buckhead Pond has an infestation of Japanese knotweed.

Glyphosate is generally considered a high risk to aquatic organisms and imazapyr is generally considered a moderate risk.

Hazard Quotients[5] (HQ) were calculated for the risk assessments. This analysis showed that all HQs for site specific conditions on the Willamette National Forest where well under a value of 1 (Table E-1) indicating a low concentration of herbicide chemicals in water and a low level of risk to humans or aquatic biota.

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[5] Hazard Quotient (HQ) – The ratio of the estimated level of exposure to a substance from a specific pesticide application to a daily dose which is not anticipated to cause any adverse effects in a human population over a lifetime of exposure (these values are derived by the U.S. EPA) for that substance, or to some other index of acceptable exposure or toxicity. A HQ less than or equal to one is presumed to indicate an acceptably low level of risk for that specific application.

Results of the aquatic Glyphosate worksheet analysis showed higher herbicide concentration values for water in Whiterock Creek adjacent to treatment sites compared to Buckhead Pond (Table E-1). Short term peak concentrations for imazapyr showed the opposite effect; concentrations in Buckhead Pond were higher than Whiterock Creek (Table E-1).

Hazard quotient values for imazapyr were extremely low, not reaching any level of concern under both the Whiterock Creek or Buckhead Pond scenarios (Table E-1). The HQ values for both aquatic glyphosate and Imazapyr are lower than the threshold of concern for sensitive fish. They approach thresholds of concern for humans only on the high end of HQ's for water consumed from a pond or stream where glyphosate was spilled.

These numbers associated with peak and long-term concentrations of herbicides in water are likely overestimations of what would actually occur on the Willamette National Forest because these values are based on use of broadcast application methods (which would not be allowed on under the PDC proposed for Willamette National Forest).

Specific effects to fish are discussed in the Fisheries Effects section. Specific effects on drinking water will be discussed in the Human Health Effects section.

Table E-1. Risk Assessment Worksheet Results, Maximum Site Specific Effects

Herbicide And location	**Short-term Peak Concentration (mg/L)**	**Long-term Concentration in water (dose) (mg/L)**	**Toxicity Values for sensitive fish(mg/L)**	**Hazard Quotient for Fish**	**Toxicity Values for Humans (mg/kg body weight)**	**Dose from Consumption of Contaminated Water (mg/kg)**	**Hazard Quotient for Humans**
Glyphosate (2 lbs/ac)					2		
Buckhead Pond	0.015 – 0.020	.0004 – 0.003	0.5 acute 2.57 chronic	0.06 – 0.08		.005-.030	.003-.002
Whiterock Creek	0.057 – 0.140	.0004 – .0007	Same as pond	0.2 – 0.6		Same as pond	Same as pond
Imazapyr (0.45 lbs/ac)					2.5		
Buckhead Pond	0.0002 – 0.0004	0.0001 – 0.0002	5.0 acute 2.7 chronic	2E-05 – 4E-05		.000006-.000020	.000005-.000008
Whiterock Creek	0.0002 – 0.0003	0.0000 – 0.0001	Same as pond	1E-05 – 3E-05		Same as pond	Same as pond

Sources: Precipitation records, local site knowledge; SERA 2003, 2004.

Appendix F: Herbicide Hazards and Project Design Criteria designed to Mitigate Hazards

Trade Name(s): **Transline**

Clopyralid				
Herbicide Characteristics	**Basic Hazard Identification**	**Risk Characterization (SERA Risk Assess.)**	**Label Restrictions & Information**	**Project Design Criteria**
Extremely SELECTIVE for broadleaves. Post emergent herbicide		Selectivity reduces threat to non-target plants	Avoid non-target contact with spray in treated areas	#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.
High water solubility	0.01 % of that applied may reach stream after first significant rainfall	Contamination threat to water resources and non-target species	Do not contaminate water. Do not apply directly to water or to areas where surface water is present. Do not contaminate irrigation ditches.	No use in 50 foot riparian buffer.
Weakly adsorbed to soil	Very high mobility in soil		Users are advised not to apply where soils have a rapid to very rapid permeability throughout the profile (such as loamy sand to sand) and the water table is shallow.	Application restricted in areas with loam to clay soils.
Human health effects	Slight skin and eye irritation		Avoid contact with skin and eyes or clothing. Avoid breathing spray mist. Applicators and handlers must wear long-sleeved shirt and long pants, waterproof gloves, shoes plus socks	#3. Applicators will use personal protective equipment when applying herbicides.

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.
	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.

Glyphosate				
Herbicide Characteristics	**Basic Hazard Identification**	**Risk Characterization (SERA Risk Assess.)**	**Label Restrictions & Information**	**Project Design Criteria**
		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
	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. Use LI-700 as only surfactant in 0-50 feet from water. #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.

Trade Name(s): **Poast**

Sethoxydim				
Herbicide Characteristics	**Basic Hazard Identification**	**Risk Characterization (SERA Risk Assess.)**	**Label Restrictions & Information**	**Project Design Criteria**
Selective for annual and perennial grasses			Low likelihood of impacting non-target plants from drift	
Very high water solubility	Leaching, run-off potential		Do not contaminate water.	No application in 50 foot riparian buffer.
Medium mobility in soil				
Human health effects	Causes skin and eye irritation	Skin or eye irritation from mishandling.	Applicators and other handlers must wear coveralls over short-sleeved shirt and short pants; chemical resistant gloves and footwear, plus socks; protective eyewear; etc.	Applicators will use personal protective equipment when applying herbicides.
Wildlife effects		Chronic risk to insect-eating birds or mammals unknown at typical and highest rates		
Aquatic Effects	Highly toxic to fish due to petroleum inert	Exposure exceeds level of concern for federally listed fish at typical rate, and max exposure assumptions	This product is toxic to aquatic organisms. Do not apply directly to water or to areas where surface water is present.	Use only outside 50 foot riparian buffer.
	No data on effects to amphibians, fish used as a surrogate	Plausible risk to amphibians		

Trade Name: **Garlon 3A**

Triclopyr				
Herbicide Characteristics	**Basic Hazard Identification**	**Risk Characterization* (SERA Risk Assess.)**	**Label Restrictions & Information**	**Project Design Criteria**
Target: Woody and herbaceous plants, especially root- or stem-sprouting species				Restricted to selective application methods by forest plan standard (R6 2005 ROD)
Absorbed thru roots, foliage and green bark.	Non-target plant effects possible; some bryophytes and lichens sensitive to triclopyr		Do not apply through any type of irrigation system.	Use calibrated spray equipment and coarse spray to reduce drift. Use backpack, wick or stem injection for chemical applications to reduce potential for drift.
Two forms: salt (acid) (Garlon 3A) and ester (Garlon 4)	Ester form more toxic and volatile		Apply at cool temps with no wind. Combustible.	Do not propose to use Garlon 4
Salt formulation is highly soluble in water	Runoff, leaching		Do not contaminate water when cleaning equipment.	Do not use within 50 foot riparian buffer.
Low adsorption to soils, varies with clay and OM content	Very high mobility in soils		The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.	Use only where soils are loamy to clay.
	Inhibits growth of soil fungi and bacteria	Transient inhibition in the growth of some bacteria or fungi might be expected		Use selective methods of herbicide application to have only small localized effects.

Triclopyr				
Herbicide Characteristics	**Basic Hazard Identification**	**Risk Characterization* (SERA Risk Assess.)**	**Label Restrictions & Information**	**Project Design Criteria**
	Can cause severe eye damage		Applicators and other handlers must wear long-sleeved shirt and long pants; shoes plus socks; protective eyewear; chemical resistant gloves.	Applicators will use personal protective equipment when applying herbicides.
Human health effects	Evidence for carcinogenicity is marginal (not convincing, but not entirely negative)			Use lowest effective application rates
	Effects to kidney are basis of risk to for acute and chronic exposures humans	At high application rates, chronic exposures to workers exceed level of concern; acute exposures do not exceed level of concern for workers. At high application rates, some acute and chronic exposures exceed level of concern for public. No exposures exceed level of concern at typical application rate.	Do not apply this product in a way that will contact workers or other persons, either directly or through drift.	Applicators will use personal protective equipment when applying herbicides. All areas of high human use will be posted and cordoned off prior to and during application.
Wildlife effects	For wildlife, acute lethality only at very high doses, but effects to kidney and liver at lower doses	Acute exposures below level of concern at typical application rate, but exceed level of concern for grass and insect eating mammals		Use lowest effective application rates

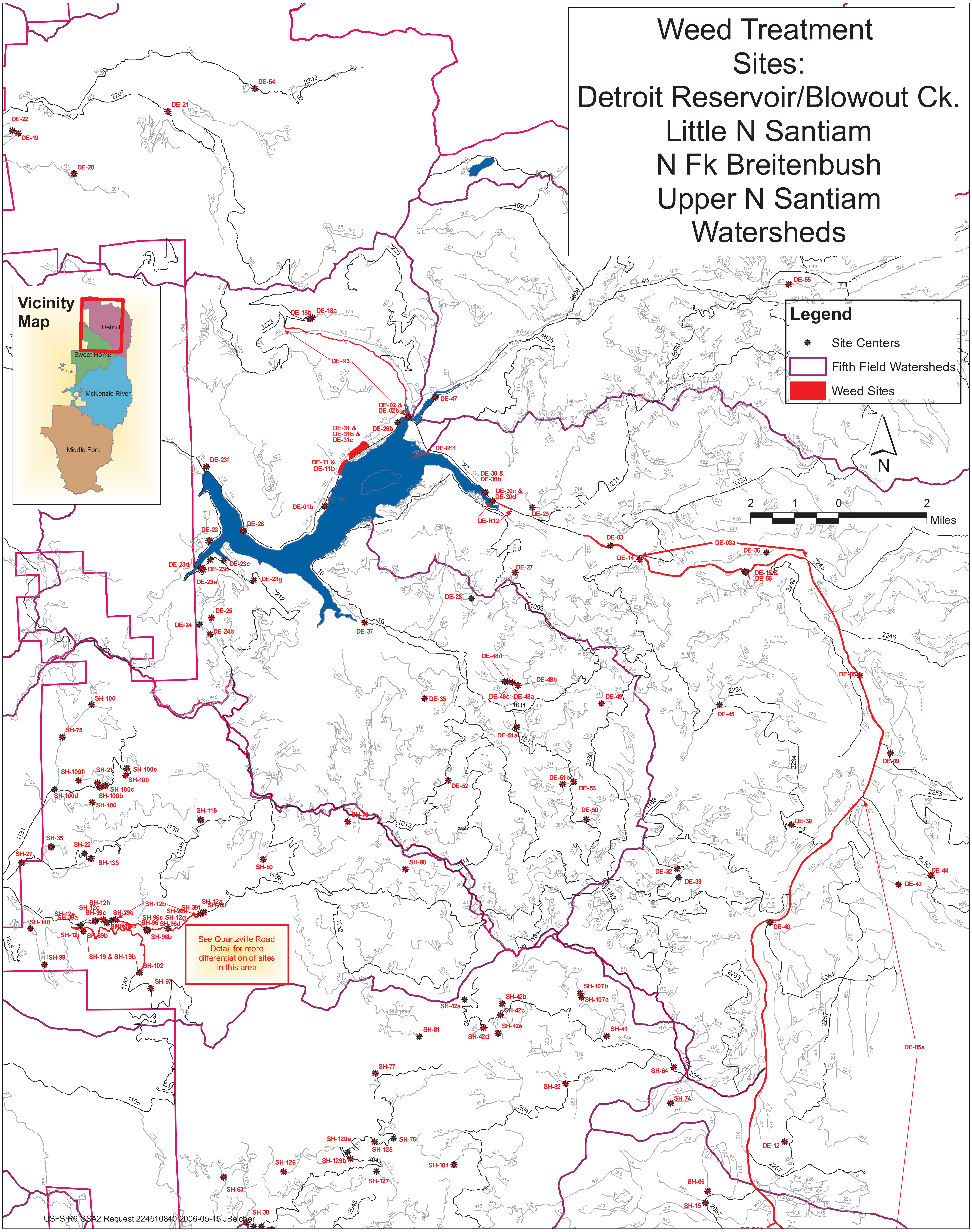
Triclopyr				
Herbicide Characteristics	**Basic Hazard Identification**	**Risk Characterization* (SERA Risk Assess.)**	**Label Restrictions & Information**	**Project Design Criteria**
	Primary effect from chronic doses is to the kidney	Using protective assumptions, chronic exposures exceed level of concern for grass-eating mammals. Risk from chronic exposure to contaminated insects unknown.		
Fish effects	Salt/acid formulation low toxicity to fish; has aquatic use label	Exposures exceed level of concern for federally listed fish at typical rate, but not other fish even at highest application rate	(Garlon 3A) Permissible to treat flood plains, marshes, swamps, bogs etc. Permissible to treat non-irrigation ditch banks. When making application to banks or shorelines of moving water sites, minimize overspray to open water.	No use of this herbicide within 50 foot riparian buffer
	Metabolite TCP much more toxic to fish than the salt form, about the same toxicity as ester	At typical application rate, no TCP exposures exceed level of concern. At highest application rate, chronic exposure exceeds level of concern		Use lowest effective application rate
	Ester form much more toxic to aquatic plants and algae than salt form	Only salt form exceeds level of concern for aquatic plants; algae not at risk from either form		No use of this herbicide within 50 foot riparian buffer

Triclopyr				
Herbicide Characteristics	**Basic Hazard Identification**	**Risk Characterization* (SERA Risk Assess.)**	**Label Restrictions & Information**	**Project Design Criteria**
	Ester formulation much more toxic to amphibians than salt formulation	At typical application rate, risk to amphibians from either form is low. At highest rate, exposure to run-off of either form could adversely affect responsiveness of tadpoles.		Use lowest effective application rate
	Practically non-toxic to bees	Exposure exceeds level of concern only for highest application rates		Use lowest effective application rate

*Results of these risk characterizations are from scenarios where triclopyr is broadcast sprayed over a large area. A standard in each Forest Plan that was added by the Region Six Invasive Plant Program ROD (USDA Forest Service 2005) prohibits this type of application. Triclopyr is restricted to selective application methods only. Therefore, in practice, it is not plausible to create the exposures causing concern during use of triclopyr for invasive plant control in Region Six.

Trade Name(s): **Arsenal, Habitat**

Imazapyr				
Herbicide Characteristics	**Basic Hazard Identification**	**Risk Characterization (SERA Risk Assess.)**	**Label Restrictions & Information**	**Project Design Features**
Non-selective				
Uptake by roots & leaves; active in soil as pre-emergent	May damage non-target plants; may be exuded into soil from roots of treated plants	Drift or runoff may cause some damage to susceptible species	Do not apply to irrigation ditches; prevent drift to desirable plants	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			Do not contaminate water	Wick or inject from streamside to 10 feet from water
Weakly bound to soil, but OM and lower pH increase adsorption to moderate levels	Moderately mobile in soils			
Human health effects	Mildly irritating to eyes and skin	Mild eye irritation from mishandling; no exposure scenario exceeded RfD for workers or public except spill		Applicators will use personal protective equipment when applying herbicides.
Aquatic Plants	Some aquatic plant species sensitive to imazapyr	Potential risk to aquatic plants at typical application rate, no risk to algae		



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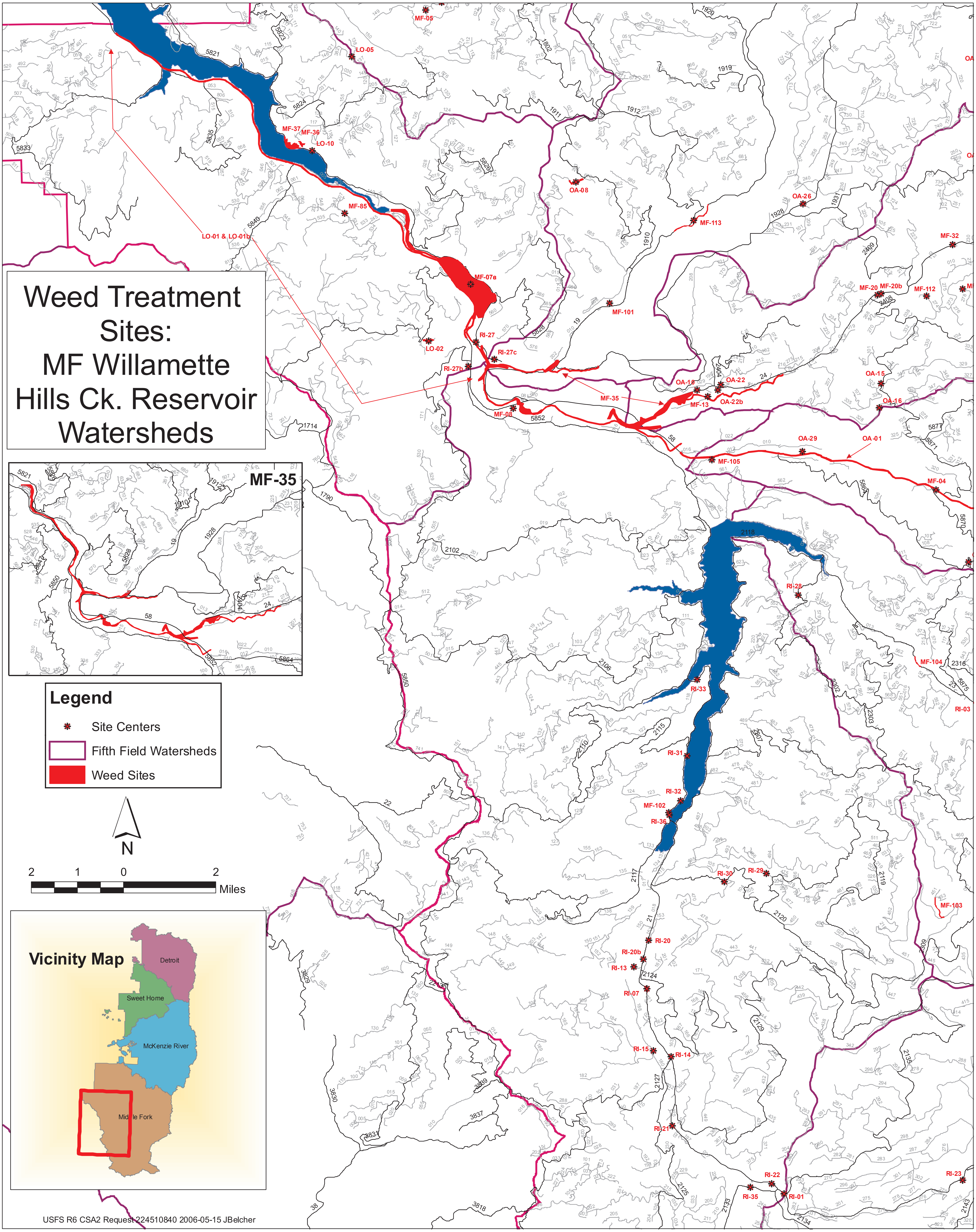
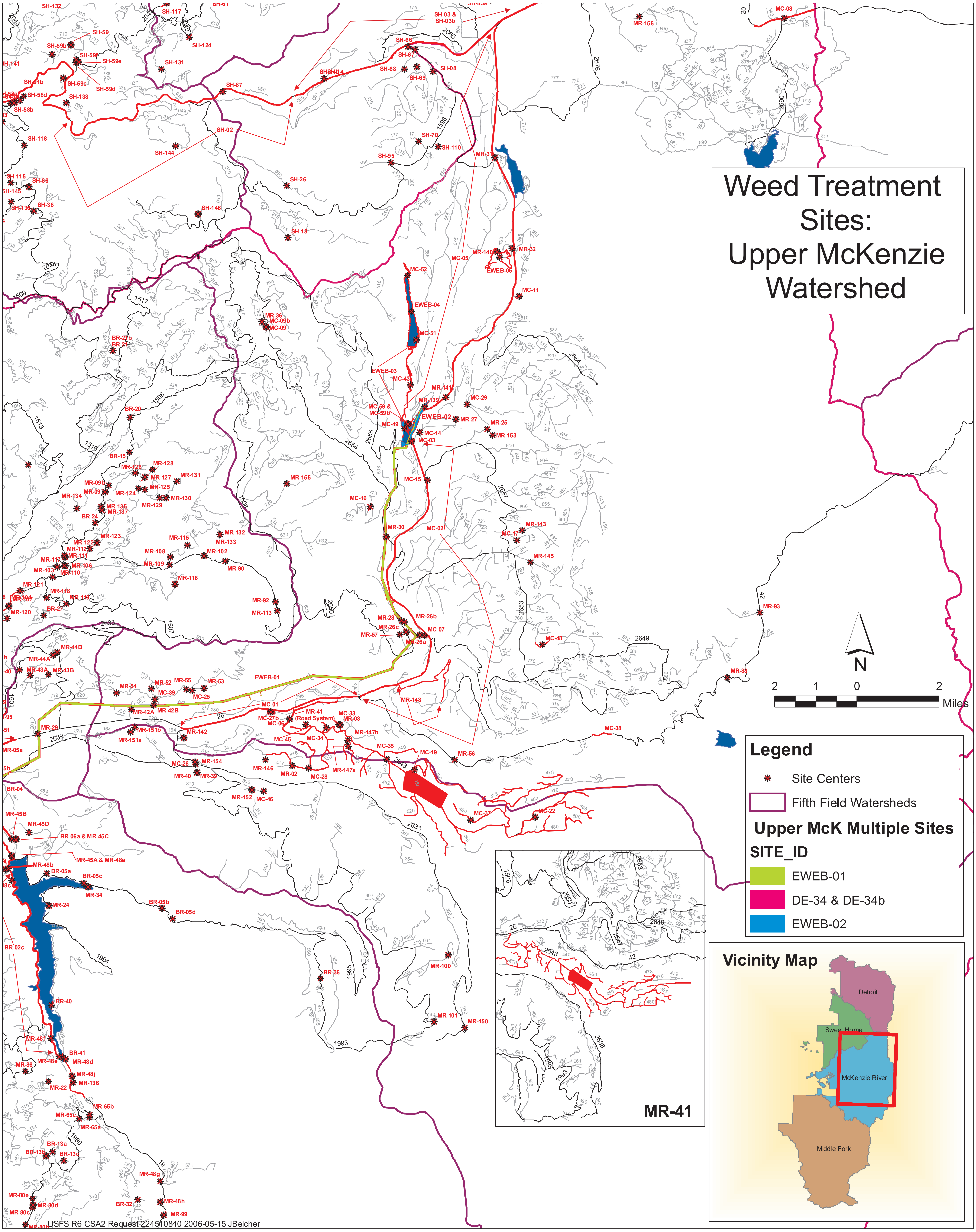
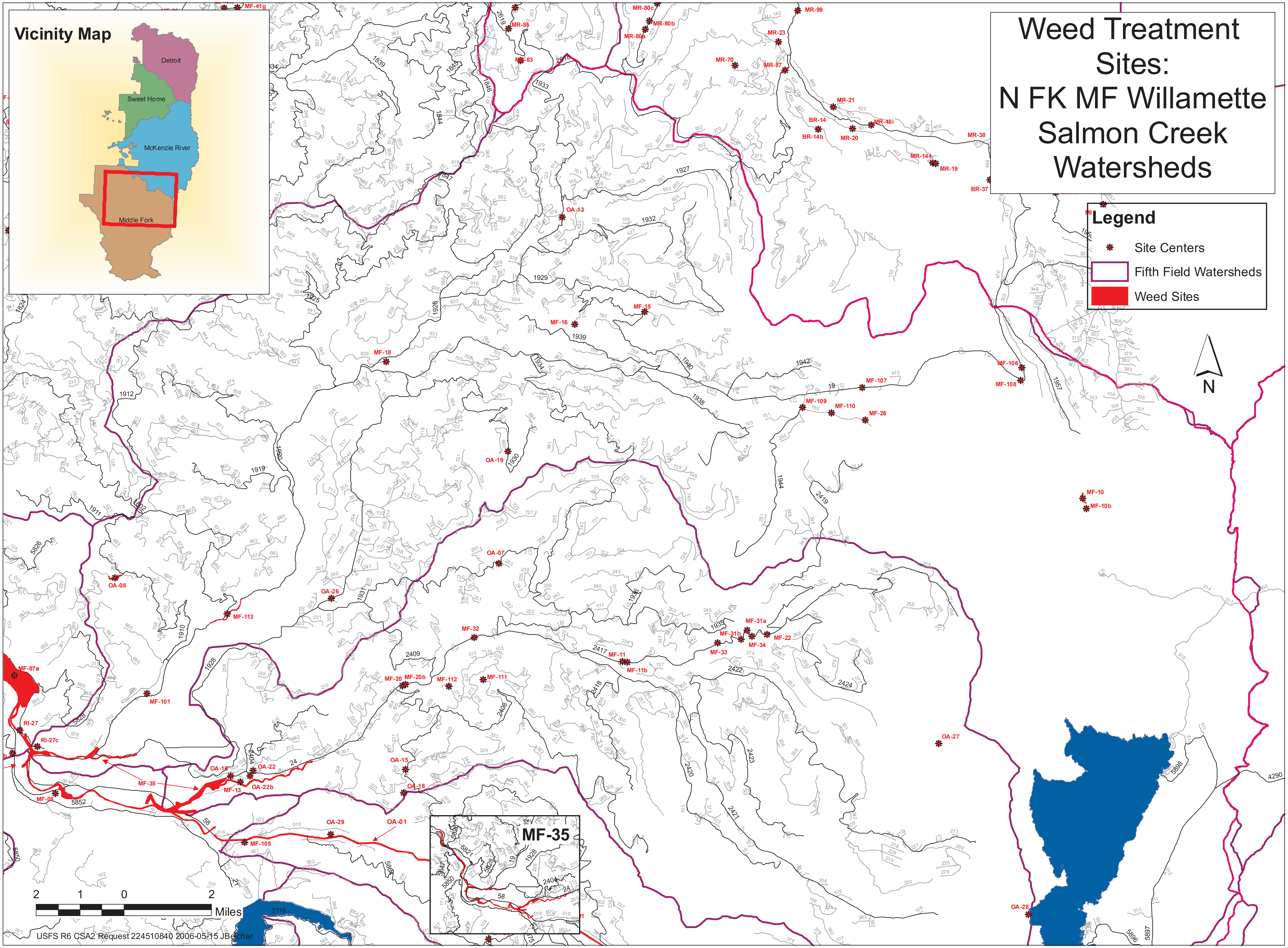
Detroit Reservoir/Blowout Ck.
Little N Santiam
N Fk Breitenbush
Upper N Santiam
Watersheds
Legend
Site Centers
Fifth Field Watersheds
Weed Sites
Vicinity Map
Detroit
Sweet Home
McKenzie River
Middle Fork
N
2 1 0 2
Miles
See Quartzville Road Detail for more differentiation of sites in this area
USFS R6 CSA2 Request 224510840 2006-05-15 JBelcher



Weed Treatment Sites: MF Willamette Hills Ck. Reservoir Watersheds
MF-35
Legend
Site Centers
Fifth Field Watersheds
Weed Sites
N
2 1 0 2
Miles
Vicinity Map
Detroit
Sweet Home
McKenzie River
Middle Fork
USFS R6 CSA2 Request 224510840 2006-05-15 JBelcher



Weed Treatment Sites: Upper McKenzie Watershed
N
2 1 0 2
Miles
Legend
Site Centers
Fifth Field Watersheds
Upper McK Multiple Sites
SITE_ID
EWEB-01
DE-34 & DE-34b
EWEB-02
MR-41
Vicinity Map
Detroit
Sweet Home
McKenzie River
Middle Fork
USFS R6 CSA2 Request 224510840 2006-05-15 JBelcher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Vicinity Map
Detroit
Sweet Home
McKenzie River
Middle Fork
Legend
Site Centers
Fifth Field Watersheds
Weed Sites
N
MF-35
2 1 0 2
Miles
USFS R6 CSA2 Request 224510840 2006-05-15 JBecher
MF-07a
RI-27
RI-27c
MF-08
MF-101
OA-08
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OA-26
OA-07
MF-32
MF-20
MF-20b
MF-112
MF-111
OA-18
OA-22
OA-22b
MF-13
OA-15
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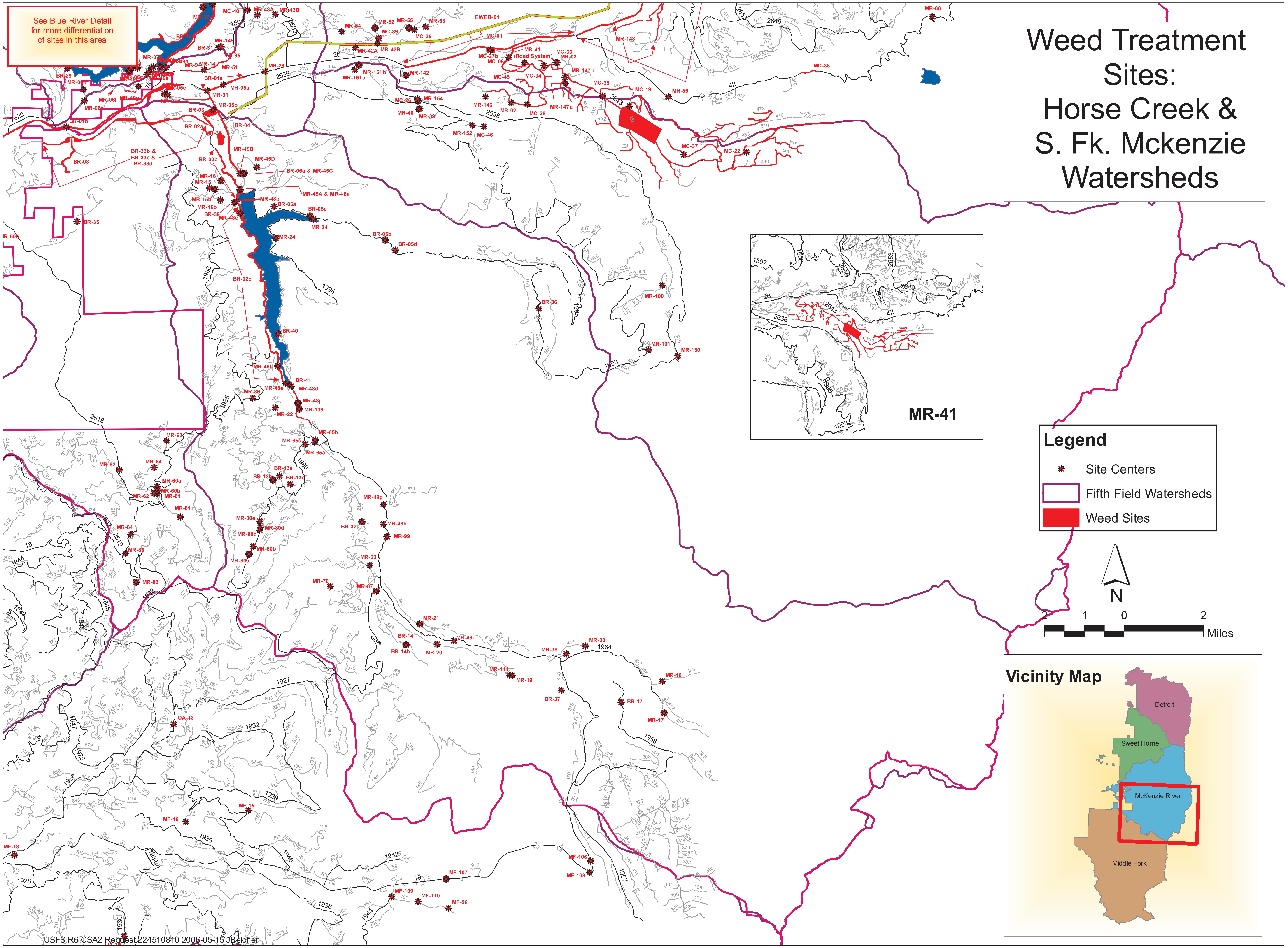
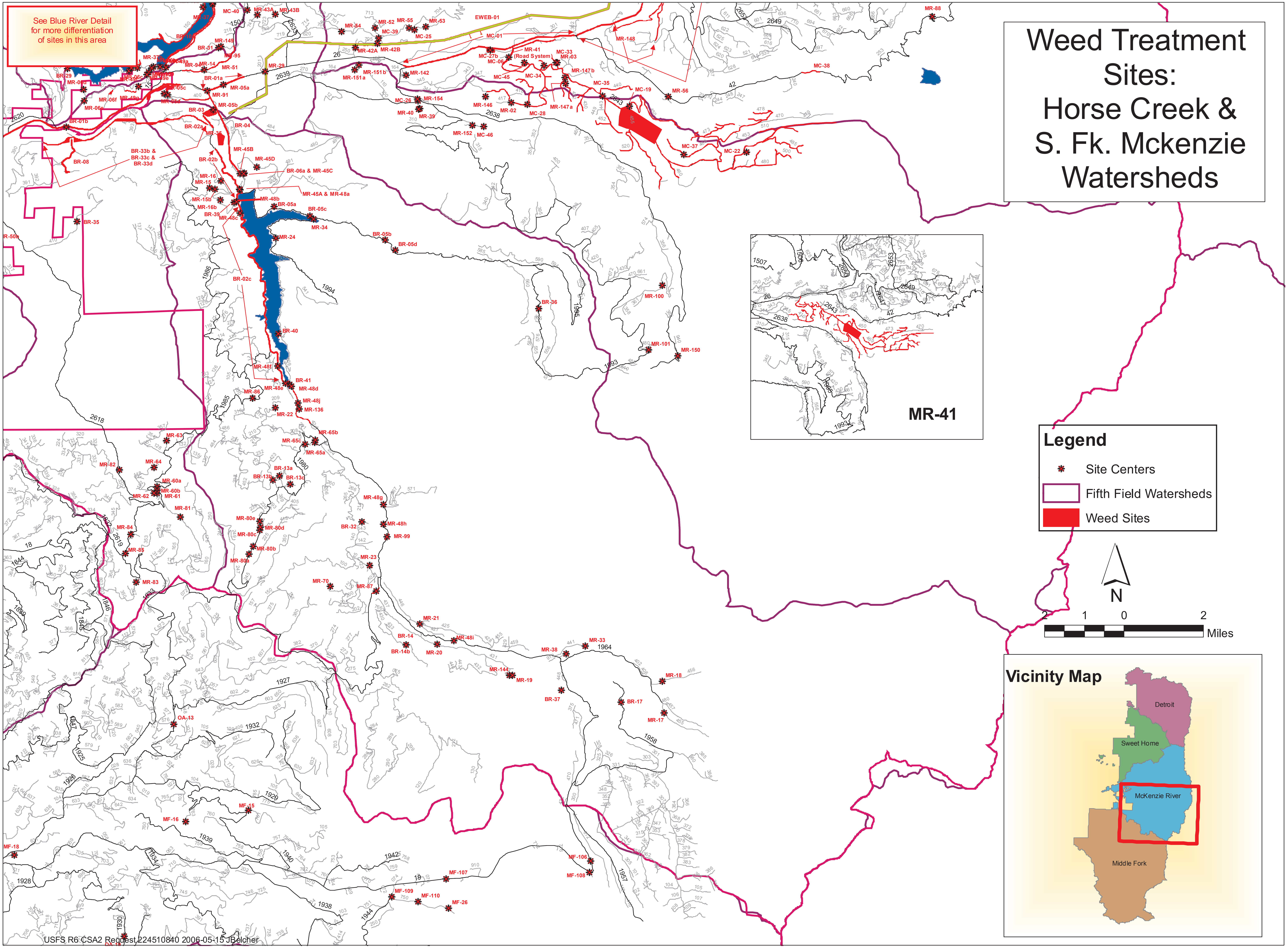
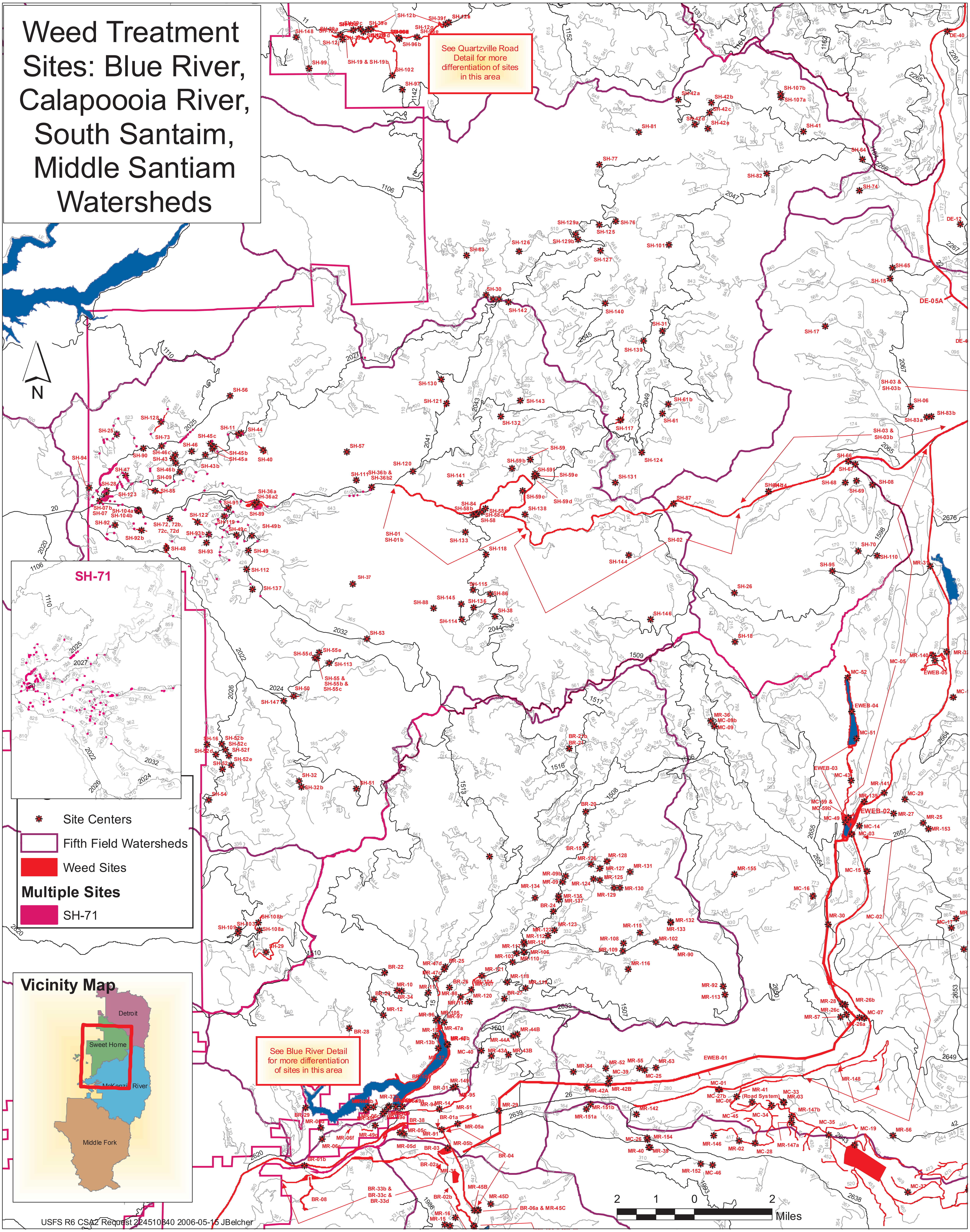
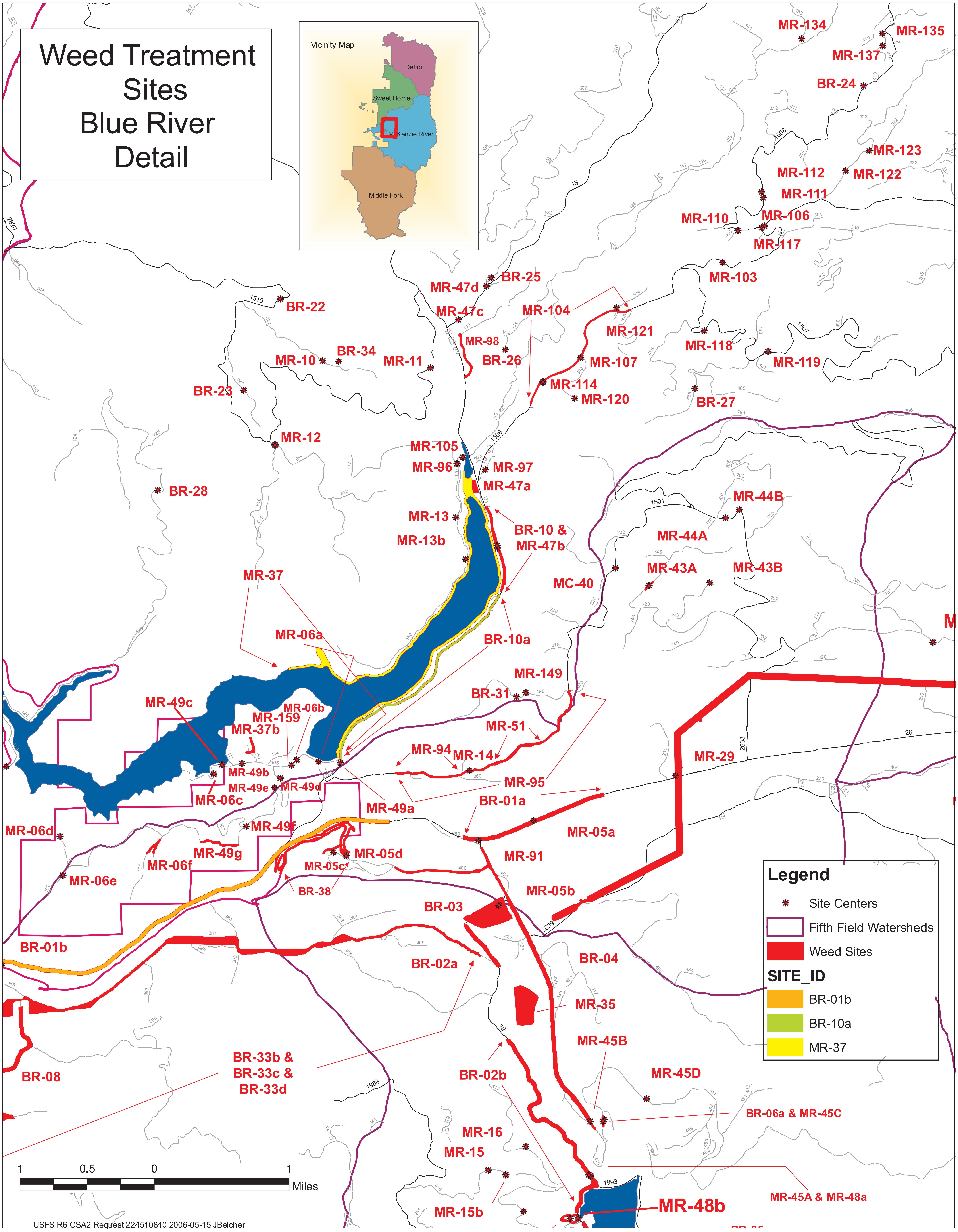

Weed Treatment Sites: Horse Creek & S. Fk. Mckenzie Watersheds
See Blue River Detail for more differentiation of sites in this area
MR-41
Legend
Site Centers
Fifth Field Watersheds
Weed Sites
N
2 1 0 2
Miles
Vicinity Map
Detroit
Sweet Home
McKenzie River
Middle Fork
USFS R6 CSA2 Request 224510840 2006-05-15 JBelcher



Weed Treatment Sites:
Horse Creek &
S. Fk. Mckenzie
Watersheds
See Blue River Detail
for more differentiation
of sites in this area
MR-41
Legend
Site Centers
Fifth Field Watersheds
Weed Sites
N
2 1 0 2
Miles
Vicinity Map
Detroit
Sweet Home
McKenzie River
Middle Fork
USFS R6 CSA2 Request 224510840 2006-05-15 JBelcher



Weed Treatment Sites: Blue River, Calapooia River, South Santaim, Middle Santiam Watersheds
See Quartzville Road Detail for more differentiation of sites in this area
See Blue River Detail for more differentiation of sites in this area
N
SH-71
Site Centers
Fifth Field Watersheds
Weed Sites
Multiple Sites
SH-71
Vicinity Map
Detroit
Sweet Home
McKenzie River
Middle Fork
2 1 0 2
Miles
USFS R6 CSA2 Request 224510840 2006-05-15 JBelcher



Weed Treatment Sites
Blue River Detail
Vicinity Map
Detroit
Sweet Home
McKenzie River
Middle Fork
Legend
Site Centers
Fifth Field Watersheds
Weed Sites
SITE_ID
BR-01b
BR-10a
MR-37
1
0.5
0
1
Miles
MR-134
MR-135
MR-137
BR-24
MR-123
MR-112
MR-122
MR-111
MR-110
MR-106
MR-117
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BR-25
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MR-47c
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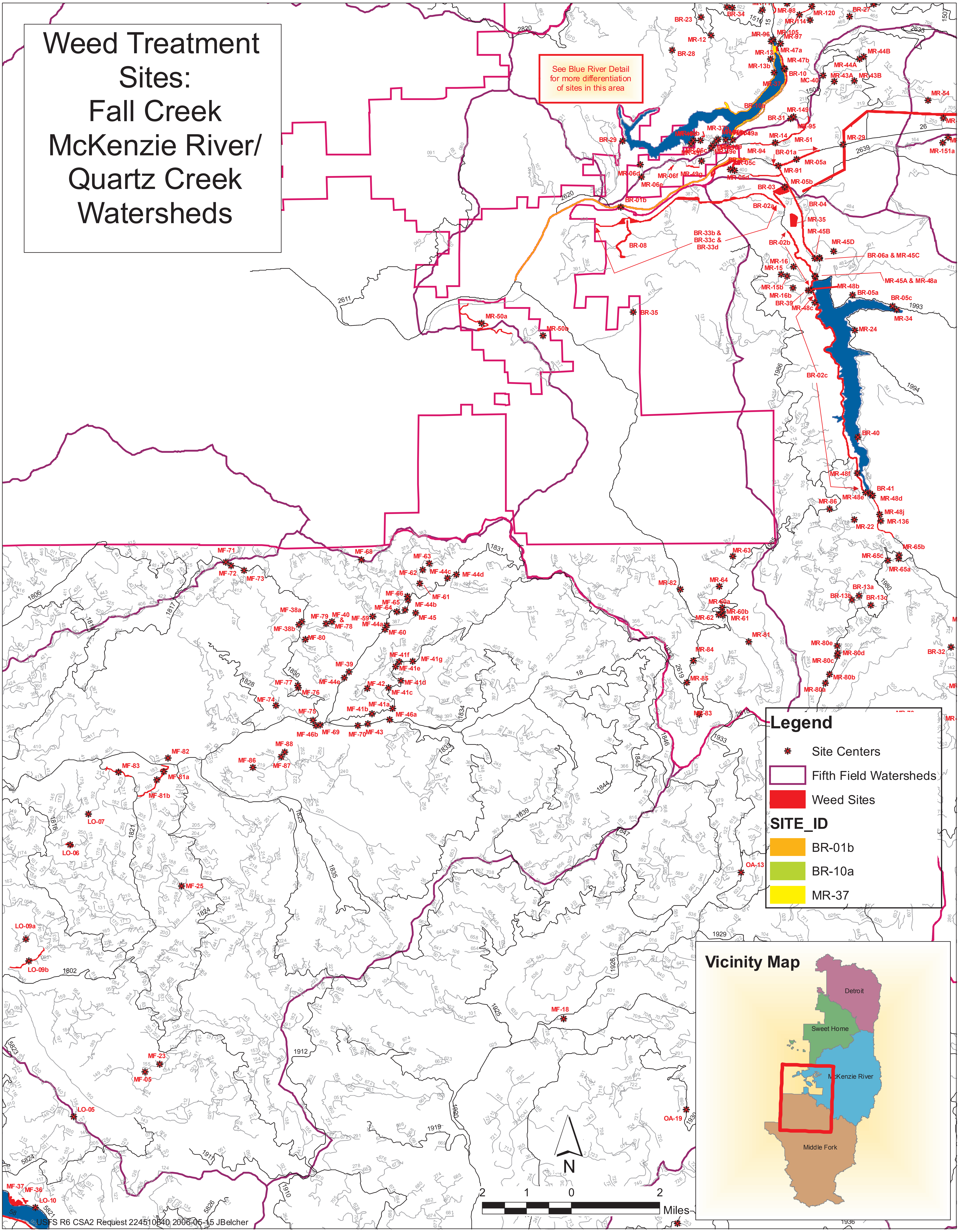
MR-96
MR-97
MR-47a
BR-28
MR-44B
MR-13
BR-10 &
MR-47b
MR-13b
MR-44A
MR-37
MR-43A
MR-43B
MC-40
MR-06a
BR-10a
MR-149
BR-31
MR-49c
MR-06b
MR-159
MR-37b
MR-51
MR-94
MR-14
MR-29
MR-49b
MR-49e
MR-49d
MR-95
MR-06c
MR-49a
BR-01a
MR-06d
MR-49f
MR-05a
MR-49g
MR-05d
MR-91
MR-06f
MR-05c
MR-06e
BR-38
MR-05b
BR-03
BR-01b
BR-02a
BR-04
MR-35
MR-45B
BR-33b &
BR-33c &
BR-33d
BR-08
BR-02b
MR-45D
BR-06a & MR-45C
MR-16
MR-15
MR-15b
MR-48b
MR-45A & MR-48a
USFS R6 CSA2 Request 224510840 2006-05-15 JBelcher



Weed Treatment Sites:
Fall Creek
McKenzie River/
Quartz Creek
Watersheds
See Blue River Detail for more differentiation of sites in this area
Legend
Site Centers
Fifth Field Watersheds
Weed Sites
SITE_ID
BR-01b
BR-10a
MR-37
Vicinity Map
Detroit
Sweet Home
McKenzie River
Middle Fork
2 1 0 2
Miles
N
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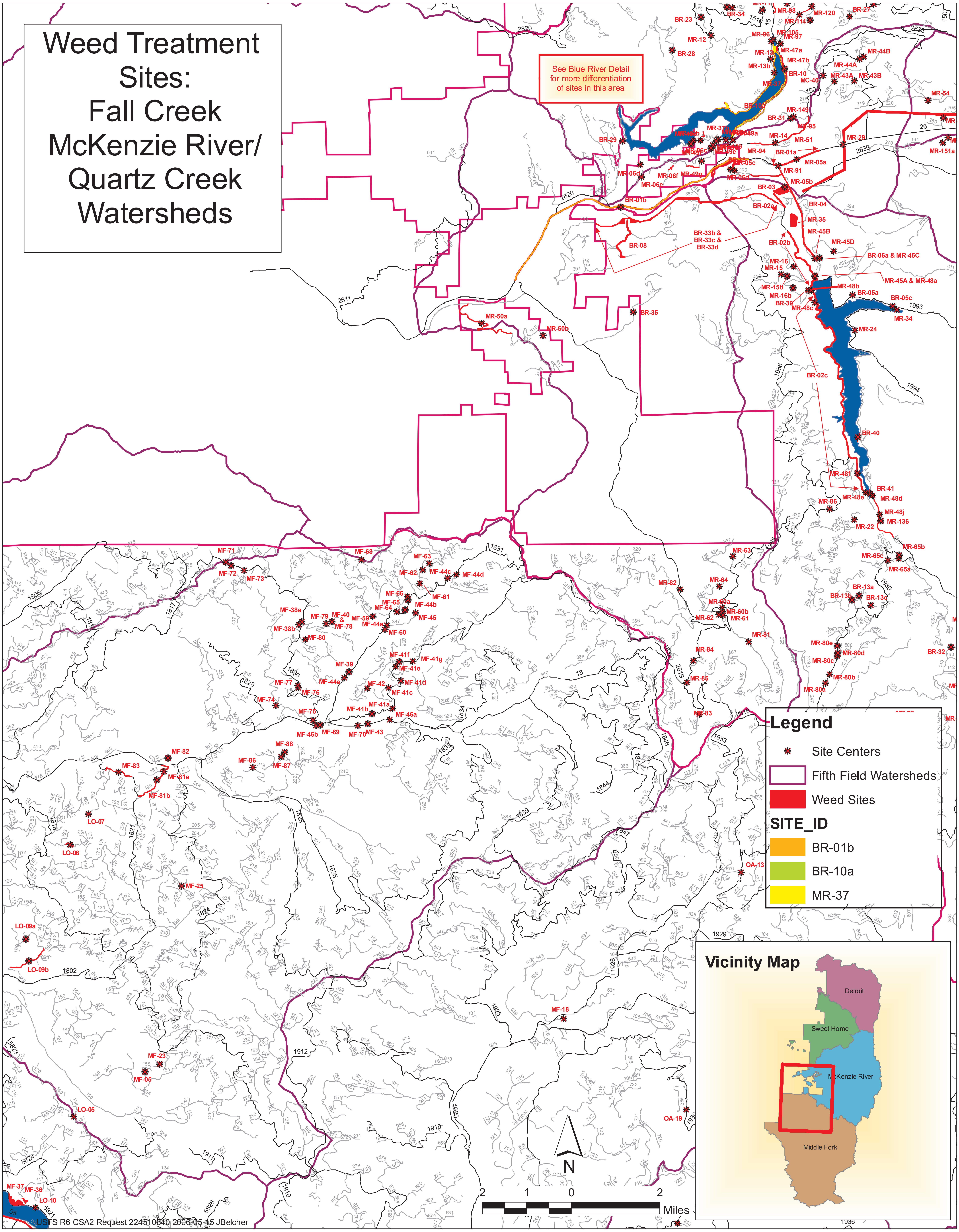
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McKenzie River
Middle Fork
N
2 1 0 2
Miles
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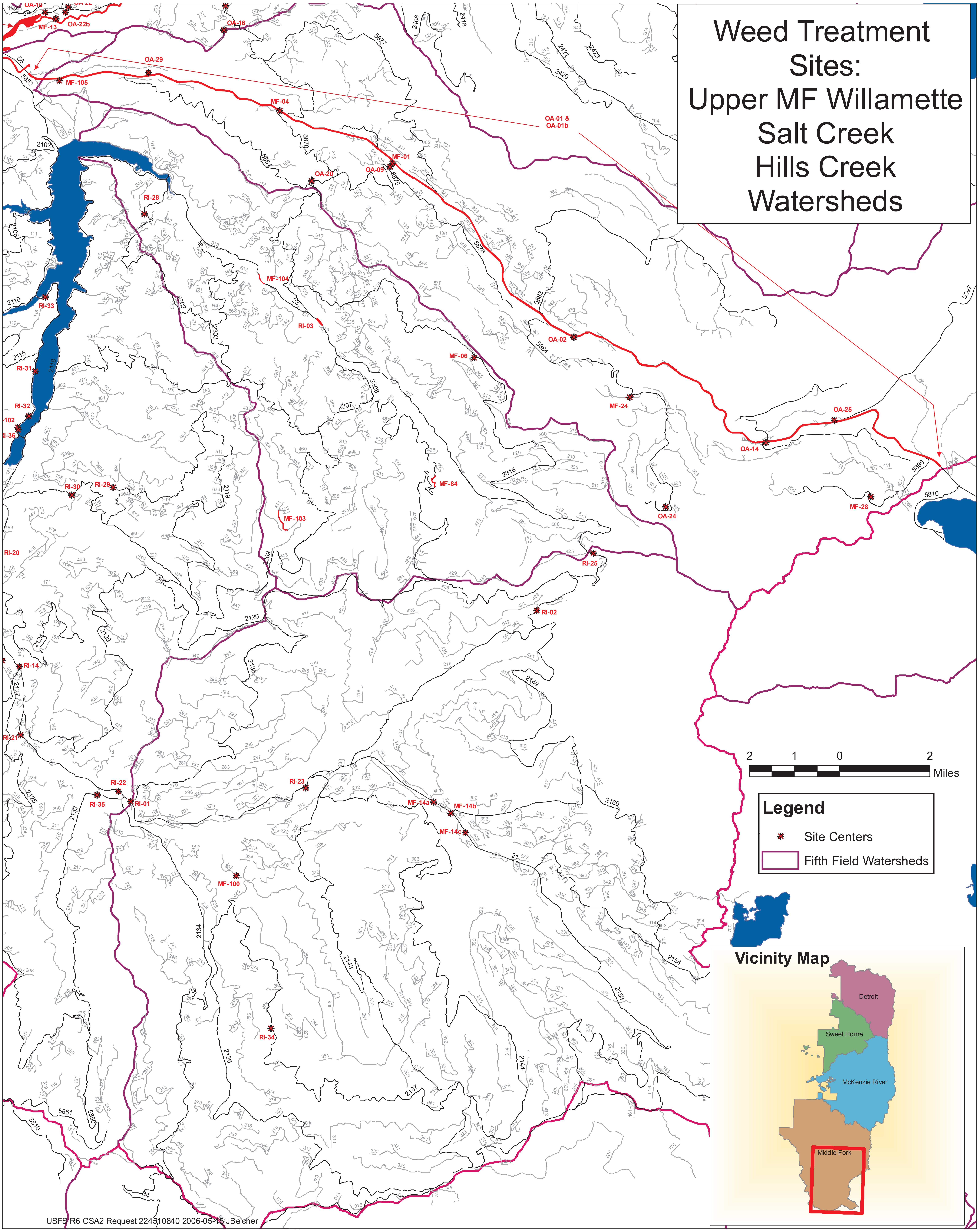
Weed Treatment Sites:
Upper MF Willamette
Salt Creek
Hills Creek
Watersheds
OA-16
OA-22b
MF-13
OA-29
MF-105
MF-04
OA-01 & OA-01b
MF-01
OA-09
OA-20
RI-28
MF-104
RI-33
RI-03
RI-31
RI-32
RI-36
MF-06
OA-02
MF-24
OA-25
OA-14
MF-28
OA-24
MF-84
MF-103
RI-30
RI-29
RI-20
RI-25
RI-02
RI-14
RI-21
RI-22
RI-35
RI-01
RI-23
MF-14a
MF-14b
MF-14c
MF-100
RI-34
2 1 0 2
Miles
Legend
Site Centers
Fifth Field Watersheds
Vicinity Map
Detroit
Sweet Home
McKenzie River
Middle Fork
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