Appendix T:

Watershed and Soils Specialist Report

Modoc National Forest

Noxious Weed Treatment Project

Soils and Watershed Report

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For the:

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Introduction

This project Soils and Hydrology report was finalized by Forest Service Hydrologists, Carol Thornton and Jenny Fryxel after review of the DEIS and draft soil and watershed report prepared by Peter Adams, Forest Hydrologist, who was assigned to other projects.

The effect of invasive plant treatments on soil and water is of public concern. There is concern that herbicide treatment on riparian areas could adversely impact water quality and aquatic ecosystems.

The purpose of this document is to analyze, interpret and discuss potential effects of invasive plant treatments on soil and water resources, located on the Modoc National Forest. Project design standards (DS) were developed to minimize the effects of invasive plant treatments on these resources.

The Modoc National Forest is proposing to treat noxious weeds across the Forest by using herbicides, physical methods, and cultural treatments, or a combination of these approaches, over a 5- to 10-year timeframe (USDA Forest Service 2007). The noxious weeds are located in approximately 50 6th-field watersheds across the forest and could potentially affect 0.61 percent of soil map units located on the Modoc National Forest. Please refer to Table 1 and Appendix A for descriptions of the soil map units that have either sensitive or shallow soils on sites that contain noxious weeds. (Appendix A is part of the Watershed and Soils specialist report, found in Appendix T, Watershed and Soils, of this final EIS.)

The 39 5th-field watersheds that are proposed to be treated under this decision lie within the jurisdictional area of three different regional water boards (RWB): Central Valley, Lahonton and North Coast. There are 143 6th-field watersheds within the 39 5th-field watersheds. Approximately 80 percent of these 6th-field watersheds are located within the Central Valley RWB and the remainder is divided between the Lahontan and North Coast RWBs. Each RWB has a different water quality standard for pesticide delivery to the surface and ground waters, with the Lahonton RWB having a no-herbicide-detected standard. Standards for the other RWB are a limit of 0.07 mg/l for 2,4-D and a limit of 0.7 mg/l for glyphosate. All three of the RWB Basin Water Quality Plans meet the State of California standard for water quality.

Analysis Area

The analysis area for direct and indirect effects is the Modoc National Forest and lands administered by the Forest. The total acreage within the Forest's boundary consists of approximately 2,029,647.7 acres. Of those acres, 1,679,007.3 are administered by the Forest Service, which is approximately 83 percent of the area. The Modoc National Forest is located in the extreme northeast corner of California. The cumulative effects analysis area is comprised of the 39 5th-field watersheds that are either totally or partially found within the Forest's administrative boundary. Approximately 39 percent of the total area of these 39 5th-field watersheds is located within the Forest boundary.

Regulatory Framework

Federal Legislation

Federal and state laws, policies, and regulations control the use of herbicides on National Forest System lands, including the Clean Water Act and the Federal Water Pollution Control Act. Section

208 of the 1972 amendments to the Federal Water Pollution Control Act (Public Law 92-500) specifically mandated identification and control of non-point source pollution. Clean Water Act Section 303(d) directs the State of California to list Water Quality Limited Water bodies (303(d)-listed streams) and develop total daily maximum loads (TDML) to control the non-point source pollutant causing loss of beneficial uses.

In the State of California, the Central Valley, Lahonton and North Coast RWBs compile this information for each region. The information is then combined into a single report by the State Water Resources Control Board. The Safe Drinking Water Act and its 1996 amendments require states to delineate public water sources, to determine potential sources of contamination, and to determine the most susceptible areas at risk for contamination. This project would comply with the standards and criteria determined by each of the three regional water quality boards.

Forest Service-related Regulation

The regulatory framework of the Modoc is guided by federal laws and regulations as well as direction from three separate forest plans. In general, the applications of these three guiding documents are as follows: the Big Valley Sustained Yield Unit is managed under the 1991 Modoc National Forest Land and Resource Management Plan (LRMP). The Medicine Lake Highlands are guided by the Northwest Forest Plan and the rest of the Forest is administered under the Sierra Nevada Framework amendment of 2004 (Figure 1). Forest plan direction is found in the 1991 Modoc National Forest LRMP, the Sierra Nevada Forest Plan Amendment (SNFPA) of 2004, and the plan referred to as the Northwest Forest Plan (USDA Forest Service 1991). Each of these guiding documents has differing direction for riparian areas. Management direction for soils, found in these three guiding documents, focuses on maintaining soil productivity and the restoration and maintainance of the physical, chemical and biological integrity of the Forest's waters, as directed by the Clean Water Act. For consistency in the Noxious Weed Treatment Project, the Forest Supervisor determined that the Sierra Nevada Forest Plan Amendment Record of Decision direction for riparian-area management will be followed Forest wide, since it provides the highest level of protection to the aquatic resource.

To help restore and maintain these aspects of water-related resources, riparian conservation objectives (RCOs) and aquatic conservation strategy objectives (ACSOs) were developed to provide specific management direction. This approach also supports the Forest's mission to provide habitat for riparian and aquatic-dependent species as directed by the National Forest Management Act, Organic Act, and Safe Drinking Water Acts.

Maintenance of soil productivity is essential to sustaining ecosystems and is mandated by every act of Congress directing national forest management. Region 5 Forest Service Handbook 2509.18.2 (USDA Forest Service 1995a) establishes regional objectives for the soils management program. The Modoc National Forest LRMP directs that soil productivity be maintained by applying guidelines to areas where management prescriptions are applied and that, as a minimum, 85 percent of areas affected by soil-disturbing activities will not exceed soil property thresholds, as defined in guidelines A-G. (Modoc National Forest Plan pages 4-21 to 4-22).

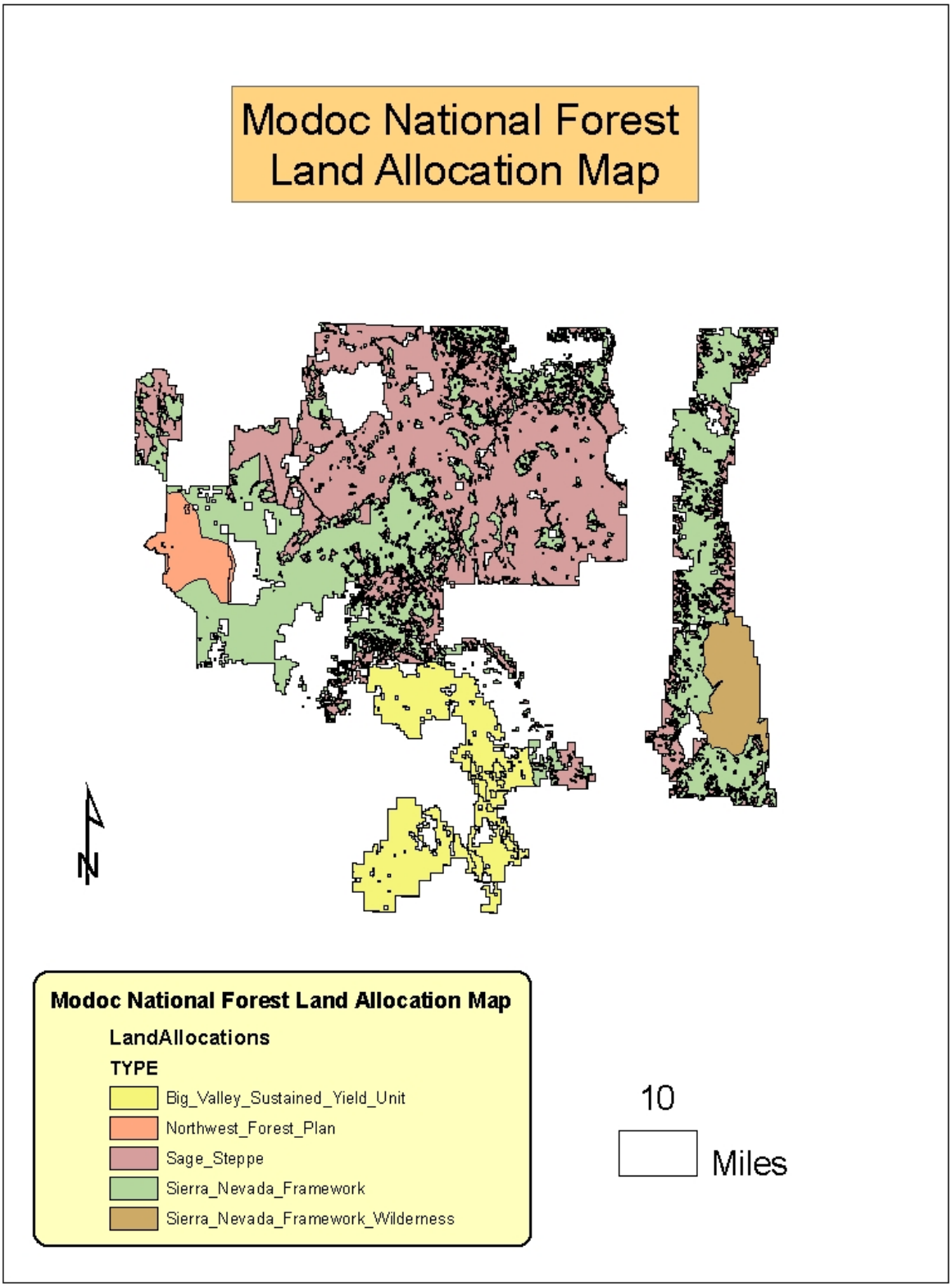

Figure 1. Modoc National Forest land allocation map

Methodology for Analysis

Project design standards were developed to ensure compliance with Region 5 direction, Modoc National Forest Plan, Sierra Nevada Framework and Northwest Forest Plan direction. Information used to develop these design standards include analysis of herbicide properties from SERA (Syracuse Environmental Research Associates, Inc.) risk assessments, soil characteristics and properties relative to herbicide properties and the proximity of treatment sites to streams. The acres to be treated under each alternative by non-herbicide and herbicide methods, as well as types of herbicides used, were compared by alternative.

Herbicide degradation in the environment is tied strongly to soils. The analysis focuses on herbicide application since this is the highest risk of the proposed actions. Main topics compared across the alternatives are (1) the risks to soil biology, (2) soil and water interactions, and (3) vegetation cover and soil erosion.

The Forest Service has a contract with Syracuse Environmental Research Associates, Inc. (SERA) to conduct human health and ecological risk assessments. These assessments are for herbicides that may be proposed for use on National Forest System lands. The information contained in this report, and in the EIS, relies on these risk assessments. Herbicide effects to stream aquatic resources were analyzed in risk assessments for each of the five herbicides included in the alternatives. The risk assessments considered worst-case scenarios including accidental exposures and application at maximum reported rates. Although the risk assessments have limitations (see R6 2005 FEIS pages 3-95 through 3-97, and the Human Health section of the Modoc Invasive Weed EIS), they represent the best science available.

The GLEAMS (Groundwater Loading Effects of Agricultural Management Systems) model examines the fate of herbicides in various soils under a variety of environmental conditions. This model was used for all the Forest Service SERA risk assessments. This is a well-validated model for herbicide transport and is the best available at this time. The SERA Risk Assessment analysis takes the herbicide concentration provided by GLEAMS and uses them in a dilution model for a stream or pond to get the water contamination rates for specific scenarios. The risk assessment model assumes broadcast treatment along a small perennial stream. The model ran a 10-acre square field as well as a treatment area modeled as 50 feet wide and 1.6 miles long (10 acres). The model also assumes even rainfall every 10 days. The herbicide concentration was very similar for both scenarios. Modeling 10 acres along a stream would overestimate herbicide in streams on the Forest as no broadcast of herbicide is proposed anywhere and buffers are required on streams (different buffer widths depending on alternative). The SERA worksheets were adjusted for the application rates to be used under this project. While the parameters do not always accurately reflect parameters at treatment sites, using this approach is considered conservative because in actuality the infestations are scattered, streams are buffered from herbicide application and broadcast applications are not allowed.

For two sites, the GLEAMS-Driver 1.8 model was used because it allows the user to input more site-specific data, particularly local climate data and treatment acreage. The model is conservative and probably overestimates herbicide concentrations because it assumes broadcast application along a stream as opposed to the targeted treatment proposed with this project.

The risk assessments, interdisciplinary team discussions, and monitoring studies of herbicide use in forested areas were used to create design standards, particularly for stream buffers and near water resources, to protect streams from potential adverse effects of treatments.

Affected Environment for Soil and Water Resources

Climate

The climate for most of the Forest ranges from warm, dry summers to cold moderately wet winters. Weather varies considerably with elevation, slope, aspect, and season. Winters are marked by the occurrence of frequent low-pressure systems and cooler temperatures reflect the influence of maritime polar air. Precipitation tends to be lighter on the Modoc Plateau, increasing in amount in the mountain areas and falls mainly as snow. Precipitation tends to taper off after March, as the flow pattern of storms shifts to the north, resulting in warm summers with light precipitation (USDA Forest Service 1983).

These patterns are reflected in the mean precipitation for Alturas, California. Mean precipitation is highest between the months of November through March, where the average precipitation is greater than 1 inch per month. The average annual precipitation is 12.2 inches per year. Correspondingly, the warmest months, which range from June through September, have the lowest precipitation averages for these months. During these months, the precipitation averages between 0.24 inches per month to a high of 0.99 inches per month (http://forest.moscowfsl.wsu.edu/cgi-bin/fswepp/rc/copypar.pl). Rainfall intensities vary from low to moderate. Rainfall intensities may vary from 1.4 to 3.0 inches for a two-year, 24-hour storm event, although the amount varies across the Forest (USDA Forest Service 1983).

Geology

The geology on the Forest has been influenced predominantly by faulting, volcanic activity, and erosion. From 60 million years ago to the present, the area has experienced volcanic activity. The Forest's three major geomorphic provinces evolved from these dominating geologic processes. The provinces are: the Cascade Range, Great Basin and Modoc Plateau (USDA Forest Service 1983).

The Cascade Range province is dominated by the Medicine Lake Highlands, which is a broad shield volcano, and considered to be active. It is currently among the top five candidates in California for future activity. Cinder cones are common and the associated bedrock is dominated by andesitic flows and pyroclastics. In recent geologic time, there has been additional activity resulting in domes and flows of rhyolitic obsidian, rhyodacites, and rhyolitic pumice. Basaltic lavas are also present, comprising a series of flows, such as the Modoc Basalt, Burnt Lava, and Black (Callaghan) and Point Pot Crater flows.

The Modoc Plateau province is relatively flat and the monotonous central portion of the survey area is called Devil's Garden. The area is capped by fissure erupted basalts that range in age from 25,000 to 20 million years ago and andesitic volcanic rocks are also present. Geologically recent basaltic cinder cones are scattered across the Plateau, and are generally associated with northwest-southeast trending faults.

The Basin and Range province is located around the Warner Mountain area, and reflects the extreme western extent of this province. Warner Mountain is formed by a westward-tilting fault block. Bedrock in this area is almost entirely volcanic in origin. Pyroclastics dominated the majority of the mountain range, with minor amounts of andesite and basalts, obsidian flows, rhyolitic rocks, volcanic mudflows and welded tuffs occurring. Sedimentary rocks of volcanic origin are present; glacial deposits may exist but have been difficult to identify. The Adin

Mountains are also present in this province and represent a series of anticlines and synclines, which have been dissected by faults (USDA Forest Service 1983).

Soils

There are approximately 2 million acres of soils mapped within the Modoc National Forest. These soils have been grouped into 22 map units, each of which consists of numerous individual soils and a wide variety of land types (USDA Forest Service 1983). These soils reflect the region's ongoing volcanogenic history, and are derived primarily from basalts, andesite, tuff, pyroclastic pumice, cinders and volcanic ash, of various ages; although some other parent material is present.

Map units defined during soil mapping on the Forest, in the early 1980s, were grouped into seven general assemblages, reflecting differing landscapes and land capabilities. These assemblages and their characteristics are summarized below in Table 1, from the Modoc Soil Survey dated 1983.

Based on a review of Table 1, it is obvious that the parent material for soils on the Forest is volcanogenic in nature. Soils in the vicinity of the Warner Mountain Ranger District are generally more erosive then elsewhere on the Forest due to recent geologic uplift of area. On the Basalt Plateau, silica duripans are found under shallow soils in this area. Where these shallow soils directly overlie the underlying basalts, the duripans, once they are well developed, thick and highly cemented, function as a barrier to water moving from the soil horizon into the ground water table

The seven general assemblages in Table 1, reflecting differing landscapes and land capabilities have been further subdivided into over 100 soil types and grouped into 207 soil mapping units (USDA Forest Service 1999). Within this survey, soils of concern were identified based on a soil's depth to bedrock, soil internal drainage, and permeability. Soil infiltration is a measurement of how quickly water can infiltrate into the soil from the surface, and soil drainage is a measurement of how quickly water can move through the soil profile. Soil permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Soil drainage is a measurement of the frequency and duration of periods of saturation or partial saturation during soil formation (Adams 2007a). A sensitive soil is defined as a soil with soil permeability of "moderately rapid" or greater, or soil drainage of "somewhat excessively drained" or greater.

Soils with the following characteristics were defined as of concern:

- Soils with a lithic or para-lithic contact (soil depth of less than 12 inches to bedrock) or a soil with a depth to bedrock of less than 20 inches. These soils are defined as "shallow"
- Soils with moderately rapid to rapid permeability
- Soils with ratings of somewhat excessive to excessive soil drainage
- Soils having maximum erosion hazard ratings of high to very high, and those with a runoff potential rating of high to very high.
- Those areas classified as rubble lands, lava fields and rock outcrops, due to high incidences of fracturing.

Table 1. Summary of map units and soil families on the Modoc National Forest

Map Unit	Soil Families	Parent Material	Geomorphic Position	Permeability Range	Maximum Erosion hazard Potential
Lower Elevation Predominantly Woodland Soils, Primarily 0-40% Slope	Lawyer-Elmore & Jacket-Deven-Hibner families	Basalt and volcanic tuff derived principally from basic igneous rock	Basalt plateaus and volcanogenic mountain uplands	Slow-Moderate	Low to High
Lower Elevation Rangeland soils, Primarily 0-40% slope	Bakeoven family-lava flow-Searles family; Puls-Indian creek-Simpson families; Deven-Bieber-Pass Canyon families; Gwin-Ruckles_Pass Canyon families; Supan-Los Gatos-Pass Canyon families; Deven-Keating-Pass Canyon families**	Basalt, cinder cones, tuff,	Basalt plateaus and volcanogenic mountain uplands	Very Slow to Moderately Rapid	Low to High
Predominantly Nearly Level Alluvial Soils That are Subject to Flooding	Aikman-Cardon family	Volcanogenic sediments	Clay basins and drainages of basalt plateaus	Very Slow	Moderate
Lower to Mid Elevation Dominantly Woodland Soils Which Have formed in Relatively Recent Volcanic Parent Materials	Alcot-Sadie-Germany deep families; Alcot-Holland families, pumice overburden; Lava flow-Germany family-Lithic Xerumbrepts; Stonewell-Yallani families; Stonewell-Yallani-Inville families, pumice overburden	Volcanic ash, cinders and recent pyroclastic material, basalt or andesite	Old alluvial fans on basalt plateaus and volcanogenic mountain uplands	Moderately Rapid to Rapid	Low to High
Mid Elevation Soils on Gently Sloping to extremely Steep Mountains in the Eastern Half of the Survey Area	Smarts-DeMasters-Patio families; Bertag-Smarts-Cavanaugh families; Anatone-Bearskin-Merlin families	Basalts, andesites or tuff	Mountain uplands	Slow to Moderate Slow	Moderate to High
High elevation Nearly Level to extremely Steep Soils on the Medicine Lake Highlands and on the Warner Mountains	Divers-Lapine-Kinzel families; Behanin deep-Gralic-Loberg families; Cheadle-Supervisor-Behanin families	Andesite, basalt, tuff cinders or obsidian	Higher elevations on both the Medicine Lake shield volcano and the Warner Mountain range	Slow to Rapid	Moderate to High
Miscellaneous Areas with Little or No Soil Present	Lava flow rock-Rock outcrop; Water	Vesicular basalt flows or obsidian	Medicine Lake Highlands, east side of the Warner Mountain range; Medicine Lake, Clear lake Reservoir and Big Sage Reservoir	Not Applicable	Not Applicable

** Approximately 85% of the acreage involved in this map unit is composed of shallow soils overlying a silica duripan, or over basal or tuff bedrock (USDA Forest Service 1983).

There are 127 soil map units rated as sensitive and/or shallow. They comprise 1,226,588 acres, or approximately 60.4 percent of the area within the Forest. This information is summarized in Appendix A to this report. (Appendix A is part of the Watershed and Soils specialist report, found in Appendix T, Watershed and Soils, of this final EIS.)

Based on Best Management Practices Evaluation Program (BMPEPs) for a multitude of projects including grazing, road maintenance, fuels reduction, timber harvest and prescribed fire, soils on the Modoc National Forest are meeting R5 soil quality standards and Modoc LRMP objectives (Adams 2007*c*).

Soil Conditions within Treatment Areas

A GIS query of known weed occurrences in relation to the forest activity tracking system (FACTS) data was completed. (The query is located in the electronic project record.) In constructing the query, roads were buffered for ¼ mile on each side of the road. The analysis determined that over 90 percent of known weed locations are found within one-quarter mile of roads. These areas have highly disturbed soil conditions. Disturbance typically includes the loss or mixing of surface organics and mineral soil into subsurface mineral soil horizons. This is often due to soil displacement, and/or altered soil structure and porosity, as a result of mineral soil compaction. Conditions affecting vegetative growth, such as available moisture holding capacities and soil porosity, are likely to also have been altered. Because many invasive plants prefer disturbed sites, this creates conditions in which invasive species are able to out-compete native species.

Table 2. Range of size in invasive plant sites on the Modoc National Forest

Size of Infestation	No. of Invasive Plant Sites	Percent of Known Sites
Less than 1 acre	652	94
1 to <5 acres	27	27
5 to < 10 acres	6	<1
10 to < 50 acres	8	<1
50 to < 100 acres	0	<1
More than 100 acres	3	<1
Total	**696**	**100%**

Ninety-four percent of the areas in which invasive species occur on the Modoc National Forest are less than 1 acre in size. The largest defined area of noxious weeds on the Forest is 5,657.8 acres infested with dyer's woad.

Infested sites not along roads can include areas burned by fires and areas where streams have acted as a corridor for movement of plants downstream. Burned areas lack plant cover, generally include disturbances from heavy equipment creating firebreaks, and can have changed soil properties from soil heating. Where streams have acted as a corridor for movement of invasive plants downstream, soils are fairly undisturbed.

As discussed above, there are approximately 2 million acres of soils mapped on the Modoc National Forest. Approximately 64 percent, or 1, 273, 954 of these acres, have soils that contain either a sensitive or shallow soil component. The known or identified noxious weed sites occur on 0.5 percent of the shallow and sensitive soils found on Forest (Adams 2007a).

Effect of Invasive Plants on Soils

Invasive plants can alter soil properties such as pH, nutrient cycling, and changes in composition or activity of soil microbes. Reductions in soil nutrient levels make it difficult for native plants to compete with the invasive plants, and probably affect the soil biotic community health. However, the long-term effects of these changes are not known (USDA Forest Service 2006). As shown in Table 2, 94 percent of the sites are less than an acre, 27 percent are between 1 and 5 acres, and less than 1 percent are greater than 5 acres. See Appendix B of the Modoc Noxious Weed EIS for more details on existing sites.

Soil and Water Interactions – Water infiltration rates and volumes can be reduced on weed-infested sites due to reduced cover (DiTomaso 2000). Significantly greater surface water runoff, indicating less infiltration, has been measured from spotted knapweed-dominated sites compared to adjacent native grass-dominated sites (Lacey, Marlow, and Lane 1989). Compaction, which is present in many weed-infested sites, also tends to reduce infiltration rates. Reductions in soil organic matter can also reduce the amount of water held in the soil profile, especially near the surface (Brady and Weil 1999, Tisdall and Oades 1982).

Vegetative Cover - Total vegetative cover may be reduced on weed-infested sites from that provide by native vegetation and can result in higher evaporation from exposed mineral soil on the surface (Lauenroth, et al. 1994). Soil water stored deeper in the profile may also be depleted more rapidly on sites where vegetative cover provided by weeds is dense and associated transpiration rates are high (Olson 1999).

Soil Erosion – Weed-infested soil has been shown to be more susceptible to erosion than soil occupied by native grass species (Lacey, Marlow, and Lane 1989). Soil erosion in a simulated rainfall test more than doubled in spotted knapweed-dominated rangeland areas when compared to natural bunchgrass/forb grasslands. This is primarily due to significantly lower infiltration rates and higher levels of bare ground on the knapweed-dominated site compared to the uninfested areas (ibid.).

Weeds are less able to dissipate the kinetic energy of rainfall, overland flow, and wind that cause soil erosion, primarily due to the loss of cover provided by native species on site (Torri and Borselli 2000, Fryrear 2000).

Soil Biota - Plants and mycorrhizal fungi are strongly dependent on each other, and species of fungi are associated with specific plants. Presence of non-native plants also leads to changes in the mycorrhizal fungus community (ibid.). These changes could increase the difficulty of reestablishing native vegetation after the invasive plants are removed.

Soil Nutrient Availability - Noxious weeds directly limit nutrient availability by out-competing native species for limited soil resources. Weeds have high nutrient uptake rates and can deplete soil nutrients to very low levels, especially in cases where weed species germinate prior to native species and exploit nutrient and water resources, before native species are actively growing (Olson 1999).

Spotted knapweed has been implicated in reducing available potassium and nitrogen (Harvey and Nowierski 1989). Potassium, nitrogen, and phosphorous levels were shown to be 44, 62, and 88 percent lower, respectively, in spotted knapweed-infested soil than in adjacent grass covered soil (Olson 1999). Some invasive plants are allelopathic to other plants, and produce secondary compounds that can directly increase the population of soil microbes capable of metabolizing this compound, while decreasing the populations of other microbes (ibid.). Allelopathic is defined as

suppression of growth of a plant by a toxin released from a nearby plant of the same or another species.

These changes will affect the soil food web and nutrient cycling, and may have impacts on the native plant community. Weed-infested areas may also indirectly limit nutrient availability as a result of soil erosion from compacted conditions or reduced effective cover. Erosion selectively removes organic matter and the finer sized soil particles that store nutrients for plant use, leaving behind soil with a reduced capacity to supply nutrients.

Water Resources

Overall Watershed Conditions

Stream surveys and stream condition assessments have been conducted since the completion of the 1991 FEIS and LRMP for the Modoc National Forest. Stream surveys and condition assessments have been completed for other analyses from 1995 to the present, both at the project level and cumulative effects levels. Based on gathered information, and the completion of the Modoc NF Watershed Condition Assessment (2001), Forest watersheds are hydrologically stable, with isolated stream reaches that have bank erosion, due to the effects of activities related to Forest management. These reaches were noted to have sustained periods of flow. In addition, review of data mentioned above indicates the majority of streams are considered to be in proper functioning condition (PFC) (Brady and Weil 1999).

Water quality and riparian condition are the two elements potentially affected by invasive plant treatments. The approximately 6,908.4 acres of invasive plants identified for treatment are scattered across the Forest in 29 of 39 5th-field watersheds. Of the 6,908.4 acres identified as having invasive plants, 136.5 acres, or 1.4 percent, are located within areas identified as part of critical aquatic refuges. An additional 2.8 percent of the acres infested with noxious weeds are located within riparian conservation areas.

Water Quality

As stated on page 3, water quality in California is regulated by the Clean Water Act and the Regional Water Boards (RWBs) identify and establish beneficial uses for surface and ground water. Each RWB has developed water quality control plans, also known as basin plans, which provide the basis for protecting water quality in the state of California. Included in each plan are water quality objectives, which the RWB has determined will ensure reasonable protection of beneficial uses identified by the RWB for surface and groundwater (http://www.waterboards.ca.gov/northcoast/programs/basinplan/basin.html).

The three RWBs that include various parts of the Modoc National Forest include the Central Valley Regional Board in areas that drain to the Pit River, the North Coast Regional Board in Klamath Basin lands, and the Lahontan Regional Board in Great Basin lands (Figure 2).

By direction of the Clean Water Act, where water quality is limited, state agencies develop total maximum daily load (TMDL) plans to improve water quality to support the beneficial uses of water. For water-quality-limited streams on National Forest System lands, the Forest Service provides information, analysis, and site-specific planning efforts to support State processes to protect and restore water quality.

The most recent listing was approved for the state of California in 2002, which compiles all the information from each regional water board[1]. GIS data from the State was downloaded and reviewed in context of the Forest boundary and defined areas of noxious weed concentrations. No impaired stream reaches were found to be within defined noxious weed sites on the Forest.

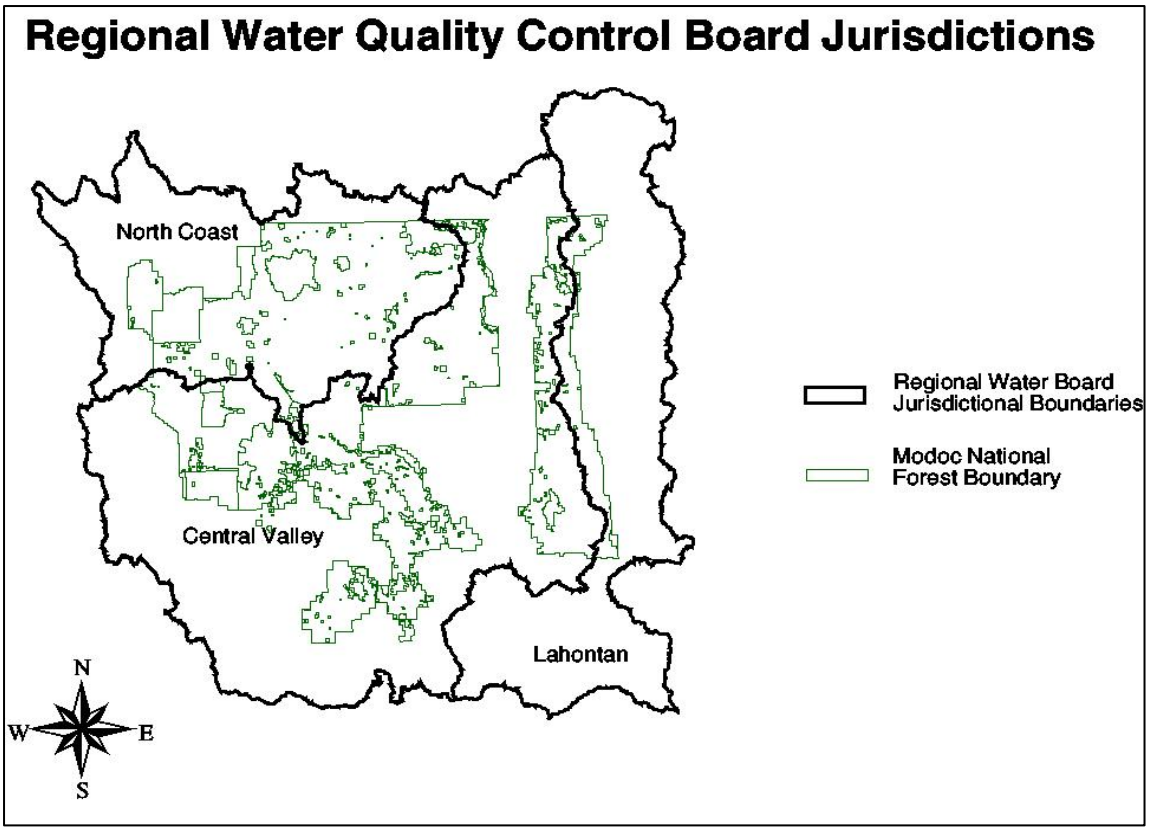

Figure 2. Regional water quality control boards and their jurisdictions on the Modoc National Forest

Water Quantity and Timing

There are approximately 5,922.2 miles of stream within the boundaries of the Modoc National Forest. Of these, 3,229.3 miles are ephemeral, which equates to 55 percent of the total stream miles within Forest boundaries. Approximately 36 percent, or 2,114.9 miles, are intermittent, and 9 percent of the stream miles, or 578 miles, are perennial. The majority of the intermittent and ephemeral streams flow during spring snowmelt and are predominantly dry in later summer and fall. The exception is that flow can occur following a major precipitation event (Adams 2007a).

Twenty of the 39 watersheds involved with the Forest produce a cumulative annual yield of 565,800 acre-feet of water per year. This does not include water yield from private lands found with the Forest boundary (USDA Forest Service 1999).

The amount of water that runs off these watersheds is related to the type of precipitation events (snowmelt versus rainfall) and rainfall intensity. High-intensity and short-duration summer storms have a tendency to yield more runoff than fall and winter storms. As the runoff increases, so does the energy to erode hillsides and transport sediment to the stream network.

[1] http://www.waterboards.ca.gov/rwqcb5/water_issues/tmdl/impaired_waters_list/index.html

Channel Morphology

Stream surveys and stream condition assessments have been conducted on selected perennial streams on the Forest. Specified and approved stream survey protocols have been used to complete stream condition assessment, including stream condition inventory (SCI), Pfankuch ratings, and proper functioning condition (PFC).

The results of stream condition assessments indicate that the majority of streams surveyed are considered to be “in equilibrium” with their geomorphic setting and are considered to be in proper functioning condition. Some channels are considered to be “functioning at risk” due to land management activities on the Forest based on their PFC ratings. Hardcopies of data collected from 1995 to the present are on file at the Forest Supervisor’s office in Alturas, California (Adams 2007b).

Those streams that are in the functioning-at-risk category are considered to be affected by site-specific disturbances. Localized disturbances are more related to site-specific impacts from logging and related infrastructure, such as landings, temporary roads, and skid trails. Additional causes of site-specific disturbances included livestock grazing, road construction, and wildfire (Adams 2007a).

Riparian and Wetland 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 providing for the formation of undercut banks, important cover for juvenile and adult fish. Riparian areas with native vegetation supply downed trees (large wood) to streams. Riparian vegetation stabilizes stream banks, and serves as a filter to prevent the runoff of soil into streams. Riparian vegetation also provides large and small wood to streams, adding to habitat complexity, and providing cover and food sources for aquatic organisms. Aquatic ecosystems have evolved with certain vegetation types; invasive plants do not necessarily provide similar habitat.

The 1991 FEIS to the Modoc Forest Plan states that there were almost 19,000 acres of riparian area found on the Forest. It states that 13, 473 of these acres were adjacent to streams, 2, 803 acres adjacent to springs and seeps; 122 acres adjacent to lakes and 2,583 acres were adjacent to wet meadows. The FEIS indicates that approximately 60 percent of riparian areas was located in the Warner Mountain District, with 20 percent in the Devil’s Garden District, and only 10 percent each on the Big Valley and Doublehead Districts. Five hundred fifty-two miles of stream were found to contain riparian habitat. Riparian vegetation was described to consist of three primary types: grass-forb understory with a willow midstory and no overstory (which was defined as the most common); a grass forb understory with no midstory or overstory (generally associated with wet meadows); and a conifer overstory with mixed-deciduous midstory and an understory, associated with perennial streams, particularly at high elevations (USDA Forest Service 1999). The FEIS also states that at the time of publication there was approximately 233 wetlands covering approximately 35,000 acres of Forest Service administered lands.

The 2004 amendment to the Sierra Nevada Framework defines two areas of interest: Riparian Conservation Areas (RCAs) and Critical Aquatic Refuges. The delineations of RCAs for this FEIS, as described below, are from the Sierra Nevada Forest Plan Amendment FEIS Record of Decision (USDA Forest Service Pacific Southwest Region 2004 p.42). For this FEIS, the terms RCA and Streamside Management Zone (SMZ) are interchangeable.

Perennial Stream RCA: 300 feet on each side of the stream, measured from the bank full edge of the stream.

Seasonally Flowing Stream RCA (includes intermittent and ephemeral streams): 150 feet on each side of the stream, measured from the bank full edge of the stream

Special Aquatic Feature RCA (includes lakes, wet meadows, bogs, fens, wetlands, vernal pools, and springs): 300 feet from edge of feature or riparian vegetation, whichever width is greater.

The primary role of Critical Aquatic Refuges (CARs) is to preserve, enhance, restore or connect habitats for aquatic or riparian dependent species at the local level and to ensure the viability of these species. In many cases, CARs support the best remaining populations of native fish, amphibian, and plant species whose distributions have been substantially reduced elsewhere in the Sierra Nevada. CARs primarily protect occupied habitat of threatened, endangered, or sensitive animal species.[2]

Since the 2004 direction applies to this project, acreages for CARs and RCAs were determined at the time of this report being written. Based on currently available GIS data, analysis determined that there are approximately 127,716 acres of defined CARs within the Forest, 226,693.7 acres of RCAs associated with streams, and 117, 285.9 acres associated with meadows, lakes and springs. Wetlands are often used for recreation and are at risk from invasive plants, such as knotweeds that colonize areas downstream of the original infestation along a stream. Wetlands can be inundated with water year-round, and others are wet only seasonally. Areas that are wet only seasonally can be infested with upland species as well as those species adapted specifically to wetland areas.

Existing conditions for CARs and RCAs were documented in the FEIS for the forest plan. It indicated that in the past, logging practices, road construction, and improper grazing practices contributed to riparian and wetland area degradation. Forest riparian areas were described as generally lacking the desired vegetation expressions to achieve overall management objectives. Riparian areas were noted to not have improved where livestock grazing was season long and where few or no structural improvements had been made. However, from 1995 to the present, surveys have been completed and a WSA completed. Results indicate that a majority of streams surveyed were considered in proper functioning condition (PFC). Watersheds are considered hydrologically stable. However, isolated reaches were noted where there was stream bank erosion or other types of site-specific disturbance are present. Periods of elevated stream flow were also noted (Adams 2007b). Where riparian vegetation is present and that reach has been documented as in PFC, riparian also would be considered in PFC. Data is on file at the Supervisors Office in Alturas, California.

Lakes and Floodplains

Lakes and floodplain areas are often popular for recreation. As a result, these areas are at risk from invasive plants brought in by visitors, as plant parts and seeds can be carried downstream of the original infestation at high flows.

There are numerous lakes and reservoirs that total an estimated 18,115.6 acres, based on current GIS data. GIS layers of floodplains were not available for the Forest and they are not discussed in the Forest Plan. However, perennial streams of lower gradients often have floodplains associated with them.

[2] http://www.fs.fed.us/r5/rsl/projects/frdb/layers/cars.html

Existing-condition information for lakes and floodplains is absent in the 1991 FEIS. However, as discussed above, data has been collected from 1995 to the present and the Watershed Condition Assessment for the Modoc National Forest was completed by Sue Becker et al. in 2000. Watersheds are considered hydrologically stable, and many stream reaches are in PFC.

For those stream reaches involving watersheds that have received a PFC rating, it can be inferred that their floodplains are functioning properly. Data is on file at the Supervisors Office in Alturas, California.

Municipal Watersheds and Domestic Water Supplies

A municipal supply watershed is one that serves a public water system as defined in Public Law 93-523 (Safe Drinking Water Act) or as defined in State safe drinking water regulations. No formal municipal watersheds or whole communities use water on-Forest. There are, however, several domestic water users scattered throughout or downstream from the Forest on numerous streams (USDA Forest Service 1991). While not a formal municipal watershed, the Fort Bidwell Indian Community gets drinking water from an area on National Forest System land. Through formal consultation with the Fort Bidwell Indian Community Council (April 6, 2006), the Forest agreed not to use herbicides to treat noxious weeds in the area of concern that supplies the community with drinking water. This area of concern is depicted on the map in Appendix N of the Noxious Weed EIS. At this time, noxious weeds have not been identified in this area of concern. Further consultation would continue to identify suitable treatment methods under Early Detection-Rapid Response if sites are identified in the future.

Alturas is the only incorporated town in Modoc County that is adjacent to the Forest boundary. The water supply for Alturas comes from groundwater wells. Neither the State Water Resources Control Board nor the Central Valley and North Coast Regional Waterboards identify any municipal watersheds on the Forest.

The California Department of Water Resources (DWR) sampled for herbicide contamination in the Pit River near Alturas, California. The results of the water quality monitoring for the years of 2001 to 2005 is summarized below in Table 3. The results of the monitoring shows that while Glyphosate, Tricloypr, 2,4-D and Dicamba were found in the water samples for the Pit River and the North Fork of the Pit River, none of the samples exceeded the “reporting limit”. The reporting limit triggers a report by the sampling agency to the EPA via the State or Regional Water Boards.

Table 3. Result of water quality monitoring on the Pit River (Lebeouf 2005)

Monitoring Results: 2001 through 2005-Pit River, North Fork, Station # A1210000			
Chemical	**Reporting Limit (ug/L)**	**Results Reported**	**Did the sample exceed the Reporting Limit**
Dicamba	<0.1	<0.1	N
Glyphosate	<25	<25	N
Tricloypr	<0.1	<0.1	N
2,4-D	<0.1	<0.1	N

Roads

GIS analysis of known weed occurrences showed that over 90 percent of known weed occurrences are found along roads. In conducting the analysis, a buffer of 1,320 ft (1/4 mile), was established on the road.

For this project, roads within riparian conservation areas are considered hydrologically connected to streams. The total number of miles of forest road, user-created roads, and railroads within the project area totals an estimated 3,900 miles, based on current GIS. In RCAs associated with streams, there are an estimated 578.0 miles of road, or 15 percent of the total road miles. In RCAs associated with springs, lakes, and reservoirs, there are an estimated 248.3 miles or 6.4 percent of the total road miles. Miles of road within noxious weed polygons, on the forest, total 26.6 miles, which is less than 1 percent of the total road miles.

Water Resources within Riparian Conservation Areas and Critical Aquatic Refuges

Invasive Plants within Riparian Conservation areas and Critical Aquatic Refuges

Table 4 and Table 5 show acres of invasive plants within RCAs and CARs of both perennial and intermittent streams. None of these species are considered specifically riparian. Canada thistle can be found in riparian areas as can Scotch Thistle and Spotted knapweed. Scotch thistle and Spotted knapweed can also be found in wet meadows. The other noxious weed species listed in Table 4and Table 5 are generally forest and upland species. However, spotted knapweed may be found in both moisture loving areas and more forested and upland settings.[3]

Canada thistle, Spotted Knapweed and Dalmatian Toadflax have either all or most of their acreage within RCAs associated with perennial streams. dyer's woad, Klamathweed, musk thistle and Scotch thistle have most of their acreages within RCAs associated with seasonal streams (Table 4 and Table 5).

Table 4 Documented invasive plants acres within RCAs on the Modoc National Forest

Primary Invasive Plant	Acres within Perennial Stream RCA	Acres within Intermittent Stream RCA	Total Acres	% Acreage Associated with Perennial Streams	% Acreage Associated with Seasonal Streams
Canada Thistle	1.2	7.7	8.9	13.2	86.8
Crupina	5.8	29.3	35.2	16.6	83.4
Dalmatian Toadflax	23.9	32.2	56.1	42.6	57.4
Diffuse Knapweed	1.2	1.1	2.3	51.7	48.3
Dyer's woad	3.7	16.3	20.0	18.4	81.6
Klamath Weed/St. Johnswort	0.1	0.5	0.6	16.4	83.6
Mediterranean Sage	4.7	0.8	5.5	85.6	14.4
Scotch Thistle	3.8	27.7	31.4	12.0	88.0
Spotted Knapweed	1.1	0.1	1.2	91.7	8.3
Yellow Starthistle	1.1	0.0	1.1	100.0	0.0
Musk Thistle	0.0	0.4	0.4	0.0	100.0

There are three critical aquatic refuges on the Forest. Mill Creek 1 has no identified invasive weed sites. The sites within riparian areas of Goose Lake and Turner Creek CARs are shown below in Table 5.

[3] http://www.cal-ipc.org/ip/inventory/weedlist.php

Table 5 Documented invasive plants acres within CARs on the Modoc National Forest

Primary Invasive Plant	Acres within Perennial Stream Goose Lake CAR	Seasonal Stream Acres within Goose Lake CAR	Seasonal Stream Acres within Turner Creek CAR	Total Acres	% Acreage Associated with Perennial Streams	% Acreage Associated with Seasonal Streams
Canada Thistle	0.2	0.0	0.0	0.2	100.0	0.0
Dalmatian Toadflax	23.9	19.1	0.0	43	55.6	44.4
Dyer's woad	0.1	12.2	0.0	12.3	0.8	99.2
Klamath Weed	0.0	0.0	0.1	0.1	0.0	100.0
Musk Thistle	0.0	0.0	0.3	0.3	0.0	100.0
Scotch Thistle	0.1	0.7	0.1	0.9	11.1	88.9
Spotted Knapweed	0.1	0.0	0.0	0.1	100.0	0.0

While most invasive plants first occupy disturbed sites, once established, any of these species can begin to invade undisturbed sites (Stohlgren et al. 1999).

Noxious weed acreage comprises 0 - 2.3 percent of the area of 5th-field watersheds (Table 6). Twenty-eight out of 39 5th-field watersheds involved within the Forest's boundary, or 71 percent, have some acreage involved with noxious weeds. However, only two watersheds or 0.05 percent of the total number of watersheds, have acreages totaling greater than 1 percent of the 5th-field watershed's total acreage (Table 6). For Copic Bay watershed, the large percentage of infestation is due to the large dyer's woad site, which consists of 5,676.5 acres. For Round Valley watershed, the large percentage of infestation is due to the Common Crupina site that is on both public and private land.

As treatments under this project would take place only on National Forest System lands, watershed involvement was reassessed by considering only those acres within the Forest boundary. When considering only those lands within the Forest boundary, by 5th-field watershed, then only the Copic Bay watershed has greater than 1 percent of its land infested with noxious weeds (Table 7). As in Table 6, this is due to one large dyer's woad-infested site.

Temperature - While invasive plants may provide some shade, they are replacing native forbs and grasses that are better bank stabilizers and promote narrower and deeper channels. Stable banks tend to provide more shade and consequently keep stream water temperatures lower.

Sediment - There are 8.8 acres of spotted knapweed and 4.1 acres of diffuse knapweed identified for treatment on the Forest. There are 1.1 acres of spotted knapweed within RCAs associated with perennial streams and 0.1 acre within RCAs associated with intermittent streams. Diffuse knapweed acreage is not associated with either RCAs or CARs. Lacey et al. (1989) reported higher runoff and sediment yield on sites dominated by knapweed versus sites dominated by native grasses.

Table 6. Acres infested by invasive plants for whole 5th-field watersheds

5th-field Watershed Name	Hydrologic Unit Code	Acres	Infested Acres	Percentage of Entire 5th-field Watershed Infested
Ash Valley-Cottonwood Creek	1802000212	102250.9	9.8	0.0
Big Valley	1802000217	87632.0	3.0	0.0
Boles-Fletcher Creek	1801020401	216746.0	3.9	0.0
Canby-Pit River	1802000209	157640.0	28.8	0.0
Canyon Creek	1802000207	61749.4	0.4	0.0
Clear Lake	1801020403	143249.0	0.2	0.0
Clover Swale Creek	1802000208	57672.8	0.4	0.0
Copic Bay	1801020411	243169.6	5676.5	2.3
Goose Lake East Shore	1802000103	156132.8	133.3	0.1
Goose Lake West Shore	1802000104	96239.2	1.6	0.0
Horse Creek	1802000301	164558.4	3.5	0.0
Jess Valley	1802000201	64125.0	1.3	0.0
Juniper Creek	1802000216	50660.3	9.5	0.0
Lower Alkali Lake	1808000103	133914.8	0.1	0.0
Lower Ash Creek	1802000215	84393.1	3.7	0.0
Lower South Fork Pit River	1802000203	139538.5	0.3	0.0
Middle Alkali Lake	1808000102	240481.2	0.9	0.0
North Fork Pit River	1802000204	139287.9	2.7	0.0
North Fork Willow Creek	1801020402	90356.0	0.6	0.0
Rattlesnake Creek	1802000205	124105.7	0.8	0.0
Round Valley	1802000213	60382.3	770.1	1.3
Taylor Lake	1802000211	235602.2	883.7	0.4
Tule Lake Sump	1801020410	127974.8	0.1	0.0
Turner Creek	1802000210	49069.5	3.3	0.0
Upper Alkali Lake	1808000101	201463.6	19.8	0.0
Upper South Fork Pit River	1802000202	208686.0	6.4	0.0
Warm Springs Valley	1802000206	44037.9	28.5	0.1
Willow Creek	1802000214	49869.2	0.9	0.0

Table 7. Acres infested by invasive plants for National Forest System land by 5th-field watersheds

Fifth Field Watershed Name/Clipped to FS boundary	Hydrologic Unit Code	Watershed Acres	Infested Acres	Percent Watershed Within Forest That Is Infested
Ash Valley-Cottonwood Creek	1802000212	42543.0	9.8	0.0
Big Valley	1802000217	9554.3	3.0	0.0
Boles-Fletcher Creek	1801020401	216746.0	3.9	0.0
Canby-Pit River	1802000209	109690.8	28.8	0.0
Canyon Creek	1802000207	16276.8	0.4	0.0
Clear Lake	1801020403	109940.6	0.2	0.0
Clover Swale Creek	1802000208	41637.3	0.4	0.0
Copic Bay	1801020411	222634.5	5676.2	2.5
Goose Lake East Shore	1802000103	67613.9	133.2	0.2
Goose Lake West Shore	1802000104	49473.1	1.6	0.0
Horse Creek	1802000301	18440.0	3.5	0.0
Jess Valley	1802000201	64125.0	1.3	0.0
Juniper Creek	1802000216	33326.0	9.5	0.0
Lower Alkali Lake	1808000103	21967.9	0.1	0.0
Lower Ash Creek	1802000215	14842.0	3.5	0.0
Lower South Fork Pit River	1802000203	28964.5	0.3	0.0
Middle Alkali Lake	1808000102	41512.8	0.8	0.0
North Fork Pit River	1802000204	64273.3	2.6	0.0
North Fork Willow Creek	1801020402	62555.5	0.6	0.0
Rattlesnake Creek	1802000205	114438.0	0.8	0.0
Round Valley	1802000213	47791.3	182.5	0.4
Taylor Lake	1802000211	201380.3	878.8	0.4
Tule Lake Sump	1801020410	84210.1	0.1	0.0
Turner Creek	1802000210	49069.5	3.3	0.0
Upper Alkali Lake	1808000101	42668.0	17.4	0.0
Upper Lost River	1801020404	30723.4	2.0	0.0
Upper South Fork Pit River	1802000202	69890.0	2.3	0.0
Warm Springs Valley	1802000206	7665.1	3.0	0.0
Willow Creek	1802000214	33936.1	0.9	0.0

Channel Morphology and Riparian Condition

In the Forest, there are approximately 46.6 acres of noxious weeds associated with perennial streams and 116.2 acres associated with intermittent streams, in RCAs (Table 4). In CARs there are approximately 24.4 acres found associated with perennial streams in the Goose Lake CAR, while 32 acres are associated with intermittent streams. In the Turner Creek CAR there is only 0.5 acre associated with intermittent streams and there is no perennial stream association (Table 5).

Native riparian vegetation plays a key role in forming aquatic habitat for fish and other aquatic species. Tree roots help stabilize stream banks, preventing accelerated bank erosion and providing for the formation of undercut banks, important cover for juvenile and adult fish. Riparian areas with native vegetation supply downed trees (large wood) to streams. In turn, downed trees in streams influence 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. Invasive plants could slow down or prevent the establishment of native trees, decreasing or delaying the future supply of large wood in stream channels (USDA Forest Service 2005)

While invasive grasses and forbs would not directly replace riparian shrubs, in degraded areas where shrubs are no longer present, invasive plants can occupy sites and out-compete native vegetation, limiting opportunities for native shrubs to reoccupy the site.

Lakes and Wetlands

There are 153,187 acres of RCAs surrounding wet meadows, lakes, and springs. Within these areas, approximately 128 acres of invasive plants have been identified (Table 8). Of these, approximately 66 are near lakes, 11 are near springs, and 40 are in meadows. Many of the lakes and springs are within the larger Dalmatian toadflax treatment area.

Table 8. Invasive plant acres within RCAs of lakes, springs, or wet meadows

Invasive Plant	Acres
Canada Thistle	10.8
Crupina	0.7
Dalmatian Toadflax	98.4
Dyer’s woad	3.0
Klamathweed	0.3
Mediterranean Sage	5.3
Musk Thistle	1.1
Scotch Thistle	8.3
Spotted Knapweed	0.0
Squarrose Knapweed	0.1
Yellow Starthistle	0.1
Total	128.0

General Watershed Function

Water temperature regimes promote recovery or enhancement of riparian vegetation. Management activities provide high levels of protection to streams, stream banks, riparian areas, and wetlands. Riparian areas in less than desirable condition have been improved to provide for riparian-dependent resources. These improvements have resulted from better control and

administration of livestock use in riparian areas, reduced timber harvest in forested riparian areas, and more roads being closed or obliterated.

Watershed and fisheries habitat improvement projects have been completed on priority streams, and riparian hardwood communities have been increased or reestablished. Bank stability, water quality, fish and wildlife habitat, recreation opportunities, and aesthetics have improved. Streamside vegetation is more diverse and abundant with native species. Any significant change in total stream flow or timing of high and low flow has primarily been a result of naturally occurring events and conditions.

Project Design Standards and Monitoring

Project Design Standards

Project design standards were developed for each of the proposed alternatives. Design standards are developed to reduce or eliminate impacts related to analysis issues and affected resources areas, and are incorporated as an integrated part of the proposed action and any action alternatives.

While developing the design standards for the proposed action and the other action alternatives, the following soil and water quality characteristics were considered:

- Soil permeability of moderately rapid to rapid (herbicide)
- Soil drainage of somewhat excessively drained to excessively drained (herbicide).
- Soil depth of less then 20 inches to bedrock when a silica duripan does not underlie the soil (herbicide).
- Unique or specialized land forms such as rubble land, rock outcrop, lava flows and saturated water tables (herbicide).
- Distance to high water mark of streams, lakes, ponds, springs and meadows from the application of herbicides
- Mobility of herbicides and considering the method of application within 100 feet of high water mark of streams, lakes, ponds, springs and meadows (herbicide).
- Maximum soil erosion hazard rating of high or very high and water runoff potential (herbicide and physical).

The design standards are listed in Table 9 through Table 12. Alternatives 2 and 4 share the same design standards, while Alternatives 3 and 5 share similar design standards. The design standards for Alternative 6 apply to that alternative alone, and Alternative 1 is the no action alternative. They are based upon standard practices, such as best management practices (BMPs) that have proven to be effective under similar circumstances and conditions (Bakke 2001, USDA Forest Service 2004).

They also would provide sideboards for early detection/rapid response. Implementation of design standards would be mandatory for the alternative selected. This would ensure that treatments would have effects within the scope of analysis. The analysis assumes buffers approximate horizontal (map) distances.

For a full description of the alternative please refer to the “Environmental Consequences” section below or Chapter Two of the Modoc Invasive Weed EIS.

Table 9. Project design standards pertinent to soil or water resources under Alternatives 2 and 4

Design Standard	Soil and Water Design Standard	Purpose of Design Standard	Source of Design Standard
DS-14	Water: Annually the amount of physical disturbance and/or herbicide application would be limited to no more than 15% of each 6th Field Sub-watersheds.	To reduce the potential for indirect or cumulative effects to 6th field watersheds	Modoc LRMP Pg 4-22, S&G Soils #2
DS-15	The specified distances for perennial streams, lakes and special aquatic features are 300 feet and 150 feet for seasonally flowing streams, both of which are consistent with Riparian Conservation Areas as defined the Sierra Nevada Framework (SNF) ROD, 2001. For the Noxious Weed FEIS, the designated zone for all Streamside Management Zones is the Riparian Conservation Areas (RCAs) on the Modoc National Forest. See the definition for Riparian Conservation Area in the glossary. Therefore, for the Noxious Weeds FEIS, the terms SMZ and RCA are interchangeable. For the purpose of noxious weed treatments, SNF RCA standards will apply Forest wide. Within these prescribed RCAs, limited hand treatments may occur for a distance of 10 feet outward from the edge of the High Water Mark.	To protect water quality and stream health from the potential indirect and cumulative effects of proposed noxious weed treatment	Modoc LRMP as Modified by the 2002 Amendment to the Sierra Nevada Framework
DS-16	The RCAs will be maintained with 50% of the acreage of the RCA as undisturbed; disturbance will be limited to no more than 25% of the acreage of the inner half of the RCA.	To protect water quality, stream health and runoff patterns of the RCAs from potential indirect and cumulative effects related to proposed noxious weed treatments.	BMP 1.8 Designation of Streamside Management Zones BMP Stream Course and Aquatic Protection 1.19 (FSHB 2509.22)
DS-17	Water - RCA Treatments: Herbicide treatment within the Riparian Conservation Areas (RCAs) will be as follows: -From the High Water Mark outward to 10 feet, no herbicide use (only Physical Methods). -From a distance of 10 feet to the outer edge of RCAs for Seasonally Flowing or Perennial Streams, only Aquatic Glyphosate may be applied by wicking it onto the plant. -From the outer edge of RCAs for Seasonally Flowing or Perennial Streams, Glyphosate, Clopyralid, Dicamba, and Triclopyr may be applied. -2, 4-D will not be applied within 1,000 feet of the High Water Mark of Seasonally Flowing or Perennial Streams.	To protect water quality from the potential contamination of the water column from the application of those herbicides with the identified potential to move off site and adversely affect soil or water quality.	Developed via IDT discussion to tier to BMP 5.12: Streamside Wet Area Protection During Pesticide Spraying; 1, 000 ft distance from surface or live water developed in consultation with USFWS and Mary Flores, Project Wildlife Biologist.
DS-20	Soils: Areas with bare soil resulting from noxious weed treatments that are greater than ¼ acre in size will be assessed for need for rehabilitation.	To provide guidance for assessing treated areas for rehabilitation	BMP 5-4: Revegetation of Surface Disturbed Areas Soil S&G E, Chapter 4 Modoc LRMP Regional Soil Quality Standards, FSHB 2509.18
DS-22	Annually the Forest Hydrologist, Watershed Specialist or Soil Scientist determines the location of the noxious weed occurrence to be treated to determine if the site to be treated is located on sensitive or shallow soils. If it is determined that the site to be treated contains sensitive or shallow soils then either DS 23 or 24 would be applied, depending on Alternative selected.	To provide guidance in protecting shallow a sensitive soils and water quality	BMP 5.7: Pesticide Use Planning Process; BMP 5-8: Pesticide Application According to Label Directions and Applicable Lega Requirements (FSHB 2509.22

Design Standard	Soil and Water Design Standard	Purpose of Design Standard	Source of Design Standard
DS-23	Soils: On noxious weed sites identified as having sensitive soils and or shallow soils, do not use herbicides with high leaching potential to treat noxious weeds.	To prevent or mitigate the incorporation of pesticides into groundwater	BMP 5.7: Pesticide Use Planning Process; BMP 5-8: Pesticide Application According to Label Directions and Applicable Legal Requirements (FSHB 2509.22)
DS-25	Soils: On those sites with soils identified as having a high or very high erosion potential or a rapid or very rapid risk to runoff do not use Physical and Physical+ methods to treat noxious weeds when the fire weather forecast for the next 24 hours states there is a likely chance of thunderstorms (generally 60-70% or greater as defined by the National Weather Service).	To protect Soil Quality Standards soil productivity and soil hydrologic function	Region 5 Soil Quality Standards FSHB 2509.18 S&G #1, Modoc LRMP Chapter 4
DS-29	Herbicides: When applying herbicides within RCAs, from the High Water Mark outward to a distance of 25 feet, all directed spray must be done in a downward direction. In addition, when the height of a weed is greater than 36 inches, the weed will be laid on the ground and sprayed in a downward direction. This will minimize herbicide drift and confine the herbicide to the drop zone of the individual weed plant being treated. Beyond 25 feet within RCAs and outside of RCAs, herbicides will be applied by on-the-ground applicators directly spraying or wicking the target noxious weed. Spraying will be done in a downward direction to the extent possible.	To control drift within the inner third of the RCA	BMP 5-12: Streamside Wet area Protection During Pesticide Spraying BMP 5-13: Controlling Pesticide Drift During Spray Application Modoc LRMP Water S&G's 1 and 2
DS-34	Control of Drift or Herbicide Migration: All herbicide application will follow EPA approved label directions in regards to control of drift of herbicides during spraying. These directions have specific wind speeds and air temperatures for application of each herbicide. In addition, applicators will utilize droplet size and spray pressure to insure droplets do not travel outside of the drip line target plant.	To control drift of herbicides	BMP 5-8: Pesticide Application According to Label Directions and Applicable Legal Requirements

Table 10. Design standards pertinent to soil or water resources under Alternatives 3 and 5

Design Standard	Soil and Water Design Standard	Purpose of Design Standard	Source of Design Standard
DS-14	Water: Annually the amount of physical disturbance and/or herbicide application would be limited to no more than 15% of each 6th field sub-watersheds.	To reduce the potential for indirect or cumulative effects to 6th field watersheds	Modoc LRMP Pg 4-22, S&G Soils #2
DS-15	The specified distances for perennial streams, lakes and special aquatic features are 300 feet and 150 feet for seasonally flowing streams, both of which are consistent with Riparian Conservation Areas as defined the Sierra Nevada Framework (SNF) ROD, 2001. For the Noxious Weed FEIS, the designated zone for all Streamside Management Zones is the Riparian Conservation Areas (RCAs) on the Modoc National Forest. See the definition for Riparian Conservation Area in the glossary. Therefore, for the Noxious Weeds FEIS, the terms SMZ and RCA are interchangeable. For the purpose of noxious weed treatments, SNF RCA standards will apply Forest wide. Within these prescribed RCAs, limited hand treatments may occur for a distance of 10 feet outward from the edge of the High Water Mark.	To protect water quality and stream health from the potential indirect and cumulative effects of proposed noxious weed treatment	Modoc LRMP as Modified by the 2002 Amendment to the Sierra Nevada Framework
DS-16	The RCAs will be maintained with 50% of the acreage of the RCA as undisturbed; disturbance will be limited to no more than 25% of the acreage of	To protect water quality, stream health and runoff patterns of the	BMP 1.8 Designation of Streamside Management Zones

Design Standard	Soil and Water Design Standard	Purpose of Design Standard	Source of Design Standard
	the inner half of the RCA.	RCAs from potential indirect and cumulative effects related to proposed noxious weed treatments.	BMP Stream Course and Aquatic Protection 1.19 (FSHB 2509.22)
DS-20	Soils: Areas with bare soil resulting from noxious weed treatments that are greater than ¼ acre in size will be assessed for need for rehabilitation.	To provide guidance for assessing treated areas for rehabilitation	BMP 5-4: Revegetation of Surface Disturbed Areas Soil S&G E, Chapter 4 Modoc LRMP Regional Soil Quality Standards, FSHB 2509.18
DS-21	Soils: Areas with bare soil created by the treatment of noxious weed, the site would be evaluated for rehabilitation (Alternative 5).	To ensure that the treatment of noxious weeds is not creating open areas or bare areas for spread of noxious weeds.	BMP 5-4: Revegetation of Surface Disturbed Areas Soil S&G E, Chapter 4 Modoc LRMP Regional Soil Quality Standards, FSHB 2509.18
DS-25	Soils: On those sites with soils identified as having a high or very high erosion potential or a rapid or very rapid risk to runoff do not use Physical and Physical+ methods to treat noxious weeds when the fire weather forecast for the next 24 hours states there is a likely chance of thunderstorms (generally 60-70% or greater as defined by the National Weather Service).	To protect Soil Quality Standards soil productivity and soil hydrologic function	Region 5 Soil Quality Standards FSHB 2509.18 S&G #1, Modoc LRMP Chapter 4
DS-29	Herbicides: When applying herbicides within RCAs, from the High Water Mark outward to a distance of 25 feet, all directed spray must be done in a downward direction. In addition, when the height of a weed is greater than 36 inches, the weed will be laid on the ground and sprayed in a downward direction. This will minimize herbicide drift and confine the herbicide to the drop zone of the individual weed plant being treated. Beyond 25 feet within RCAs and outside of RCAs, herbicides will be applied by on-the-ground applicators directly spraying or wicking the target noxious weed. Spraying will be done in a downward direction to the extent possible.	To control drift within the inner third of the RCA	BMP 5-12: Streamside Wet area Protection During Pesticide Spraying BMP 5-13: Controlling Pesticide Drift During Spray Application Modoc LRMP Water S&G's 1 and 2

Table 11. Design Standards pertinent to soil or water resources under Alternative 6

Design Standard	Soil and Water Design Standard	Purpose of Design Standard	Source of Design Standard
DS-14	Water: Annually the amount of physical disturbance and/or herbicide application would be limited to no more than 15% of each 6th Field Sub-watersheds.	To reduce the potential for indirect or cumulative effects to 6th field watersheds	Modoc LRMP Pg 4-22, S&G Soils #2
DS-15	The specified distances for perennial streams, lakes and special aquatic features are 300 feet and 150 feet for seasonally flowing streams, both of which are consistent with Riparian Conservation Areas as defined the Sierra Nevada Framework (SNF) ROD, 2001. For the Noxious Weed FEIS, the designated zone for all Streamside Management Zones is the Riparian Conservation Areas (RCAs) on the Modoc National Forest. See the definition for Riparian Conservation Area in the glossary. Therefore, for the Noxious Weeds FEIS, the terms SMZ and RCA are interchangeable. For the purpose of noxious weed treatments, SNF RCA standards will apply Forest wide. Within these prescribed RCAs, limited hand treatments may occur for a distance of 10 feet outward	To protect water quality and stream health from the potential indirect and cumulative effects of proposed noxious weed treatment	Modoc LRMP as Modified by the 2002 Amendment to the Sierra Nevada Framework

Design Standard	Soil and Water Design Standard	Purpose of Design Standard	Source of Design Standard
	from the edge of the High Water Mark.		
DS-16	The RCAs will be maintained with 50% of the acreage of the RCA as undisturbed; disturbance will be limited to no more than 25% of the acreage of the inner half of the RCA.	To protect water quality, stream health and runoff patterns of the RCAs from potential indirect and cumulative effects related to proposed noxious weed treatments.	BMP 1.8 Designation of Streamside Management Zones BMP Stream Course and Aquatic Protection 1.19 (FSHB 2509.22)
DS-18a	Water - RCA Treatments: Within the Riparian Conservation Areas (RCAs) outside of the Lahontan Regional Water Board area of jurisdiction, herbicide treatments will be as follows: -From the High Water Mark outward, aquatic formulations of Glyphosate may be used in RCAs for Seasonally Flowing or Perennial Streams (as well as Physical (+) Methods. -From a distance of 10 feet from the High Water Mark outward to the outer edge of RCAs for Seasonally Flowing or Perennial Streams, Glyphosate and Amine forms of 2, 4-D may be used. -From 25 feet from the High Water Mark outward to the outer edge of RCAs for Seasonally Flowing or Perennial Streams, Chlorsulfuron, Dicamba, Clopyralid, Triclopyr; and Tank Mixes 1 and 2 with only amine forms of 2, 4-D. -From 100 feet from the High Water Mark outward to the outer edge of RCAs for Seasonally Flowing or Perennial Streams, Chlorsulfuron, Dicamba, Clopyralid, Triclopyr; and Tank Mixes 1 and 2 with either ester or amine forms of 2, 4-D.	To protect water quality from the potential contamination of the water column from the application of those herbicides with the identified potential to move off site and adversely affect soil or water quality.	Gill, R., 1993. Letter from California Regional Water Quality Control Board - Lahontan Region to Diane K. Henderson, Forest Supervisor on Noxious Weed Control EIS. Nov. 4, 1993.
DS-18b	No more than 10 percent of the acreage with RCAs for the Frog Waterhole (6th Field HUC 180200021103) and RCAs for lakes found within Clarks Valley (6th Field HUC 18020030106) would be treated with herbicide each year, from the edge of the High Water Mark for a distance of 100 feet. When applied from the High Water Mark to a distance of 25 feet from water, herbicides would be applied by wicking them directly on the plant.	To protect water quality and avoid cumulative effects.	Developed by Peter Adams, Forest Hydrologist.
DS-19a	In the areas under the Lahontan Water Quality Control Board jurisdiction (see Figure 3-2), with Alternative 6 no herbicide treatment will occur from the High Water Mark for a distance of 10 feet. From a distance of 10 to 100 feet from the High Water Mark, only aquatic Glyphosate will be used. At a distance greater than 100 feet from the High Water Mark, the other herbicides shown in the Alternative may be applied.	To meet Lahontan RWB Objective of No detectable Pesticides in the water column.	BMP 1.19 Stream course and Aquatic Protection
DS-19b	Do not use herbicides to treat noxious weeds in the Area of Concern that supplies the Ft. Bidwell Reservation with drinking water (see map in Appendix N). If weeds become established in the future, consult with the Ft. Bidwell Tribe to determine suitable treatment methods under Early Detection – Rapid Response.	To protect water quality from the potential contamination of the water column from the application of those herbicides with the identified potential to move off site and adversely affect soil or water quality.	P. Adams and D. Meza, 2006
DS-20	Soils: Areas with bare soil resulting from noxious weed treatments that are greater than ¼ acre in size will be assessed for need for rehabilitation.	To provide guidance for assessing treated areas for rehabilitation	BMP 5-4: Revegetation of Surface Disturbed Areas Soil S&G E, Chapter 4 Modoc LRMP Regional Soil Quality Standards, FSHB 2509.18

Design Standard	Soil and Water Design Standard	Purpose of Design Standard	Source of Design Standard
DS-21	Soils: Areas with bare soil created by the treatment of noxious weed, the site would be evaluated for rehabilitation (Alternative 5).	To ensure that the treatment of noxious weeds is not creating open areas or bare areas for spread of noxious weeds.	BMP 5-4: Revegetation of Surface Disturbed Areas Soil S&G E, Chapter 4 Modoc LRMP Regional Soil Quality Standards, FSHB 2509.18
DS-22	Annually the Forest Hydrologist, Watershed Specialist or Soil Scientist determines the location of the noxious weed occurrence to be treated to determine if the site to be treated is located on sensitive or shallow soils. If it is determined that the site to be treated contains sensitive or shallow soils then either DS 23 or 24 would be applied, depending on Alternative selected.	To provide guidance in protecting shallow an sensitive soils and wa quality	BMP 5.7: Pesticide Use Planning Process; BMP 5-8: Pesticide Application According to Label Directions and Applicable Lega Requirements (FSHB 2509.22)
DS-24a	Soils: Treatment of noxious weeds on sensitive and/or shallow soils utilizing herbicides other than Glyphosate will not exceed 1 acre per 6th field sub-watershed on an annual basis.	To reduce the potential for an indirect or cumulative affect to soil and watershed resources from the treatment of noxious weeds.	FSH 2509.18 R5 Supplement No. 2509.18.95-1 (R5 Soil Quality Standards)
DS-24b	Soils: Limit annual herbicide treatments in 6th field sub-watersheds to no more than 10% of the acreage of the 6th field sub-watershed.	To reduce the potential for an indirect or cumulative affect to soil and watershed resources from the treatment of noxious weeds.	FSH 2509.18 R5 Supplement No. 2509.18.95-1 (R5 Soil Quality Standards)
DS-25	Soils: On those sites with soils identified as having a high or very high erosion potential or a rapid or very rapid risk to runoff do not use Physical and Physical+ methods to treat noxious weeds when the fire weather forecast for the next 24 hours states there is a likely chance of thunderstorms (generally 60-70% or greater as defined by the National Weather Service).	To protect Soil Quality Standards soil productivity and soil hydrologic function	Region 5 Soil Quality Standards FSHB 2509.18 S&G #1, Modoc LRMP Chapter 4
DS-29	Herbicides: When applying herbicides within RCAs, from the High Water Mark outward to a distance of 25 feet, all directed spray must be done in a downward direction. In addition, when the height of a weed is greater than 36 inches, the weed will be laid on the ground and sprayed in a downward direction. This will minimize herbicide drift and confine the herbicide to the drop zone of the individual weed plant being treated. Beyond 25 feet within RCAs and outside of RCAs, herbicides will be applied by on-the-ground applicators directly spraying or wicking the target noxious weed. Spraying will be done in a downward direction to the extent possible.	To control drift	BMP 5-12: Streamside Wet area Protection During Pesticide Spraying BMP 5-13: Controlling Pesticide Drift During Spray Application Modoc LRMP Water S&G's 1 and 2
DS-34	Control of Drift or Herbicide Migration: All herbicide application will follow EPA approved label directions in regards to control of drift of herbicides during spraying. These directions have specific wind speeds and air temperatures for application of each herbicide. In addition, applicators will utilize droplet size and spray pressure to insure droplets do not travel outside of the drip line target plant.	To control aerial drift of herbicides	BMP 5-8: Pesticide Application According to Label Directions and Applicable Legal Requirements

The stream buffers shown below by alternative are synthesized from the above design standards for all alternatives that allow herbicide use.

Table 12. Summary of distances from High Water Mark for Alternatives that allow herbicide use

Herbicide	Distance from High Water Mark (feet)			
	Alt 2	Alt 4	Alt 6	Alt 6 within CARs
	(ft)	(ft)	(ft)	(ft)
Aquatic Glyphosate	10	10	High water mark	High water mark
2-4-D (amine form)	1000	1000	10	100
2-4-D (ester form)	1000	1000	100	100
Non-aquatic Glyphosate	150/300*	150/300*	10	100
Dicamba	150/300*	150/300*	25	100
Clopyralid	150/300*	150/300*	25	100
Triclopyr	150/300*	150/300*	25	100
Chlorsulfuron	None Allowed	None Allowed	25	100
Mixture 1 (Chlorsulfuron + 2,4-D)	None Allowed	None Allowed	25	100
Mixture 2 (Dicamba + 2,4-D)	None Allowed	None Allowed	25	100

*150 ft. for intermittent streams and 300ft. for perennial streams

These design standards are assumed to protect the treatment areas presently inventoried as well as new or previously undiscovered infestations that would be treated using the range of methods described in detail in the proposed action of the *Modoc National Forest Noxious Weed Treatment Project EIS*. The intent of the Early Detection/Rapid Response approach is to treat new infestations when they are small so that the likelihood of adverse treatment effects is minimized. **The approach is based on the premise that the impacts of similar treatments to similar acreages are predictable, even though the precise location or timing of the treatment may be unpredictable.**

Herbicide use would become more restrictive as treatment occurs closer to water. Design standards and herbicide use buffers within RCAs and CARs were developed based on label advisories, interdisciplinary team discussions ((Table 9, Table 10, Table 11) Bakke 2001) SERA risk assessments, and monitoring results from previous monitoring for Region 5.

Monitoring

The Modoc National Forest Noxious Weed Treatment Project EIS Appendix H documents, in detail, the monitoring approach that will be used for both implementation and effectiveness monitoring (USDA Forest Service 1991, Appendix H-Monitoring). Implementation monitoring would determine whether the selected alternative was implemented as directed, and whether the objectives and priorities were realistic and achievable. Effectiveness monitoring would determine if the treatments were effective in meeting the planned objectives.

It would also determine if the noxious weeds were continuing to spread beyond the control actions and if treatment methods were effective in preventing the spread of noxious weeds into traditional Tribal gathering areas.

Table 13 Summary comparison of alternatives

Alternative Features	Alt 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Number of herbicides used	0	5	0	5	0	6+ 2 mixes
Containment versus eradication at large sites	-	no	no	no	yes	yes
Early Detection/Rapid Response	no	no	no	100acres/year 200 acres total	100acres/year 200 acres total	100acres/year 200 acres total
Treatment Methods	**Sites/Acres**	**Sites/Acres**	**Sites/Acres**	**Sites/Acres**	**Sites/Acres**	**Sites/Acres**
physical	20-30	161/31	494/5993	161/31		
Physical+					527/139	116/19
Physical or chemical		333/5961		333/5961		371/116
chemical		32/907		32/907		46/65
Total pounds of herbicide used	0	3,341-15118 lbs ae		3,341-15118 lbs ae		137-1832 lbs ae
Goats	0	0	0	0	5/41	5/41
Total Acres Treated	**20-30**	**6899**	**5993**	**7099**	**480**	**541**

Environmental Consequences

Explanation of Proposed Action and other Action Alternatives

Six alternatives have been proposed for analysis. The characteristics of each alternative are summarized in below:

Alternative 1: a forest-wide noxious weed program would not be implemented.

Alternative 2: Under this alternative, the Modoc National Forest proposes to treat noxious weeds using herbicides and physical methods over a five-year time frame. The annual combination of methods used would vary depending on noxious weed species, distance from water or other sensitive areas, and the most economical and efficient treatment methods available. There would be no aerial spraying of herbicides and there would be no herbicide use within 10 feet of water. Listed below are features of Alternative 2:

- Between 300 to 1,500 acres would be treated annually for the next five years.
- A total of 536 sites would be treated.
- Physical methods would be used at 161 sites (31 acres) that are less than 10 feet from any water source to include manual hand pulling, digging, grubbing, and hoeing.
- Use of physical and/or herbicide methods on 333 sites (5,961 acres) located greater than 10 feet from any water source targeting nonrhizomatous noxious weed species.

- Treatment using herbicide would occur on 26 sites (2.4 acres) located greater than 10 feet from any water source and comprised of rhizomatous species.
- Partial treatment would occur on 16 sites of rhizomatous species that have some acreage within 10 feet of water. On these 16 sites, the acreage within 10 feet of water would not be treated and the acreage that is further than 10 feet from water would be treated with aquatic glyphosate (904.3 acres).
- No treatment would occur at five sites (0.45 acres). These sites are comprised of rhizomatous species and are within 10 feet of water.
- Herbicides would be applied by directed spray and wicking treatments.
- Herbicides include: Clopyralid, Dicamba, Glyphosate, Triclopyr, and 2,4-D.
- Herbicide treatments would include use of surfactants and dyes. Surfactants increase the absorption of herbicide by the weeds, and dyes assist the applicator in efficiently treating target weeds.

Alternative 3: Alternative 3 does not include the use of herbicides. Listed below are features of Alternative 3:

- Treating between 300 to 1,500 acres annually for the next five years,
- Treatment using physical methods to include manual hand pulling, digging, grubbing, and hoeing would occur on 494 sites (5,993 acres).
- No treatment would occur on 47 sites (916 acres) as these sites are comprised of rhizomatous species and physical methods are ineffective in treating rhizomatous species.

Alternative 4: Alternative 4 focuses on providing flexibility in physical and herbicide treatment methods for current occurrences and expanding or new infestations of noxious weeds. Alternative 4 includes an Early Detection - Rapid Response Strategy not included in Alternatives 2 and 3. Listed below are features of Alternative 4:

- Treating a total of 6,899 acres at 536 sites over the next 10 years (average annual 500-1,500 acres)
- Physical treatment methods would be utilized at 161 sites (31 acres) that are less than 10 feet from any water source.
- Use of physical and/or herbicide methods on 333 sites (5,961 acres) located greater than 10 feet from any water source and with nonrhizomatous noxious weed species.
- Treatment with herbicides would occur on 26 sites (2.4 acres) located greater than 10 feet from any water source and comprised of rhizomatous species.
- Partial treatment would occur on 16 sites of rhizomatous species that have some acreage within 10 feet of water. On these 16 sites, the acreage within 10 feet of water will not be treated and the acreage that is further than 10 feet of water would be treated with aquatic glyphosate (904.3 acres).
- No treatment would occur at five sites (0.45 acres). These sites are comprised of rhizomatous species and are within 10 feet of water.
- Herbicides would be applied by directed spray and wicking treatments.
- Herbicide treatments include: Clopyralid, Dicamba, Glyphosate, Triclopyr, and 2-4-D.
- Herbicide treatments in Alternative 4 would include use of surfactants and dyes. Surfactants increase the absorption of herbicide by the target weeds, and dyes assist the applicator in efficiently treating target weeds.

- An Early Detection - Rapid Response Strategy would be implemented in this alternative. This strategy would provide the opportunity to treat new sites of the identified species that have developed, existing sites that have expanded, and new sites of new noxious weeds using the same treatments as outlined for the noxious weed species identified, provided that environmental effects are within the design standards, and effects analyses are reflected in this EIS. Proposed treatment under Early Detection – Rapid Response would be capped at 200 acres over the life of the alternative with no more than 100 acres being treated in any given year. The rationale for this cap is to provide limited flexibility to treat new and/or expanding weed sites while remaining within the range of effects as displayed in this analysis.

Alternative 5: Alternative 5 provides a non-herbicide alternative with additional non-herbicide treatments, and an Early Detection - Rapid Response Strategy. Alternative 5 includes additional manual treatment methods not included in Alternatives 2 and 3. Alternative 5 includes an Early Detection - Rapid Response Strategy. Under Alternative 5, only the perimeter of a 5,658-acre site (DH013ISTI) of dyer's woad would be treated with either herbicide or physical methods. Listed below are features of Alternative 5:

- Utilize non-herbicide methods to eradicate, control, or contain approximately 280 acres at 541 known sites of noxious weed species.
- There is potential to treat 5 sites (41 acres) using goat grazing. These sites may alternatively be treated using physical methods.
- Treatment using physical methods, including manual hand pulling, grubbing, hoeing, clipping (including use of "weedeaters"), and mulching/tarping would occur on 527 sites (139 acres).
- There would be limited treatment to contain infestations on 9 sites (6,728 acres). These sites include the large dyer's woad site (5,658 acres), one crupina site (159 acres) and seven sites of rhizomatous noxious weeds (913 acres). The common crupina site is part of a larger site on adjacent private lands (an additional 586 acres). Limited treatment of these sites is expected to be 100 acres. Project design standards have been implemented in determining the treatment method that these acres will receive. These sites are comprised of rhizomatous species and are greater than 0.10 acre. Physical methods are not as effective in treating rhizomatous species as herbicides, thus treatment goals would only include containment of the current infestation.
- An Early Detection - Rapid Response Strategy would be implemented in this alternative. This strategy would provide the opportunity to treat new sites of the identified species that have developed, existing sites that have expanded, and new sites of new noxious weeds using the same treatments as outlined for the noxious weed species identified, provided that environmental effects are within the design standards, and effects analyses are reflected in this EIS. Proposed treatment under Early Detection – Rapid Response would be capped at 200 acres over the life of the alternative with no more than 100 acres being treated in any given year. The rationale for this cap is to provide limited flexibility to treat new and/or expanding weed sites while remaining within the range of effects as displayed in this analysis.

Alternative 6: Alternative 6 proposes use of additional herbicide formulations, while treating fewer acres with herbicides, and proposes additional manual treatment methods. Alternative 6 provides the opportunity to use an additional herbicide (chlorsulfuron) and two mixtures of herbicides not included in Alternatives 2 and 4. Alternative 6 also includes the additional manual treatment methods and the Early Detection - Rapid Response Strategy included in Alternative 5.

Under Alternative 6, only the perimeter of a 5,658-acre site (DH013ISTI) of dyer's woad, the 159-acre (BV001CRVU2) Common Crupina and the 851 acre Dalmatian toadflax (WM003LIDA) sites would be treated with either herbicide or physical methods. Physical methods are physical treatments which include manual hand pulling, grubbing, hoeing, clipping (including use of "weedeaters"), and mulching/tarping. Under Alternative 6, the Modoc National Forest proposes to treat noxious weeds over a ten-year time frame. Listed below are features of Alternative 6:

- Treating approximately 341 acres (541 known sites).
- Treatment using physical methods, including manual hand pulling, grubbing, hoeing, clipping (including "weedeaters"), and mulching/tarping would occur on 116 sites (19 acres).
- Treatment using physical methods listed above and/or herbicides would occur on 371 sites (116 acres).
- Treatment using herbicide methods would occur on 46 sites (65 acres).
- There is potential to treat five sites (41 acres) using goat grazing. These sites may alternatively be treated with physical and/or herbicide methods.
- Limited treatment methods along major travel ways to reduce potential for spread would occur on three sites (5,658 acre dyer's woad site, 159 acre common crupina site, and 850 acre Dalmatian toadflax site). These sites would be treated around the borders to contain the infestations. The estimated number of acres treated would be 100 acres along the borders. These treatment acres are estimated proportionally to the size of the current inventoried acres for these three sites.
- Herbicide treatments include: Chlorosulfuron, Clopyralid, Dicamba, Glyphosate, Triclopyr, 2-4-D, and two herbicide mixtures (Mix 1: Chlorosulfuron + 2,4-D, and Mix 2: Dicamba + 2,4-D).
- No 2,4-D treatments would be applied to noxious weed occurrences greater than 2 acres in size.
- Herbicide treatments in this alternative would include use of surfactants and dyes. Surfactants increase the absorption of herbicide by the target weeds, and dyes assist the applicator in efficiently treating target weeds.
- Herbicide treatments would be the primary treatment for rhizomatous species.
- An Early Detection - Rapid Response Strategy would be implemented in this alternative. This strategy would provide the opportunity to treat new sites of the identified species that have developed, existing sites that have expanded, and new sites of new noxious weeds using the same treatments as outlined for the noxious weed species identified, provided that environmental effects are within the design standards, and effects analyses are reflected in this EIS. Proposed treatment under Early Detection – Rapid Response would be capped at 200 acres over the life of the alternative with no more than 100 acres being treated in any given year. The rationale for this cap is to provide limited flexibility to treat new and/or expanding weed sites while remaining within the range of effects as displayed in this analysis.

Effects on Soil and Water Resources

The following sections discuss the general effects of manual, mechanical and herbicide treatments on soil and water resources. Specific differences in alternatives are detailed after the general discussion.

Effects to Soils

General Effects of Physical Treatment

Physical treatments are proposed under all alternatives. Proposed physical treatments are hand pulling, grubbing, digging and hoeing. Physical methods are proposed under Alternatives 5 and 6, and include the clipping of the seed head or plant including using a “weedeater” as well as mulching and tarping.

The overall impacts of these activities are low. These methods would temporarily decrease ground cover, leading to incremental effects from erosion or slight decreases in soil moisture from ground cover reductions. These methods would not lead to adverse effects on soils since soil organic matter would be supplemented from cut vegetative material. These methods would also loosen small amounts of soil at the surface, potentially increasing the chance of localized erosion. This is a very minor and temporary effect and changes would be within the natural range of variability. The use of weedeaters would not contribute to soil disturbance.

The proposed manual treatments result in an input of dead root material, in the form of dead roots into the soil. As the roots are broken down in the soil food web, nutrients are released. The use of hand clipping would also provide organic material, in those cases where the whole plant is cut and dropped to the ground. Rainfall may cause these nutrients to be lost to surface runoff or to groundwater. Where bare soils occur, if they are combined with high nutrient levels, these areas may provide ideal conditions for the establishment of many invasive species. However, in lower intensity infestations, non-target vegetation could provide erosion control as well as a seed source for establishing native vegetation. In areas with larger amounts of bare soil (0.25 acre), Alternatives 2 and 4 design standards would require restoration activities to be considered in order to reestablish native vegetation. The intent is to reestablish competitive local, native vegetation post-treatment in areas of bare ground, to control soil erosion and provide native competition to invasive plant seeds.

Removal of plant roots would break mycorrhizal hyphae in the soil and probably cause a transient reduction of mycorrhizal function. Studies on crop plants have shown that leaving an undisturbed mycorrhizal network in the soil after harvest (e.g. zero-till agriculture) increases the nutrient uptake of the subsequent crop (Evans and Miller 1990). Establishment of native plants may be more successful on undisturbed soil. Indirect negative impacts from manual control could be attributed to soil disturbance and opening of the canopy (understory or depending on the species). This could cause minor and transient shifts in microsite conditions such as reduction in soil moisture, disruption of mychorrhizal associations, and cause an increase in surface temperatures. As the treatment areas associated with this project are generally in previously disturbed sites, treatment would improve the condition of the site by allowing reestablishment of native vegetation.

Physical treatments may slightly increase the potential for delivery of fine sediment to streams the year after treatment. Removal of surface cover could cause minor localized erosion trapped by surrounding vegetation for approximately one season until vegetation becomes reestablished.

Using weedeaters would not create any additional soil impacts. The use of truck-mounted pressurized sprayers (See Figure 2-2, Chap. 2, pg 48, Modoc Noxious Weed FEIS) off-road has the potential to compact soil. Soil compaction eliminates soil pores and so reduces water infiltration, aeration, and the ability of plants to root effectively. While the relative amounts of physical treatments vary between the alternatives, the treatments are similar; therefore differences in terms of intensity or duration of effects from such treatments have no substantive differences.

General Effects of Cultural Treatments

Cultural treatments can include grazing, mulching, tarping, fertilizing and reseeding. Grazing can be effective in reducing a large infestation or eliminating a smaller infestation (Tu et al. 2003). By treating the invasives with grazing first, the intent is to lower impacts on the site from subsequent treatments.

Tarping would shade or heat the soil to kill undesirable plants. This would only be used in small treatment areas as this method is most effective in damp soils (Tu et al. 2003). The dry conditions found on the Modoc are not conducive to widespread use of this method (Table 2-1 Modoc Invasive Weed EIS). Mulching would also be used only on small areas. It is not used on larger areas to avoid impacts to desirable vegetation. Fertilizing and reseeding would help encourage the growth of desirable vegetation.

General Effects of Herbicides on Soils

The effect of chemical treatments may affect soils directly by having short-term adverse impacts on certain soil microbes and indirect impacts from losses in vegetative cover. Most of the proposed chemicals are decayed primarily by soil microbes. Only Chlorsulfuron is mainly degraded through hydrolysis (Table 14). Results from field and laboratory testing are mixed since soil conditions are highly variable. In general, herbicides decay over time; therefore, effects are reduced when microbial metabolic rates are highest (such as during spring when adequate warmth, moisture, and microbial substrate are abundant).

The effect of a chemical treatment on the soil depends on the particular characteristics of the chemical used, how it is applied, and the physical, chemical, and biological condition of the soil medium. In general, primary herbicide routes in soil are leaching, hydrolysis, and adsorption/desorption onto soil particles, and biological degradation. Appendix E of the Modoc Noxious Weed EIS, contains a summary of the factors limiting herbicide treatments, including soil-related factors, such as drainage and permeability. Soil characteristics affect the herbicide residency time through drainage and adsorptive capacities. Highly drained soils have greater propensity to transfer herbicides to groundwater stores. Organic rich soils and finer texture soils have higher adsorption potential for holding herbicides. Herbicides will vary in the degradation potential based on their chemical structure and the biologic potential of the soil.

Overall, the proposed herbicide types and application rates are low enough to facilitate decay by soil microbes. The proposed herbicide usage would have a low risk for soils since the bulk of treatments focus along roads where soils are unproductive and soil communities are uniform. Adverse effects may occur where diverse native grasslands are treated with unselective herbicides and broadcast methods. These impacts are related to the short-term loss of non-target broadleaf forbs that support diverse soil communities. Soil attributes at greatest risk from chemicals include damage to soil organisms and erosion from removal of ground cover. A more extensive discussion of the individual herbicide properties can be found in Appendix E of the Noxious Weed EIS.

Below is a brief summary, for each chemical proposed for use detailing each chemical's behavior in soils, including permeability and drainage:

2,4-D: 2,4-D is degraded in soils primarily by microbes. Studies indicate that the size of the microbial population, the concentration of 2,4-D and the ratio of the two factors determine the 2,4-D degradation rates (Hemmett and Faust 1969). Soil conditions that enhance microbial populations (i.e. warm and moist) facilitate 2,4-D degradation rates (Foster & McKercher 1973).

Wilson et al. (1997) found that adequate soil moisture was the most influential parameter affecting the degradation rates.

Lag times of up to eight weeks during which 2,4-D degradation is slow, have been reported following the first application of 2,4-D to soil (Audus 1960). Most formulations of 2,4-D do not bind tightly with soils and have the potential to move down into the soil column. 2,4-D is considered to be highly mobile and is prone to move off site in surface runoff and subsurface flow (Tu et al. 2003). The EPA reports that 2,4-D is broken down into inert particles by soil microbial activity and that within 7 days following application, 2,4-D has low soil persistence (Tu,M, Hurd, C & J.M. Randall 2001). The half-life in soil is less than 7 days. Soil microbes are primarily responsible for its disappearance. Despite its short half-life in soil and in aquatic environments, the compound has been detected in groundwater supplies in at least five states and in Canada. Very low concentrations have also been detected in surface waters throughout the U.S (Weed Control Methods, The Nature Conservancy, April 2001).

Chlorsulfron: Chlorsulfron should not be applied to soils when they are saturated or when they are subject to periods of intense rainfall, as this chemical is degraded mainly through hydrolysis Drift potential is high during a surface inversion (Source- Specimen Label Telar DF (EPA Reg. No. 352-522).

Tank mix of 2,4-D and chlorsulfron should not be applied to saturated or coarse textured soils or when intense rainfall (summer thunderstorm) is likely to occur within 7 days of application. Both of these chemicals are highly mobile and can be transported by surface runoff into the streams and lakes.

Clopyralid: Clopyralid is relatively persistent in soil and is degraded by soil microbes. It is not susceptible to photo or chemical degradation. Clopyralid does not bind strongly with soil particles. Once it has been applied, it rapidly disassociates, becoming extremely soluble in water and does not bind strongly with soil particles (Shang and Arshad 1998). This means that Clopyralid has the potential to be mobile, and could contaminate ground and surface waters via leaching. The average half-life of Clopyralid is one to two months but can range from one week to one year depending on the soil type, temperature, and rates of application. Clopyralid should not be applied to areas where soils are very permeable and the water table is shallow. Because Clopyralid is highly soluble in water, there is a potential for it to move off site during summer thunderstorm activity where there are high-intensity and short-duration precipitation events (Tu et al. 2003). From the specimen label for Transline, Clopyralid should not be applied where soils have a rapid to very rapid permeability or the depth to ground water is shallow (EPA Reg. No. 62719-259 revised 07-26-99).

Dicamba: Dicamba is not adsorbed by most soils. It is highly mobile and is moderately persistent in most soils. Dicamba has a half-life of 1 to 6 weeks in soil with degradation due to soil microbial activity. The rate of degradation of Dicamba is slower at low temperature and low soil moisture (Pesticide Fact Sheet prepared by Information Ventures, Inc.). Dicamba can be introduced to groundwater and surface water during application or in combination with 2,4-D on sensitive or shallows soils, which can introduce the active ingredient into the ground water table.

Glyphosate: Glyphosate is highly water-soluble but unlike most water-soluble herbicides has a very high adsorption capacity. Once Glyphosate contacts soil it is rapidly bound to soil particles rendering it essentially immobile (Roy et al. 1989*a*, Feng 1990).

Unbound or free Glyphosate molecules are degraded at a steady and relatively rapid rate by soil microbes. Because glyphosate binds strongly to soils, it is unlikely to enter waters through surface or subsurface runoff except when the soil itself is washed away by runoff, and even then, it remains bound to soil particles and unavailable to plants (Rueppel et al. 1977, Malik et al. 1989).

Most glyphosate found in waters likely results from runoff from vegetation surfaces, spray drift and direct overspray. Feng et al (1990) found that 10-meter (32.8-foot) buffer zones limited unintentional effects (Tu et al. 2003).

Triclopyr: Microbial metabolism accounts for a significant percentage of Triclopyr degradation in soils. In general, warm moist soils with a high percentage of soil organic matter will support the largest microbial populations and the highest rate of metabolism. The reported half-life of Triclopyr in soil varies from 3.7 to 314 days depending on specific soil and environmental conditions (Newton et al. 1990). Coarse textured soils that are highly permeable may therefore retain Triclopyr but most studies have found that Triclopyr does not tend to move in significant quantities below the top 15 cm (0.5 inches) of soil (Norris et al. 1987, Newton et al. 1990, Stephenson 1990, and Johnson et al. 1995a).

From the specimen label for Garlon 3A (EPA Reg. No. 6271937) treatment of aquatic weeds can result in oxygen depletion or loss due to the decomposition of dead plants. To minimize this hazard, do not treat more then one-third to one-half of the water area in a single operation.

Garlon 4 includes kerosene as an inert ingredient. Triclopyr is active in the soil and adsorbed by clay particles and organic matter in the soil. Microorganisms degrade Triclopyr and it has a relatively short half-life of 46 days under ideal conditions (warm moist soil conditions). It is highly mobile and is moderately persistent in most soils. The rate of degradation of Dicamba is slower at low temperature and low soil moisture (Pesticide Fact Sheet prepared by Information Ventures, Inc.).

Tank Mixes: 2,4-D is proposed to be applied in combination with Chlorsulfron as **Tank Mix #1** or in combination with Dicamba as **Tank Mix #2**. 2,4-D is identified by the EPA as having characteristics that make it an herbicide with a high leaching potential and very water-soluble thereby making it subject to movement by runoff when applied adjacent to or near water.

Chlorsulfron should not be applied to soils when they are saturated or when they are subject to periods of intense rainfall. Tank Mix #1 is highly mobile and is moderately persistent in most soils.

Application of Banvel (dicamba) or in combination with 2,4-D on sensitive or shallows soils can introduce the active ingredient into the ground water table. Tank Mix #2 should not be applied to saturated or coarse textured soils or when intense rainfall (summer thunderstorm) is likely to occur within 7 days of application. Both of these chemicals are highly mobile and can be transported by surface runoff into the streams and lakes. 2,4-D is proposed to be applied within the RCAs either alone or in combination with Dicamba as a Tank Mix#1 or in combination with chlorsulfuron as Tank Mix #2.

Chlorsulfuron should not be applied to soils when they are saturated or when they are subject to periods of intense rainfall. Tank mix of 2,4-D and chlorsulfuron should not be applied to saturated or coarse textured soils or when intense rainfall (summer thunderstorm) is likely to occur within 7 days of application. Both of these chemicals are highly mobile and can be transported by surface runoff into the streams and lakes (SERA. 2004 and 1999).

Dicamba is not adsorbed by most soils. It is highly mobile and is moderately persistent in most soils. Application of Dicamba or in combination with 2,4-D on sensitive or shallows soils can introduce the active ingredient into the ground water table. Clopyralid has been identified as extremely water-soluble and has a high potential for mobility and leaching into the soil profile. It is not approved for application on or near water.

Clopyralid should not be applied to areas where soils are very permeable and the water table is shallow. The usage of this herbicide in areas where soils are considered to be sensitive, shallow depth or where the water table is shallow may result in groundwater contamination. Because Clopyralid is highly soluble in water, there is a potential for surface waters to be contaminated if Clopyralid is applied directly to bodies of water or wetlands (Tu et al. 2003).

Triclopyr (Garlon 3A) has been identified for treatment of aquatic weeds associated with impounded waters (i.e. lakes, ponds and reservoirs) but not free flowing streams. This herbicide has properties and characteristics associated with chemicals detected in groundwater. The usage of this herbicide in areas where soils are considered to be sensitive, shallow depth or where the water table is shallow may result in groundwater contamination. Triclopyr binds to clay (fine textured soils) and organic matter and is highly mobile (SERA 2003f).

Herbicide Effects to Soil Organisms

The low application rates and type of herbicides proposed in general have a low impact on soil organisms. At high rates, Triclopyr (Garlon, Access) can affect soil microbes and may adversely affect some fungi and algae. Effects are short term and transitory since effects decrease with time as the herbicides degrade. Dicamba and 2,4-D may also affect mycorrhizal fungi at high rates. Functional groups of microbes that have similar metabolic pathways as the target weeds would be most sensitive to the herbicides. However, collective adverse effects of the proposed herbicides on soil microbes are hard to predict, given the diversity of the soil community and varying resistance to the particular herbicides. For example, some laboratory studies found glyphosate adversely impacted several types of microbes, although populations rebounded quickly (Tu et al. 2003). Similarly, Busse et al. (2001) found no long-term impact on microbial communities when using glyphosate on ponderosa pine plantations.

Ultimately, soil microbes facilitate the degradation of the herbicides by using the herbicides as growth substrate, co-metabolizing, polymerizating, accumulating, or altering the chemical structure by influencing the pH of the soil environment (Bollag and Liu 1998). The residency times shown in Table 14 are a gross collective function of average soil types, application timing and frequency, and finally the unique chemical structure.

Soil Cover

The treatment of sites with herbicides could also indirectly affect site productivity in the short term through changes in total organic production on site and annual input into the soil. Chemically treated plants would die and become incorporated into the soil as organic matter during the first years following treatment. Annual input in subsequent years would be limited by the number of non-target species interspersed between invasive plants or the rate at which vegetation returned to the site.

Physical Properties of Herbicides

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 can modify certain properties of herbicides such as mobility in soils and half-life (time it takes for half the amount of chemical present to breakdown). General characteristics for the proposed herbicides are displayed in Table 14. Many of the proposed herbicides are highly soluble in water (Table 14). In general, this is often taken as an indicator of the mobility of the chemical in soils. There are exceptions, however. Glyphosate, while having a high solubility, also binds tightly with soil particles, and because of this it has low mobility. Herbicides with high mobility potential and long half-lives have a greater potential for leaching into near-surface ground water.

Water

Streams are complex and dynamic systems that reflect the balance between stream flow, sediment input and substrate/bank composition. As stated on page 12, riparian condition and water quality are the two elements potentially affected by invasive plant treatments.

General Effects of Non-herbicide Treatment

Physical treatments generally consist of grubbing, digging or pulling weeds. If weed seeds are present, the weeds would be bagged and taken off site. Removal of soil cover would be very small under these circumstances. However, there could be small localized areas of erosion and subsequent sediment input to the stream. Such effects would be transitory and too small to measure.

Pulling weeds along stream banks could also destabilize the banks in highly localized areas. In general, weeds provide very little stabilization for stream channels. Any localized effects would be expected to last only a season until vegetation becomes reestablished at these sites. Other physical treatments within riparian areas could accelerate sediment delivery to streams through ground disturbance. Most of the treatment areas are previously disturbed roadways and trails so additional ground disturbance would not be a significant change from the existing condition. Modification of surface ground cover can change the timing of runoff, but given the small areas of treatment, any changes would be transitory and too small to measure.

General Effects of Herbicide Treatments

None of the alternatives have the potential to influence stream flow and channel morphology due to the small portion of any watershed that would be treated. Treating invasive plants would improve riparian stability where invasive plants have colonized along stream channels and out-competed native species. All invasive plant treatments carry some risk that removing invasive plants could exacerbate stream instability; however, the restoration plan accounts for these areas and prescribes mulching, seeding and planting as needed to revegetated riparian and other treated areas.

Table 14. Herbicide properties compiled from the Region 6 Invasive Plant FEIS (USDA Forest Service 2005b), SERA risk assessments and The Nature Conservancy Weed Manual (Tu et al. 2003)

Herbicide	Toxicity to Soil Microbes	Potential Mobility[1]	Water Solubility[1]	Degradation path and half life[2]	Activation Mechanism[2]
2,4-D	Effect to 3 species of ectomychorrhizal fungi in laboratory experiments (Estok et al., 1989) Inhibits growth of some soil algae at 1 mg/L. Mycorrhizal fungi less sensitive; little effect at 10 ppm, substantial inhibition at 1000 ppm. (SERA, 1998, 2,4-D)	Highly mobile	High to low depending on form	Soil microbes 7 days reported by EPA 1-30 days in SERA risk assessments	Plant growth regulator
Chlorsulfuron	Low	High Very high in clay soils	Very High	Hydrolysis 37-168 days	Acetolactate synthesis inhibitor (Selective: controls broadleaves and some grasses)
Clopyralid	Low	Very high especially in sandy soils	High	Soil microbes 14 to 29 days	Plant growth regulator (Very selective to broadleaves; post emergent)
Dicamba	Transitory effects at high concentrations	High	High	Soil microbes 1-30 days	Plant growth regulator
Glyphosate	Low	Low	Very High	Soil microbes 30 to 60 days	Inhibits 3 amino acids and protein synthesis (Non-selective; quickly absorbed by leaves with rapid movement through plant; no root absorption)
Triclopyr	Inhibits algae at low rates Toxic to fungi at high rates.	Very High	Medium	Soil microbes 46 days	Plant growth regulator (Absorbed thru roots, foliage and green bark)

1 Mobility and water solubility categories from Shauwna Bautista R6 invasive plant specialist and are general breakdowns not a definitive classification.
2 Deschutes Ochoco Invasive Plant EIS Soils Report, 2006.

A primary issue for this analysis is the potential for herbicides to enter streams and impact aquatic organisms. This section describes how project design standards minimize the possibility that herbicides would enter water and impact water quality.

Drift, Runoff and Leaching

The routes for herbicide to contaminate water are direct application, drift into streams from spraying, runoff from a large rain storm soon after application, and leaching through soil into shallow ground water or into a stream. This section addresses each of these delivery routes.

No direct application of herbicide to water is intended in any alternative. No emergent plants would be treated under any alternative.

Effects from drift, runoff, and leaching were considered in the herbicide risk assessments, assuming broadcast treatments occurring directly adjacent to streams. The Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model was used to estimate the amount of herbicide that may potentially reach a reference stream via runoff, drift and leaching in a 96-hour period, assuming broadcast treatments on a 50-foot strip along about 1.6 miles of perennial stream. SERA risk assessments evaluated the hazards associated with each herbicide based on the concentrations of herbicide predicted by the GLEAMS model using these parameters. The risk assessment worksheets used in this project (SERA worksheets) overestimate the herbicide concentrations that would plausibly enter most streams from this project for three reasons: 1) The worksheets don't take into account a "no herbicide use" area within a Riparian Conservation Area; 2) The estimate for the rainfall is generic and is not adjusted to the dry conditions found on most of the Forest; 3) The model assumes broadcast treatments along the stream versus the wicking and targeted spray treatments proposed under this project. The results from the SERA worksheet are found below in Table 15.

Wicking and targeted spray treatments allowed with this project are inherently far less likely to deliver herbicide to water than broadcast treatments because the herbicide is applied to individual plants, so drift, runoff, and leaching are greatly minimized. Small amounts of some herbicides can trans-locate from the plant to the soil or an adjacent plant, but the concentrations of herbicide that may be delivered to streams from this mechanism is much less than GLEAMS predictions (P. Adams 2007), which models broadcast spraying of herbicide next to the stream with no buffer between the spraying and the stream.

Monitoring Studies

Berg's (2004) compilation of monitoring studies on herbicide treatments with various buffer widths showed that any buffer helps lower the concentration of herbicide in streams adjacent to treatment areas. In California, buffers between 25 and 200 feet generally had no detectable concentrations of herbicide in monitored streams with detection limits of 1-3 mg/m^3 (ibid).

The USGS, in partnership with the Oregon Department of Transportation, studied runoff of herbicides along roads (Wood 2001). The study was conducted on runoff associated with several herbicides (including glyphosate) along a road in western Oregon simulating rainfall at 1/3 inch an hour at 1, 7 and 14 days after treatment. Samples were collected at the shoulder of the road and found concentrations of nearly 1,000 parts per billion (ppb) of glyphosate on the road shoulder that could potentially leave the road shoulder. In the fall, the road was again sprayed and the ditch line of the road was checked during natural rainstorms for three months. Glyphosate was not found at the shoulder, ditch line, or stream. This study indicates that the greatest risk of herbicides moving off site is from large storms soon after herbicide application.

Table 15. Herbicide and application rates with peak water concentrations generated in SERA worksheets (worksheets can be found in the project record)

Herbicide	Range of Application Rates (per acre)	Range of water concentration rates (per pound per acre)	Range of Water concentrations (mg/l)	Average water concentration (mg/l)
Chlorsulfuron	0.56-1 ounce	0.01-0.2	0.007-0.0125	0.0047
Clopyralid	0.13-.25 pound	0.005-0.07	0.00065-0.0175	0.005
2,4-D	0.5 to 2 pounds	0.13-0.42	0.065-0.84	0.22
Dicamba	0.25 to 2 pounds	0.00006-0.01	0.000015-0.02	0.003
Glyphosate	0.75 to 3.75 pounds	0.001-0.4	0.001-1.5	0.05
Triclopyr	0.5 to 1.5 pounds	0.001-0.4	0.0005-0.6	0.09

Berg (2004) reported that herbicide applied in or along dry ephemeral or intermittent stream channels may enter streams through runoff if a large rainstorm occurred soon after treatment. This risk is minimized if intermittent and ephemeral channels are buffered as would occur under the action alternatives (ibid.). If a large rainstorm occurs after herbicide application, sediment contaminated by herbicide could be carried into streams. As most herbicide application occurs in the late spring through the early fall, which is the driest time of the year, the probability of a large rainstorm soon after application of herbicides is low at any particular site.

Region 5 Monitoring

Water quality monitoring in R5 from 1991 to 1999 occurred on multiple projects in the Regional Forests. Most projects were for control of non-conifers in conifer plantations. The Angeles monitoring included an invasive weed project within riparian areas (USDA Forest Service 2001).

Glyphosate was used in four Forests on eight projects. With buffers as small as 10 feet, Glyphosate was found to be non-detectable in collected samples with levels of detection between 9 and 24 parts per billion (ppb; some samples gave no level of detection). On the Angeles National Forest, Aquatic Glyphosate was used within the channel for control of aquatic plants. In this instance, one out of 12 samples had a concentration above the level of detection of 9 ppb. This sample had 15 ppb a quarter of a mile downstream of the treatment site (USDA Forest Service 2001).

Triclopyr was used on five projects on three Forests. Where Triclopyr was used with buffers of 10-15 feet, there were 3 projects where detections occurred. The levels of detection ranged between 0.1 to 1 ppb where specified. One detection of 82 ppb was determined to be from not establishing a buffer on an ephemeral channel. The other detection was on a project with buffers of 10 feet; it had detection during winter storms of 0.63 ppm (parts per million) and 0.6-0.7 ppm. Another project with buffers of 15 feet had a single detection of 1 ppb (USDA Forest Service 2001).

Accidental Spill

Concentrations of herbicides in the water as a result of an accidental spill depend on the rate of application and the stream ratio of surface area to volume. The persistence of the herbicide in water depends on the length of stream where the accidental spill took place, velocity of stream flow, and hydrologic characteristics of the stream channel. The concentration of herbicides would decrease rapidly downstream because of dilution and interactions with physical and biological properties of the stream system (Norris et al.1991).

Accidental spills are not considered within the scope of the project. Project design standards would reduce the potential for spills to occur, and if an accident were to occur, minimizes the magnitude and intensity of impacts. An herbicide transportation and handling plan is a project requirement. This plan would address spill prevention and containment.

Lakes, Wetlands and Floodplains

Herbicides affect lakes and wetlands differently than streams. Dilution by flow or tributary inflow is generally less effective in lakes. Dilution is partially a function of lake size, but dilution could be rapid in small lakes with large water contributing areas. Decreases in herbicide concentration in lakes, ponds, and other lentic water bodies are a function of chemical and biological degradation processes or preferential adsorption of the herbicide into the lake sediments rather than from dilution. As no emergent treatments are proposed, the primary pathways for herbicide to enter lakes would be from drift or runoff.

Some invasive plants may grow in wetlands or near lakes and reservoirs. A large rain event after treatment could carry herbicide into water resulting in minor amounts of herbicide contacting surface water.

Emergent Vegetation

There is no treatment of emergent vegetation proposed under any alternative.

Municipal Watersheds

There are no municipal watersheds within 13 miles downstream of the project area. However, the Fort Bidwell Indian Community water source would be protected under an agreement between the Forest and the Tribe. Design standard 19b requires that no herbicide be used for noxious weed treatments in the area above the water source. A map of this area of concern is found in Appendix N of the Modoc Noxious Weed EIS.

Comparison of Alternatives

Alternative 1 – No Action

Direct and Indirect Effects to Soils

There could be a short-term (1 to 2 years) reduction in soil cover for the areas treated. This localized reduction in cover would increase treated areas vulnerability to soil erosion. The effects would be minimal given the poor quality of groundcover provided by the invasive species proposed for treatment, the scattered nature of the treatments and the small amount of land treated.

Adverse impacts to soils may occur where some noxious weeds are left to populate. Alternative 1 would only treat 20 to 30 acres per year. Specific changes to soil nutrient regimes are associated with large spotted knapweed infestations (Lejeune and Seastedt 2001), allelopathic influences

(Bais et al. 2003), in addition to changes in surface hydrology where the plant communities are moved from bunchgrass-dominated to taproot-forb-dominated (Lacey 1989). Similarly, the influx of cheatgrass (*Bromus tectorum*) can alter soil dynamics with changes in structure, nutrient pulses and soil moisture status (Norton et al. 2003). These changes may be coincident with the long-term shifts from perennial grasslands to annual grasslands as documented in California (D'Antonio and Vitousek 1992). Other noxious weed species may have similar impacts as demonstrated by Vinton and Burke (1994) where fertilization caused long time shifts to favor weedy forb species.

Adverse tradeoffs with Alternative 1, in this case the risk of no treatment, would be highest for *Centaurea spp.* and others that can spread into relatively undisturbed grasslands (see Tyser and Key 1988). These tradeoffs are weighed by addressing spread rate versus the impact from treatment (D'Antonio et al. 2004), especially in regards to affecting non-target plant species (see Ortega 2005b).

Cumulative Effects

This alternative is covered under other NEPA projects. Treatments would occur on an extremely small percentage of any watersheds in the Project Area. Direct and indirect effects are so insignificant and temporary that treatment under No Action could not plausibly contribute to significant cumulative effects.

Alternative 2

Direct and Indirect Effects to Soils

Thirty-one acres are proposed for physical treatment only. Effects of physical treatments on small scattered treatment sites would be similar to those discussed under general effects and are expected to be minor and transitory as the treatment sites are small and dispersed across the Forest.

Herbicide treatments only are proposed for 907 of the total 6,908 acres inhabited by invasive plants (Table 13). Up to 5,961 acres would be treated with either physical or herbicide methods. Approximately 300 to1,500 acres of treatment are expected to occur in any one year do to budget constraints.

One risk from herbicide use is from herbicide contact with soil affecting soil productivity by inhibiting the growth of soil organisms. Dicamba, Triclopyr and 2,4-D all have potential to inhibit soil organisms at high rates, with less inhibition at normal application rates. These changes are temporary as the organisms rebound and the herbicides degrade.

This risk would be minimized by design standard 29, which requires direct spray to the plant or patch of plants or to wick the herbicide directly onto the plant. This would minimize drift off site as well as minimize the amount of herbicide in contact with soil. This target spray technique also avoids spraying desirable vegetation, leaving it as a seed source to reseed treated areas.

Approximately 90 percent of the sites are within a quarter mile of roads. Soil communities along roads are largely uniform and disturbance oriented; therefore, impacts to soil organisms are not anticipated.

DS-01 and DS-22 requires that the annual treatment plan be provided to the Forest soil scientist to review and field verify sites to protect soils. The design standards use properties of the soils to control movement of herbicides off-site. Design standard 23 requires that herbicides with a high

leaching potential not be used on sensitive or shallow soils (see Appendix A). (Appendix A is part of the Watershed and Soils specialist report, found in Appendix T, Watershed and Soils, of this final EIS.) This would also protect groundwater from herbicide contamination. If possible, treatments would occur during times of the year when soils are driest.

Cumulative Effects

Most of the five herbicides used under this alternative do not negatively affect soil organisms at typical application rates and would not affect soil productivity. Cumulative soil productivity is protected due to the fact that the application methods proposed under design standard 29 requires a targeted spray or wicking directly onto the plant to minimize herbicide contact with soil protecting soil organisms and therefore soil productivity. Soil cover is protected by design standard 20 rehabilitation activities. Design standard 14 requires that physical disturbance or herbicide treatments are limited to no more than 15 percent of any 6th-field watershed to minimize cumulative effects from treatments.

Alternative 2 is unlikely to have significant effects to soil and therefore is unlikely to approach a threshold of concern, so would not contribute to significant cumulative effects. No adverse cumulative effects are expected from implementation of this alternative.

Alternative 3

Direct and Indirect Effects to Soils

This alternative includes only the physical methods of controlling invasive plants discussed above under general effects of physical treatment. As rhizomatous species are not effectively treated without herbicides, 47 sites occupying 916 acres would be dropped and not treated allowing for the further spread of these invasive plants.

Up to 494 sites (5,993 acres) would be treated with physical methods over a 5-year time period. There would be more soil disturbance under this alternative than under Alternative 2 as the primary methods are pulling, digging, grubbing and hoeing to remove invasive species. This is still a small amount of disturbance in any one area as 94 percent of the sites are less than 1 acre in size (Table 2). The sites are generally not a solid infestation of invasive plants but are often a mixture of invasives and more desirable plants. Only the invasive weeds would be removed, leaving the desirable vegetation for soil cover to protect the site from erosion, as well as for a seed source. The effects of treatment at any site are expected to be short-term, lasting only a year or so until the site is revegetated.

Cumulative Effects

Treatments are primarily pulling noxious weeds, which is a fairly low impact activity. Treatments would take place on between 300 and 1,500 acres a year. Given the cost of treating by pulling weeds, probably the number treated would be closer to 300 acres a year. These acres would be scattered across the Forest. Design standard 14 requires that physical disturbance or herbicide treatments are limited to no more than 15 percent of any 6th-field watershed to minimize cumulative effects from treatments.

Alternative 4

Direct and Indirect Effects to Soils

The effect of this alternative would be the same as for Alternative 2 except this alternative would be implemented over a 10-year timeframe and would include Early Detection –Rapid Response.

This would allow for a longer time period to control the weed infestations and would give the Forest the flexibility to treat 100 acres of new infestations a year with a cap of 200 acres of new infestations treated for the life of the project.

Cumulative Effects

Cumulative effects would be the same as discussed under Alternative 2.

Alternative 5

Direct and Indirect Effects to Soils

Overall, there would be fewer disturbances with Alternative 5 than for Alternative 3 because fewer acres would be treated. A total of 480 acres would be treated out of the 6,908 acres of inventoried weeds. All the sites would receive some treatment. Nine sites would receive only limited treatment. These sites are the dyer's woad site (5,658 acres) of the larger common crupina site (159 acres), the Dalmatian toadflax site (850 acres) and seven smaller sites of rhizomatous noxious weeds (913 acres).

Most of the treatment effects are the same as discussed under general effects of physical treatments and those discussed under Alternative 3. However, this alternative has more physical treatments available than Alternative 3. These treatments are generally not soil-disturbing activities and they include mulching/tarping and cutting the plant, including using a weedeater.

This alternative includes potentially using goat grazing for five sites totaling 41 acres. The sites range in size from 4 to 25 acres and are occupied by musk thistle or scotch thistle. By itself, it will not eradicate weeds but when combined with other treatments can be effective at controlling invasive species. Grazing can be effective in reducing a large infestation or eliminating a smaller infestation (Tu 2003). Potentially, goats would be used on the site first and herbicide could be used for follow-up on the smaller number of remaining plants.

Early Detection-Rapid Response (for 100 acres a year with a project cap of 200 acres total) is allowed for sites similar to those presently included for treatment under this alternative. Design standard 22 requires that the Forest soil scientist or hydrologist annually verify treatment locations to ensure proper design standards are used for each site.

Cumulative Effects

Cumulative effects are similar to those discussed under Alternative 3. As no significant direct or indirect effects are expected under this alternative, no significant contribution to cumulative effects is expected.

Alternative 6

Direct and Indirect Effects to Soils

Alternative 6 treats only 541 acres, far fewer acres than proposed for Alternatives 2 and 4. Therefore, there would be less overall disturbance under this alternative. Up to 541 acres would be treated under this alternative. As with the previous alternative, the three largest sites would have only the perimeter of the sites treated. The physical treatments would be the same as discussed above under Alternative 5. One hundred and sixteen sites totaling 19 acres would be treated with physical methods with 371 sites totaling 116 acres treated with either physical methods or herbicide.

This alternative allows use of chlorsulfuron. This herbicide has low potential to affect soil organisms. This herbicide targets broadleaf vegetation leaving grasses unaffected. This alternative also allows the use of two mixtures of herbicides. As noted under General Herbicide Effects dicamba, Triclopyr and 2,4-D have temporary effects on soil organisms. Herbicide only is proposed for 46 sites on 65 acres. DS-22 require the Forest Soil Scientist field verify treatment locations. DS-24a restricts use of herbicides (except glyphosate) to 1 acre per 6th field a year on sensitive or shallow soils. This could allow minor amounts of herbicide to leach into shallow aquifers. This effect is likely to be small given the dry climate and the small acreage of this type of soils proposed for treatment.

This alternative treats fewer acres with both herbicides and with physical treatment than the other alternatives that allow herbicide use. All treatment sites would be evaluated for rehabilitation on a site-by-site basis. Given the few acres treated, the scattered nature of the treatments, and the use of design standards, this alternative is unlikely to have noticeable effects.

Cumulative Effects

Cumulative effects are similar but more limited than those discussed under Alternative 2.

Effects to Water Resources

Alternative 1

Direct and Indirect Effects

Under this alternative, no Forest wide management of invasive plants would occur. Under this alternative, 20 to 30 acres would be treated by physical means each year.

Invasive plants would continue to grow on sites where their treatment is currently not authorized by NEPA analysis. Invasive plants are often less effective for stream bank stabilization than deeper rooted native plant species. Most invasive plants also provide less stream shading than native hardwoods and conifers.

Alternative 2

Direct and Indirect Effects

Up to 150 acres of treatment, including chemical treatment, could take place in stream RCAs. In reality, most of these areas have only discontinuous infestations of invasive plants, but, as acres of infestations change year to year; analysis is done as if all the land within a treatment area is infested.

None of the treatments are extensive enough under any alternative to affect peak flows, low flows, or water yield. Methods used for treatment would have negligible effect on water infiltration into soil and associated surface runoff as discussed in the general effects section and the soils section above. No 5th-field watershed has more than 2.5 percent proposed for treatment and most have well under 1 percent (Table 6). This amount is much too small an area to show effects to flows from treatment.

The sites identified below in Table 16 are the larger invasive plant sites on the Forest. All the sites identified are listed in Appendix B of the Modoc Noxious Weed EIS.

Table 16. Larger invasive sites on the Forest

Species	ID Number	Town-ship	Range	Section	Site Acres	Acres Within RCAs	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Canada Thistle	WM009CIAR4	T47N	R15E	27	9.99	9	PT-H	NT	PT-H	LT	H
Crupina	BV001CRVU2	T40N	R10E	36	158.65	35	P	P	P	LT	LT
Dalmatian Toadflax	WM003LIDA	T46N	R14E	13	44.57	27.2	PT-H	NT	PT-H	LT	H
Dalmatian Toadflax	BV006LIDA	T42N	R6E	28	850.82	98.4	PT-H	NT	PT-H	LT	LT
Dyer's woad	DH013ISTI	T43N	R7E	7	5657.75	1.4	P or H	P	P or H	LT	LT
Dyer's woad	WM002ISTI	T46N	R15E	5	12.65	5.1	P	P	P	P+	P+ or H
Dyer's woad	WM004ISTI	T47N	R15E	32	12.27	2.4	P	P	P	P+	P+ or H
Scotch Thistle	BV284ONAC	T39N	R10E	8	16.3	15.9	P	P	P	G or P+	G or P+ or H
Scotch Thistle	WM004ONAC	T45N	R15E	14	9.72	0	P or H	P	P or H	G or P+	G or P+ or H

P - Physical: hand pulling, hoeing, grubbing
P+ - Physical+: hand pulling, hoeing, grubbing, clipping seed head or plant, trimming with weedeater, mulching/tarping
H - Herbicide
NT - No Treatment
LT - Limited Treatment: perimeter treatment only to contain infestation
G - Goat Grazing
PT-H - Partial Treatment of site with herbicides

Generally, small areas would be treated along streams. Thirty-one acres of physical treatment are proposed within 10 feet of streams in RCAs scattered across 161 sites. Treatment would be discontinuous and limited at any one site. As most invasive plants provide little shade, removal of these plants is unlikely to have any measurable effect to stream temperature. Where manual methods remove invasive plants near streams, there could be minor loss of ground cover and soil disturbance leading to erosion and a minor localized increase in fine sediments particularly if

vegetation is removed from stream banks. This increase is not considered significant as it would only last a season or two until vegetation became reestablished. Many treatment sites are small and would reseed naturally with existing native vegetation. Restoration would occur on sites greater than ¼ acre lacking native vegetation seed source to ensure revegetation occurs and erosion is controlled.

No herbicide would be used within 10 feet of streams. Aquatic glyphosate, licensed for use in water, would be used within RCAs of 150 feet for intermittent streams and 300 feet for perennial streams. Glyphosate tends to bind strongly to soils and would move only if the soil particle was carried into water. The spray methods used would be targeted spray or hand application of herbicides to the target plants. Drift would be minimal under these circumstances and risk to native riparian vegetation is small. Spot treatments would also remove less vegetation than broadcast treatments so there is less potential for erosion. There are approximately 40 acres of treatment within 10 feet of water scattered across the Forest. Under this alternative, only the nonrhizomatous acres would be treated with manual methods.

The other herbicides would not be used within RCAs. Buffers of 150 feet on intermittent streams and 300 feet on perennial streams would protect water quality. These buffers are considered adequate to minimize herbicide concentrations in water because, buffer studies in forested areas (Berg 2005, USDA Forest Service 2001) show that buffers greater than 25 feet commonly lower herbicide concentrations below any threshold of concern and often below detectable limits. For 2,4-D, a 1,000 foot buffer from streams is required under design standard 17.

Project design standards also minimize the chance of herbicides reaching streams or wetlands through drift, runoff, or leaching into soils. Design standard 23 prohibits use of the more mobile herbicides on shallow or sensitive soils. This would protect groundwater, particularly in areas of the Forest where shallow soils cover fractured bedrock.

Where physical methods remove invasive plants near streams, there could be minor loss of ground cover and soil disturbance leading to localized erosion, and a minor localized increase in fine sediments, particularly if vegetation is removed from stream banks. This increase is not considered significant as it would only last a season until vegetation became reestablished. Many treatment sites are small and would reseed naturally with existing native vegetation. Where more than a ¼ acre site has bare soil from treating invasives, design standard 20 requires the site be assessed for rehabilitation. Rehabilitation would allow sites lacking a native vegetation seed source to be revegetate to control erosion.

Specific Sites

Some of the larger sites were looked at more closely for effects. These sites are listed in Table 16. Alternative 2 allows only aquatic glyphosate within RCAs and gives a 10-foot, no-herbicide-use buffer to both perennial and intermittent streams. Under Alternative 2, three of the nine treatment areas shown in Table 16 would be treated with aquatic glyphosate outside the 10-foot buffer. Glyphosate adheres well to soil and is the least mobile of the herbicides proposed under this project. The large Common Crupina site, the Scotch Thistle site with almost 16 acres in RCAs and two Dyer's Woad sites of approximately 12 acres apiece would all be treated with physical treatments.

Site WM009Ciar4 is infested with Canada Thistle. This site is in section 27 just south of Mill Creek. The site is almost entirely within either a lake or spring RCA or an intermittent stream RCA. The entire polygon is approximately 10 acres with 9 acres within the RCA of a lake, spring,

or seasonal stream RCA. This site is within the Lahonton Regional Waterboard, which allows only aquatic glyphosate application by wicking directly to the plant at least 10 feet from the stream or water feature. Given these tight constraints, it is unlikely that adverse effects would occur from this treatment.

The large dyer's woad site (DH013ISTI) would be treated either physically or with chemicals. This site has an intermittent drainage to the south side of the treatment area. This treatment is unlikely to affect water quality because only 1.4 acres of the site is within the seasonal stream RCA.

For the large Dalmatian toadflax site,(BV006LIDA) the 850 acre site has a series of small ponds, wetlands and meadows scattered around the site. The individual RCAs range in size from the approximately 35-acre meadow to a 1-acre lake. This area has 64 acres within RCAs with a set of small lakes and 34 acres within a meadow. Approximately 14 acres are in the inner 100 feet of the RCAs. This site receives an average of 20 inches of precipitation a year. Outside the RCA, any of the other herbicides can be used with 2,4-D having an additional buffer of 1,000 feet from the high water mark.

Given that only aquatic glyphosate would be used in RCAs and 2,4-D has a 1,000 foot buffer from use near water, it is impossible for the concentrations to approach those calculated in Table 15 for any herbicide except glyphosate. Glyphosate application was modeled with the GLEAMS-Driver model with site-specific parameters for a small lake and a small stream (Table 17).

The parameter changes for this model included a yearly rainfall of 21 inches a year and a 16-acre treatment site. This is a conservative model because it models as if broadcast spray occurred up to the edge of the stream and the highest possible application rate was assumed. In reality, there is a 10-foot, no-herbicide buffer, and no broadcast spraying occurs. Instead, the herbicide is applied directly to the plant by wicking it onto the plant. This would keep herbicide from contacting either desirable plants or contacting soil. Modeling results in Table 17 show water concentrations below any level of concern. Given these results and the conservative use of herbicides with this alternative, adverse effects from herbicide use are unlikely under this alternative.

Table 17. GLEAMS-driver model results with site-specific climate and acre data

Herbicide	Acres treated	Yearly Average Rainfall (inches)	Low Herbicide Concentration in Water (mg/l)	Median Herbicide Concentration in Water (mg/l)	High Herbicide Concentration in Water (mg/l)	EPA Drinking Water Maximum Contaminant level (mg/l)	Modeled Feature
glyphosate	16	21	0.014	0.015	0.025	0.7	stream
glyphosate	16	21	0.0091	0.011	0.012	0.7	pond

Roads

There are 26.6 miles of road within treatment areas. Of these, only 3 miles (11 percent) are within RCAs. There is an additional 0.8 miles of road within RCAs associated with ponds, lakes and wetlands within treatment areas. Roads and their associated ditch lines are often connected to streams and during storm events can carry herbicide to streams. However, as only targeted spray

techniques would be used, very little herbicide applied to the soil would be available for transport to streams.

Lakes, Wetlands and Floodplains

There are approximately 128 acres of treatment proposed within RCAs of wetlands, lakes, ponds, or reservoirs on the Forest. The main invasive plants found at these sites are Dalmatian toadflax (98.4 acres), Canada thistle (10 acres) and Scotch thistle (8.3 acres).

Most of these treatment acres are near the High Reef area just south of Lava Lake in the largest treatment area for Dalmatian toadflax. There are 98 acres of noxious weeds in eight polygons ranging in size from 0.3 acres to 34 acres. These are all part of a large 851-acre treatment area of Dalmatian toadflax. Under this alternative most of this site would be treated with herbicides except for the infestations within 10 feet of the high water mark. Because Dalmatian toadflax is a rhizomatous species, these acres would not be treated. This leaves plants for reinfestation of the site. The infested areas 10 feet away from water would be treated with aquatic glyphosate within the RCA and potentially other herbicides outside the RCA. Glyphosate is the herbicide that most strongly adheres to soil and is unlikely to move into water in any significant amounts. Even where soil particles move into water the glyphosate preferentially stays on the soil particle (SERA 2003b). As only aquatic glyphosate can be used with the RCAs, it is unlikely that the other herbicides would be of concern for water resources.

While the design standards make it highly unlikely that herbicide concentration in water would reach a level of concern, high rainfall soon after application could deliver herbicide to a lake or pond. To model this scenario, the risk assessment worksheet (SERA worksheet) was run for specific rainfall for glyphosate (only herbicide that is allowed within RCAs). No concentrations of concern were reached for any herbicide Table 17. Use of design standards discussed above further lowers potential for higher concentrations of herbicides near the lakes. Therefore, treatments are unlikely to affect functioning of wetlands or water bodies or to contribute to significant adverse effect on beneficial uses.

To control the infestation, the treatments would continue over several years, with fewer acres needing treatment each year. Wetlands would be treated using non-herbicide methods where such treatments are likely to be effective.

Alternative 3

Alternative 3 uses only physical treatments. Under this alternative rhizomatous species would not be treated because physical methods are not effective on these species. There would be more ground disturbance under this alternative than under Alternative 2.

Direct and Indirect Effects

Under this alternative, up to 494 sites totaling 5,993 acres could be treated over 5 years. The 47 sites (916 acres) of rhizomatous infestations would not be treated. The primary treatments would be pulling, hoeing, and grubbing weeds. Within 10 feet of water, there are 31 acres at 161 sites of potential physical treatment. Physical treatment close to water is more likely to lead to additional sediment input to streams that treatment farther from the streams.

Alternative 3 increases the risk of trampling and instability of stream banks due to its reliance on non-herbicide treatments, particularly in areas where invasives grow directly along stream banks. This would be a short-term effect until revegetation occurred. The risk of long-term adverse effects from these treatments is low. Invasive plants provide little shade; therefore, removing

them would not lead to a measurable change in temperature. In the long term, temperature would be improved on streams currently impacted by invasive plants. The treatments proposed are unlikely to result in significant amounts of decaying plants or nutrients entering a stream at one time, and therefore, no measurable effect to oxygen levels is anticipated.

Alternative 4

Direct and Indirect Effects

The effects from treatment under this alternative are the same as for Alternative 2 except that EDRR could take place under this alternative and treatments would occur over a 10 year timeframe.

Alternative 5

The effects of this alternative are the same as for alternative 3 except that this alternative includes additional physical treatments, use of grazing and Early Detection-Rapid Response. The additional physical treatments include cutting weeds, mulching, and tarping. These are not considered ground disturbing and would have minimal effects to treated sites.

Grazing is proposed for 5 sites including two Scotch thistle sites shown in Table 16. These sites are approximately 10 and 16 acres in size. The 10-acre site is dry but the 16-acre site is within the RCA of a seasonal stream. As long as the goats are moved in a timely manner, using goats for grazing noxious weeds can be an effective way to weaken or kill plants to make the site smaller for further treatment with other methods (Tu et al. 2003).

Alternative 6

Alternative 6 allows the most flexible use of herbicides. It includes the use of chlorsulfuron and herbicide mixtures. Mix 1 is Dicamba and 2,4-D and Mix 2 is Chlorsulfuron and 2,4-D. Alternative 6 proposes smaller stream buffers than alternatives 2 and 4 (Table 12).

Glyphosate is the only herbicide proposed for use when spraying within 10 feet of bankfull along stream channels. Glyphosate is highly water-soluble but because it adheres tightly to soils is unlikely to be carried into a stream unless the soil particle is carried into the stream. This is unlikely to happen during the late spring or summer when herbicides would be applied because there is less rain in the summer and more vegetation growth to hold soil particles in place. However, large thunderstorms capable of moving sediment occasionally occur in the summer. It is impossible to predict where these would occur. If glyphosate is carried into a stream by runoff, it would preferentially bound with the soil particle over partitioning into water (SERA 2003b).

Herbicides entering surface water through surface runoff are also expected to be minimal, since targeted spraying techniques would be used to apply herbicide. This would minimize the amount of herbicide reaching the ground surface as well as minimize the potential for herbicide drift.

Site-specific Analysis

The three largest sites listed in Table 16 would get limited treatment under this alternative. The crupina site, a Dalmatian toadflax site, the large dyer’s woad site, and six smaller sites (not listed in Table 16) would get limited treatment around the edges of the sites and along major roads, to keep the invasive weeds from spreading. The total estimated treatment for these sites is 100 acres. The Dalmatian toadflax site has an additional mitigation allowing treatment of only 10 percent of the acreage within the inner 100 feet of RCAs to occur annually to protect water quality. Where

treatment may occur, wicking the herbicide directly onto the plant is the required application type.

The two smaller dyer's woad sites, as well as the 44-acre Dalmatian toadflax site shown in Table 16, are within the Goose Lake CAR. To protect TES aquatic species, only aquatic glyphosate is allowed within 100 feet the high water mark of streams (design standard 11). Given these requirements, adverse effects from treatments are unlikely.

The 10-acre Canada thistle site is within the Lahonton Regional Water Board (LRWB) plan area. Within the LRWB area, all sites have a 10-foot, no-treatment buffer from herbicide use along streams. Outside this buffer, aquatic glyphostate can be used by wicking it directly onto plants. This would allow the project to meet the LRWB Basin Water Quality Standard for zero detection of herbicide in streams. The 9.7-acre Scotch thistle site is not near water and therefore treatment of this site would have no impact on water quality.

Two of the sites with larger treatment acres in RCAs were modeled using the GLEAMS-Driver model. The 16.3-acre Scotch thistle site is located along Messenger Creek, which is a seasonal stream. The site was modeled with the GLEAMS-Driver with a rainfall of approximately 21 inches a year and 16 acres of treatment. The other site modeled was the Canada thistle site with 33 inches of rain and 10 acres of treatment to match the treatment site. The herbicides that could potentially be used at these sites were modeled. Even when modeled at the highest allowed application rate, using broadcast application up to the edge of a stream (no buffer), no concentrations were over a level of concern. In reality, 2,4-D is not allowed on sites over 2 acres in size and would not be used at either of these sites.

Table 18. GLEAMS-Driver model parameters and results

Herbicide	Acres	Rainfall	Soil Type	Soil Depth	Lower concentration (mg/l)	Median Concentratio n (mg/l)	Upper Concentration (mg/l)	EPA Drinking Water Maximum Contaminant level (mg/l)
glyphosate	16	21	loam	24	0.014	0.015	0.025	0.7
dicamba	16	21	loam	24	0.0074	0.0083	0.009	-
2,4-D	16	21	loam	24	0.0075	0.008	0.013	0.07
glyphosate	10	33	loam	24	0.023	0.024	0.058	0.7
dicamba	10	33	loam	24	0.012	0.013	0.060	-
clopyralid	10	33	loam	24	0.0016	0.003	0.026	-
chlorsulfuron	10	33	loam	24	0.00038	0.00041	0.00057	-
Triclopyr	10	33	loam	24	0.0094	0.011	0.031	-

When all the acres of infestations within the inner 100 feet of RCAs were totaled by watershed, there were less than 15 acres infested within 10 feet of any RCA and only 116 acres total within the inner 100 feet of the RCA (Table 19). This is a small amount of disturbance given the scattered nature of the treatments.

Table 19. Acres of infestations within 100 feet of streams, lakes, springs or meadows by 6th-field watershed

Watershed Hydrologic Unit Code	Watershed Name	Infested Acres within 10 feet of streams, lakes, springs and meadows	Infested Acres within 25 feet of streams lakes, springs and meadows	Infested Acres within 50 feet of streams lakes, springs and meadows	Infested Acres with 100 feet of streams lakes, springs and meadows
180102040103	Mosquito Creek	0.29	0.49	0.81	1.38
180102040106	Fairchild Swamp	0.11	0.23	0.34	0.47
180102040204	Lower North Fork Willow Creek	0	0	0.03	0.19
180102041102	Spaulding Butte	0	0	0	0.25
180102041105	Knobcone Butte	0.01	0.03	0.07	0.10
180102041106	Double Head Mountain	0.03	0.06	0.08	0.08
Subtotal	North Coast RWB	0.44	0.81	1.33	2.47
180200010303	North Fork Cottonwood Creek	0.65	1.64	3.26	6.55
180200010304	Willow Creek	0.27	1.31	2.70	5.78
180200010305	Lassen Creek	1.87	4.63	9.23	18.83
180200010306	Ross Creek	0.06	0.16	0.24	0.30
180200010307	Davis Creek	0.02	0.05	0.14	0.28
180200010403	Corral Creek	0.01	0.03	0.07	0.10
180200020103	Southern Jess Valley	0.09	0.23	0.44	0.76
180200020202	Parsnip Creek	0.06	0.16	0.18	0.18
180200020203	Warm Creek	0.11	0.25	0.46	0.87
180200020207	Crooks Canyon	0.03	0.08	0.10	0.10
180200020303	Fitzhugh Creek	0	0	0.10	0.08
180200020401	Headwaters North Fork of Pit River	0	0	0.02	0.09
180200020402	Joseph Creek	0.09	0.22	0.42	0.64
180200020403	Thoms Creek	0	0	0.01	0.19
180200020504	Baker and Thomas Reservoir	0	0	0.02	0.11
180200020903	Canby-Pit River	0.48	1.03	1.98	4.66
180200020904	Stone Coal Creek	0.47	1.03	1.90	4.08
180200020906	Roberts Reservoir-Pit River	0.02	0.04	0.09	0.10
180200021001	Washington Creek	0.03	0.06	0.10	0.10
180200021002	Upper Turner Creek	0.05	0.06	0.12	0.19
180200021003	Hulbert-Turner Creek	0	0	0.03	0.10
180200021101	Kephart Creek	0	0	0	0.01

Watershed Hydrologic Unit Code	Watershed Name	Infested Acres within 10 feet of streams, lakes, springs and meadows	Infested Acres within 25 feet of streams lakes, springs and meadows	Infested Acres within 50 feet of streams lakes, springs and meadows	Infested Acres with 100 feet of streams lakes, springs and meadows
180200021103	Frog Waterhole	2.80	4.55	7.53	13.69
180200021203	Upper Ash Valley	0	0.05	0.14	0.29
180200021204	Cottonwood Creek	0.36	0.63	1.07	1.37
180200021205	Lower Ash Valley	0.10	0.21	0.41	0.53
180200021301	Rush Creek	2.35	5.94	11.96	23.85
180200021302	Messenger Gulch	1.72	4.01	7.39	13.35
180200021303	Upper Dutch Flat Creek	0	0	0.28	0.30
180200021304	Lower Dutch Flat Creek	0	0	0.05	0.10
180200021401	Upper Willow Creek	0	0	0	0.04
180200021401	Lower Willow Creek	0.10	0.10	0.10	0.10
180200021501	Butte Creek	0.07	0.09	0.10	0.17
180200021503	South Big Swamp	0	0	0	0.01
180200021601	East Fork Juniper Creek	0.05	0.13	0.25	0.35
180200021602	South Fork Juniper Creek	0.38	0.87	1.56	2.69
180200021603	Lower Juniper Creek	0	0	0	0.03
180200021704	Lower Big Valley	0.03	0.08	0.10	0.10
180200030101	Van Sickle Lake	0.01	0.04	0.08	0.10
180200030105	Wagontire Creek	1.00	1.16	1.34	1.92
180200030106	Clarkes Valley	0.04	0.10	0.16	0.20
Subtotal	Central Valley RWB	13.32	25.94	54.13	103.29
180800010102	Bidwell Creek	1.00	2.51	5.08	10.36
180800010201	Northwest Shore Middle Alkali Lake	0.01	0.03	0.14	0.43
180800010202	West Shore Middle Alkali Lake	0	0.01	0.05	0.11
Subtotal	Lahontan RWB	1.01	2.55	5.27	10.90
Totals		14.77	29.3	60.73	116.66

Critical Aquatic Refuges (CARs)

Where aquatic TES species are present more conservative buffers would be used as shown in Table 5. No herbicides would be used within 10 feet of a stream's high water mark and only aquatic glyphosate would be used within 100 feet of the stream. This additional protection makes it exceedingly unlikely that herbicides would reach any threshold of concern in these areas.

For the treatments within the Lahonton Water Board area, no herbicide treatment would take place within 10 feet of a stream. Only aquatic glyphosate could be used within the RCA using wicking to apply the herbicide directly to the plant.

Table 20 Noxious weed sites and infested acres within RCAs of the Lahonton Water Board

Weed ID	Weed Name	Acres	SMZ Type
WM001CIAR4	Canada Thistle	0.10	Seasonal Stream
WM002ONAC	Scotch Thistle	0.10	Seasonal Stream
WM003CIAR4	Canada Thistle	0.06	Seasonal Stream
WM003CIAR4	Canada Thistle	0.10	Perennial Stream
WM003CIAR4	Canada Thistle	0.09	Meadow
WM006CIAR4	Canada Thistle	0.10	Seasonal Stream
WM007ISTI	Dyer's woad	0.45	Seasonal Stream
WM009CIAR4	Canada Thistle	8.04	Lake
WM009CIAR4	Canada Thistle	6.16	Spring
WM009CIAR4	Canada Thistle	8.42	Seasonal Stream
WM009ISTI	Dyer's woad	1.21	Perennial Stream
WM010ISTI	Dyer's woad	0.83	Perennial Stream
WM014ISTI	Dyer's woad	0.75	Seasonal Stream
WM017ONAC	Scotch Thistle	0.10	Seasonal Stream
WM017ISTI	Dyer's woad	0.10	Seasonal Stream
WM018ISTI	Dyer's woad	1.13	Perennial Stream
WM018ISTI	Dyer's woad	1.12	Seasonal Stream
WM019ISTI	Dyer's woad	0.10	Perennial Stream
WM022ONAC	Scotch Thistle	0.15	Perennial Stream
WM025ONAC	Scotch Thistle	0.10	Perennial Stream
WM025ONAC	Scotch Thistle	0.10	Seasonal Stream
WM027ONAC	Scotch Thistle	0.10	Perennial Stream
WM027ONAC	Scotch Thistle	0.08	Seasonal Stream
WM036ONAC	Scotch Thistle	0.10	Perennial Stream
WM037ONAC	Scotch Thistle	0.14	Perennial Stream
TOTALS		29.73	

Early Detection-Rapid Response

Early Detection-Rapid Response is part of this alternative. Under this approach, new or currently unknown infestations may be treated using the range of methods analyzed in the Modoc Invasive Weed FEIS 2008, on sites similar to those presently proposed for treatment. Design standards limit types of treatments and types of herbicides by aquatic risk within RCAs and would minimize the risk of treating these new or undiscovered infestations.

Cumulative Watershed Effects

A watershed cumulative impact can be defined as the total impact, positive or negative, on runoff, erosion, water yield, floods, and/or water quality that result from the incremental impact of a proposed action, when added to other past, present and reasonably foreseeable future actions occurring within the same natural drainage basin, or watershed (CEQ 1997).

The cumulative effects analysis area for this project is comprised of the 29 5th-field watersheds that are either totally or partially found within the Forest's administrative boundary. Cumulative

effects information for this report is primarily derived from Chapter 3 of the EIS. Additional sources of information are referenced accordingly.

Past, Present and Foreseeable Actions

For a complete list of all past, present, and reasonably foreseeable actions, please refer to Chapter 3 of the EIS.

Past Noxious Weed Treatments and Adjacent Treatments

Prior to 2002, Modoc County Department of Agriculture treated weeds on the Forest through a Memorandum of Understanding. Billing records and correspondence between the Forest and Modoc County indicate treatments were done for about 30 years.

The Modoc National Forest contains Modoc, Lassen and Siskiyou counties. Pesticide application data is summarized annually by the California Department of Pesticide. The Department produces a report each year summarizing pesticide use by category, total pounds of pesticide applied, number of treatments, acres and treatment type. The annual reports put out by the California Department of Pesticide do not contain information as to where the pesticides are applied geographically. Herbicide application data for the categories of forestry, rangeland and right-of-way (ROW) is summarized in Appendix B in Table 24 for the years 2002-2006.[4] (Appendix B is part of the Watershed and Soils specialist report, found in Appendix T, Watershed and Soils, of this final EIS.)

The table summarizes the amount of chlorsulfuron, clopyralid, 2,4-D, dicamba, glyphosate and triclopyr applied, for the years 2002-2006. These are the herbicides proposed for use under the proposed action. The table also determines what percentage these herbicides comprised in terms of the total amount applied in each county for 2002-2006, as well as pounds per acre. The use of herbicides on road rights-of-way is assumed to be primarily for noxious weed treatments. However, the acreage associated with right-of-way treatments is inconsistently reported. As a result, the average rates of application have been calculated only for forestry and rangelands.

The Forest has not been extensively involved in herbicide application in the last 5 years. However, in 2002 there was minor use of clopyralid, 2,4-D, dicamba, glyphosate, and hexazinone, all of which were used for noxious weed control. From 2003 through 2007, no herbicides were applied on the Forest outside of existing permits. As a result, it is assumed that the majority of the herbicide applications summarized in Table 24 have been applied to lands other than national forest.

In 2006, no herbicides were applied in Modoc County for forestry. In the same year, no herbicides were applied for rangelands in both Lassen and Modoc counties. This is also the case for both Lassen and Modoc counties in 2004. However, in 2003 rangelands in Modoc County received herbicide application while Lassen County did not. In 2002, herbicide applications were not reported for rangelands in both counties. It is assumed that from 2003-2006 that the herbicide use in the forestry category was on lands owned or administered by other entities than the Forest Service.

Herbicide use for each of these categories appears to have widely varied from 2002-2006. The total amount of chlorsulfuron, clopyralid, 2,4-D, dicamba, glyphosate and tricoplyr, for the forestry category, ranged from a low of 1,569.4 in 2002 to a high of 11,108.6 in 2006 for Siskiyou

[4] http://www.cdpr.ca.gov/docs/pur/purmain.htm

County. For rangelands, the maximum reported amount of herbicides applied from 2002-2006 occurred in 2003 in Siskiyou County where 928.4 pounds were applied. Right-of-way applications have ranged from a low of 139.9 in Lassen County in 2004 to a high of 6, 463.6 lbs in Siskiyou County during 2004.

At no time during the period of 2002-2006 did the total amount of chlorsulfuron, clopyralid, 2,4-D, dicamba, glyphosate and triclopyr exceed 0.1 percent of the total amount of herbicides applied in Lassen, Modoc and Siskiyou counties.

Table 21. Previous treatments of noxious weeds using herbicides, Modoc National Forest

Weed	Control agent	Scope of program
Scotch thistle	Herbicide & Physical	Over 500 Locations
Knapweeds	Herbicide	25 Locations
Leafy spurge	Herbicide	2 Locations
Yellow starthistle	Herbicide	25 Locations
Yellows pine thistle	Herbicide	3 Locations
Dalmatian toadflax	Herbicide	15 Locations
Musk thistle	Herbicide	2 Locations
Crupina	Herbicide	1 Location
Russian knapweed	Herbicide	4 Locations
Perennial pepperweed	Herbicide	12 Locations

Past activities also include:

- Mechanical treatment of less than 1 acre on the Goosenest District of the Klamath National Forest.
- Control of noxious weeds in areas adjacent to the Modoc by the Hat Creek District of the Lassen National Forest. Targeted species include dyer's woad, Scotch thistle, and squarrose knapweed. Ten acres of noxious weeds located on the Shasta Trinity National Forest have been treated by the Lassen N.F. as these acres are administered by the Lassen.
- Various noxious weeds (425 acres) have occurred on BLM land in Modoc and Lassen Counties that have been treated with physical methods, including prescribed fire, or with chemicals between 1997 and 2002. Of these acres, 410 were populated by Medusahead.
- Noxious weed eradication was performed by the Pit River Indian tribe, using a combination of herbicide and mechanical methods, on Tribal lands. Details on which herbicides have been used were not available. Eleven acres were treated on the Fort Bidwell Reservation for Mediterranean sage, Scotch thistle and dyer's woad using mechanical methods.
- Approximately 10,000 acres a year have been treated with herbicides on private, commercial farm ground and private forests within Modoc County. Approximately 1,000 acres per year of regulatory noxious weed control occurs. Additional detail on these activities was unavailable when this report was written.

Relevant Present Activities

Fuel treatments, fire, range management, dam construction and maintenance, recreation, timber harvest, and vegetation treatments, reforestation projects, road and right-of-way management

(including state and county easements and railroads), and special uses are all ongoing activities on the Forest. Each of these management activities in some way tie in to the dispersal and propagation of weeds, typically through transporting seeds or providing seed bed opportunities. For a complete discussion of all these present activities, and how they relate to the spread and propagation of noxious weeds, Chapter 3 of the EIS.

Present activities related specifically to the inventory and treatments of noxious weeds are listed below. These activities may belong to other agencies and the lands they administer, but occur within the boundaries of the 29 5th-field watersheds that are either wholly or partially located within the boundary of the Modoc National Forest.

- Klamath National Forest, Goosenest District: noxious weed inventory
- Ongoing noxious weed control on the Klamath and Lassen National Forest's mentioned above under relevant past activities
- Modoc National Wildlife Refuge that treats 200 acres annually to control Scotch thistle. Rodeo, Roundup, 2-4D, and other chemicals are applied by hand, ATV and truck. In addition, a limited amount of hand grubbing occurs.
- BLM-Alturas and Surprise Valley Offices: Approximately 50 acres in Modoc County are treated annually primarily for the control of Scotch thistle and Mediterranean sage. Both Telar and 2-4D are applied using trucks and helicopters. The treatment of 3,500 acres of exotic invasive plant species are treated annually by a combination of manual, mechanical, chemical (both aerial and ground applications, grazing, biological and prescribed fire methods.
- Ongoing weed eradication on Pit River tribal lands (see past activities for more detail)
- 10,000 acres a year on private, commercial farm ground and private forests are treated. 1,000 acres a year of regulator weed control occurs each year. Details regarding these treatments were not available at the time this report was written.

Relevant Foreseeable Activities

- Ongoing noxious weed control on the Klamath and Lassen National Forest's mentioned above under relevant past activities
- Modoc National Wildlife Refuge that treats 200 acres annually to control Scotch thistle. Rodeo, Roundup, 2-4D, and other chemicals are applied by hand, ATV and truck. In addition, a limited amount of hand grubbing occurs.
- Ongoing weed eradication on Pit River tribal lands (see past activities) for more detail
- 10,000 acres a year on private, commercial farm ground and private forests are treated. 1,000 acres a year of regulator weed control occurs each year. Details regarding these treatments were not available at the time this report was written.
- The Western Area Power Administration is proposing to vegetation and other types of maintenance along 1,400 miles of 69-500 kV transmission lines, of which approximately 456.2 of these miles are located within the Forest's boundary. The purpose of the right-of-way project is to maintain existing transmission lines and legal access road rights-of-way in order to ensure maintenance crews have safe and all-weather access to transmission line structures (Western Area Power Administration 2007). By implementing the project, the threat of vegetation to interfere with power lines and towers would be eliminated, vegetation would be controlled in a cost effective and environmentally sensitive manner, and year-round access would be facilitated.

The preferred alternative proposes using a combination of manual, mechanical, and herbicide methods to create favorable conditions for the establishment of low-growing plant communities. Seeding or planting may occur. Spot and broadcast herbicide applications would be used. Aerial applications would not occur. These methods would be applied to areas underneath and adjacent to the power lines and substations.

Under their proposed action, Western Area Power Administration may expand their use of herbicides for vegetation management. In Appendix G of their environmental assessment, Western proposes to use up to 25 herbicides, all of which have been approved and had human health and ecological risk assessments prepared (Western Area Power Administration 2007). At the time this report was written, information as to how much of each herbicide would be used, and when, and associated application method was not available. In addition, information as to how much herbicide would be applied on a watershed basis was also not available. The herbicides proposed for use by Western are listed below in Table 22.

Discussion of Cumulative Effects

Only the land and roads within the National Forest System would be treated in the action alternatives proposed by this EIS. The Forest, however, is intermingled with other federal, state, county, and private ownerships. Management activities and actions on neighboring lands may contribute to spread or containment of invasive plants on National Forest system lands, and vice versa.

Alternative 1 – Cumulative Effects

This alternative is covered under other NEPA projects. Existing levels of pesticide treatments would continue, by Tribes, the County, and on other private and public lands. No new treatments would be associated with this project. Treatments on the Forest would occur on an extremely small percentage (<0.1%) of any watersheds in the project area. Direct and indirect effects from treatment are so insignificant and temporary that treatment under the no action alternative does not contribute to significant cumulative effects. Lack of treatment would allow the continued spread of invasive plants and the associated changes in ecosystems.

Alternative 2 - Cumulative Effects

Only the land and roads within the National Forest System would be treated in the action alternatives proposed by this EIS. The Forest, however, is intermingled with other federal, state, county, and private ownerships. Management activities and actions on neighboring lands may contribute to spread or containment of invasive plants on National Forest System lands, and vice versa. The treatments described above by county would probably continue at similar levels in the future.

Very little vegetation would be removed in any watershed therefore none of the treatments are extensive enough under any alternative to effect peak flows, low flows or water yield in any watershed. No mechanical ground-disturbing activity is proposed for this project; therefore, methods used for treatment would have negligible effects on water infiltration into soil and associated surface runoff. No 5th-field watershed has more than 2.5 percent proposed for treatment and most have less than 1 percent (Table 6). This amount is much too small an area to show effects to flows from treatment.

The three 5th-field watersheds with the largest treatment acres were looked at closely. These all have one large treatment site for each watershed.

Table 22. Herbicides proposed for use in the Western Area Power Administration project

Herbicide	Use
Bromacil and Diuron	Substations and non sensitive areas only
Chlorsulfuron	Right of Way
Clopyralid	Noxious Weed Control
2,4-D	Substations, Right of Way
Clopyralid and 2,4-D	Substations, ROW and Noxious Weed Control
Dicamba	Right of Way (stump treatment) and Substations
Dithiopur	Landscaped Areas
Diuron	Substations
Flumioxazin	Bare-ground – Substations and Kochia (Mexican burning bush) control
Fosamine Ammonium	Right of Way
Glyphosate	Substations and areas near water and wetlands
Imazapyr	Substations, Right of Way and Stump Treatment
Oxyfluorfen	Landscaped Sites and Bare-ground control
Sulfometuron Methyl	Storage yards and Substations
Sulfometuron Methyl and Chlorsulfuron	Bare-ground and substations
Tebuthiuron and Diuron	Substations
Mefluidide	Buffers and around Substations (on grass)
Imazapyr and Diuron	Substations and Right of Way
Tebuthiuron	Substations
Triclopyr	Right of Way and Stump Treatments
Pendamethalin	Substations
Oryzalin	Substations
Fluroxypyr	Right of Way, Substations especially for Kochia (Mexican burning bush)
Paclobutrazol	Right of Way (sensitive areas)
Trifluralin	Substations and yards

Coptic Bay has the largest number of acres of invasive plants identified; 5,676 with 2.3 percent of the watershed proposed for treatment (Table 6). This is due to the single large treatment area for dyer's woad (5,658 acres) which has only 1.4 acres of treatment in a seasonal RCA. As there is little water present, treating this site is unlikely to effects water resources. All other sites within

the watershed are less than 1 acre in size. There are 5 acres proposed for physical treatments. Only 12 percent of the treatments are proposed are within riparian areas.

Round Valley has one large site of common crupina that is on both national forest and private land. This infestation is about 159 acres on national forest land and 586 acres on adjacent private land. On Forest land this site would be treated with physical means under Alternative 2. There is a 16-acre treatment site for scotch thistle which would also be treated with physical means. All the other sites within the watershed are less than 1 acre in size.

Taylor Lake has an 851-acre treatment site for Dalmatian toadflax, which includes treatment within RCAs of ponds, springs and wetlands. This site was modeled in Table 17 and was below any threshold of concern.

Alternative 2 allows only the use of aquatic glyphosate in RCAs with a 10 foot no treat buffer. This protects water resources from direct and indirect effects of herbicide use at each site. Chemical treatments are scattered in small patches across the watersheds, making it unlikely that herbicide concentrations would be additive with similar treatments at the watershed scale. The potential for cumulative effects is negligible due to the implementation of design standards that limit direct and indirect effects, the scattered nature of the treatments, and the dilution over time and space by mixing and addition of inflow downstream.

Alternative 2 is unlikely to have significant effects on water resources and therefore is unlikely to approach a threshold of concern or contribute to significant cumulative effects. No adverse cumulative effects are expected from implementation of this alternative.

Alternative 3 - Cumulative Effects

Alternative 3 allows only physical treatments. Small acreages are being treated within each 6th-field watershed. As these treatments are primarily pulling weeds in sites scattered across the Forest, it is unlikely that these treatments would have significant direct and indirect effects, and are therefore unlikely to add significantly to cumulative effects. Design standards 14, 16 and 25 protect the watersheds from cumulative effects.

Alternative 4 - Cumulative Effects

The cumulative effects are the same as those discussed under Alternative 2.

Alternative 5 - Cumulative Effects

This alternative treats only 480 acres scattered across the Forest primarily with physical means. Given the minor effects at any site, and the scattered nature of the proposed treatments, cumulative effects from this alternative are unlikely.

Alternative 6 - Cumulative Effects

This alternative treats only 541 acres scattered across 527 sites. Design standard 14 requires that no more than 15 percent of any 6th-field watershed can be treated in one year under this project. Design standard 18b protects specific watersheds with high amounts of treatment in RCAs by limiting acres treated within RCAs. Given these and other design standards, it is unlikely that this alternative would contribute significantly to cumulative effects.

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Appendix A – Summary of Sensitive and Shallow Soils, Acreage and Herbicide Treatment Limitations, by Soil Map Unit, Modoc National Forest

Table 23. Summary of Sensitive and Shallow Soils, Acreage and Herbicide Treatment Limitations, by Soil Map Unit, Modoc National Forest

Soil Map Unit	Soil Map Unit Acres within MDF	Comments	Limiting Factors for Herbicide Treatment
104	4176	Map unit is composed of sensitive soils due to soil drainage is somewhat excessively drained.	Soil permeability and drainage
105	3617	Soil permeability is rapid and soil drainage is somewhat excessively drained.	Soil permeability and drainage
106	6228	Soil permeability is rapid in the pumice overburden to moderately rapid and soil drainage is somewhat excessively drained for 50% of the map unit	Soil permeability and drainage
107	8026	Soil permeability moderately rapid and soil drainage is somewhat excessively drained for 45% of the map unit	Soil permeability and drainage
108	3020	Soil permeability is rapid in the pumice overburden to moderately rapid below and soil drainage is somewhat excessively drained for 45% of the map unit.	Soil permeability and drainage
110	12505	15% of the map unit is composed of rock outcrop	Rock outcrop
111	6399	60% of the unit is shallow depth to bedrock	Soil depth
112	7676	65% of the unit is shallow depth to bedrock	Soil depth
113	1728	65% of the unit is shallow depth to bedrock and 20% of unit is composed of rock outcrop	Soil depth and Rock outcrop
114	796	40% of the unit is shallow depth to bedrock and 20% of unit is composed of rubbleland	Soil depth and Rubbleland
115	4560	45% of the unit is shallow depth to bedrock	Soil depth
116	7409	45% of the unit is shallow depth to bedrock	Soil depth
117	18377	45% of the unit is shallow depth to bedrock and 15% of map unit is composed of rock outcrop	Soil depth and Rock outcrop
118	35782	Soil permeability is moderately rapid, soil drainage is somewhat excessively drained for the map unit, shallow depth to bedrock and lava flows.	Soil permeability, drainage, depth and lava flows
120	4595	Soil permeability is moderately rapid and soil drainage is somewhat excessively drained for 45% of the map unit and 35% of the map unit is composed of rock out crop.	Soil permeability, soil drainage and rock outcrop
121	2631	Soil permeability is moderately rapid, soil drainage is somewhat excessively drained and shallow depth to bedrock for 40% of the map unit and 25% of the map unit is composed of rock out crop.	Soil permeability, soil drainage, soil depth and rock outcrop
122	6734	Soil permeability is moderately rapid for 35% of the map unit and 65% of the map unit is shallow depth to bedrock and 20% of the map unit is composed of lava flows.	Soil permeability, depth and lava flows
123	3270	25% of the map unit is shallow depth to bedrock	Soil depth

Soil Map Unit	Soil Map Unit Acres within MDF	Comments	Limiting Factors for Herbicide Treatment
124	2328	30% of the map unit is shallow depth to bedrock	Soil depth
127	2893	20% of the map unit is shallow depth to bedrock	Soil depth
132	48822	30% of the map unit is shallow depth to bedrock	Soil depth
137	546	25% of the map unit is shallow depth to bedrock.	Soil depth
139	2150	Soil permeability is moderately rapid for 35% of the unit and 25% of the map unit is shallow depth to unweathered bedrock.	Soil permeability and soil depth
140	3861	35% of the map unit is shallow to unweathered bedrock.	Soil depth
142	2465	15% of the map unit is rock outcrop and 40% of the map unit is shallow depth to bedrock.	Soil depth and rock outcrop
145	2667	30% of the map unit is shallow depth to bedrock and 15% of the map unit is composed of rock outcrop.	Soil depth and rock outcrop
147	14407	30% of the map unit is shallow depth to bedrock	Soil depth
150	2872	80% of the map unit is shallow depth to bedrock	Soil depth
151	51941	45% of the map unit is shallow depth to bedrock	Soil depth
152	4375	40% of the map unit is shallow depth to bedrock	Soil depth
153	51753	60% of the map unit is shallow depth to bedrock	Soil depth
154	49425	80% of the map unit is shallow depth to bedrock	Soil depth
155	7413	65% of the map unit is shallow depth to bedrock	Soil depth
156	19246	65% of the map unit is shallow depth to bedrock	Soil depth
157	8781	60% of the map unit is shallow depth to bedrock	Soil depth
158	17776	50% of the map unit is shallow depth to bedrock	Soil depth
159	9600	65% of the map unit is shallow depth to bedrock and 15% of the map unit is composed of rock outcrop.	Soil depth and rock out crop
161	6017	Soil permeability is rapid in the overburden and moderately rapid to rapid and soil drainage is somewhat excessively drained (65%).	Soil permeability and drainage
162	3749	Soil permeability is moderately rapid to rapid for the map unit and soil drainage is somewhat excessively drained (65%).	Soil permeability and drainage
163	1300	Soil permeability is rapid in the overburden and moderately rapid to rapid and soil drainage is somewhat excessively drained for the map unit. 15% of the map unit is rock outcrop.	Soil permeability, drainage and rock out crop
166	12730	30% of the map unit is shallow depth to bedrock	Soil depth
169	1644	25% of the map unit is composed of lava flows and is considered to sensitive landforms as it is composed of fractured vesicular basalt with minor accumulation of aeolian soil deposited in some fractures.	Lava flows
170	3133	25% of the map unit is shallow depth to bedrock	Soil depth
171	3025	30% of the map unit is shallow depth to bedrock	Soil depth
173	2786	Soil permeability is moderately rapid for the map unit	Soil permeability
174	56077	Soil permeability is moderately rapid for the map unit. 25% of the map unit is shallow depth to bedrock and 20% of the map unit is composed of lava flows and is considered to sensitive	Soil permeability, soil depth and lava flows

Soil Map Unit	Soil Map Unit Acres within MDF	Comments	Limiting Factors for Herbicide Treatment
		landforms as it is composed of fractured vesicular basalt with minor accumulation of aeolian soil deposited in some fractures.	
175	3235	Soil drainage is somewhat excessively drained for 15% of the map unit. The entire soil map unit is shallow depth to bedrock	Soil drainage and soil depth
176	7722	Soil drainage is somewhat excessively drained for 15% of the map unit and the entire map unit is shallow depth to bedrock	Soil drainage and soil depth
177	6171	20% of the map unit has soil drainage that is somewhat excessively drained and the entire map unit is shallow depth to bedrock	Soil drainage and soil depth
178	2626	65% of the map unit is considered to be shallow soils and 20% percent of the map unit is composed of rock outcrop.	Soil depth and rock outcrop
179	5830	20% of the map unit is considered to be shallow soils.	Soil depth
180	8024	25% of the map unit is considered to be shallow soils	Soil depth
181	5889	35% of the map unit is considered to be shallow soils	Soil depth to bedrock
182	3483	65% of the map unit has a soil permeability of rapid in the overburden	Soil permeability in the pumice overburden.
183	6265	Soil permeability is rapid in the overburden (80% of the map unit).	Soil permeability in the pumice overburden.
186	4764	Soil permeability is rapid in the overburden (75% of the map unit) and moderately rapid below (55% of the map unit).	Soil permeability in the pumice overburden.
187	9622	30% of the map unit is shallow depth to bedrock	Soil depth
188	22624	30% of the map unit is shallow depth to bedrock	Soil depth
189	3351	30% of the map unit is shallow depth to bedrock	Soil depth
191	16161	35% of the map unit is shallow depth to bedrock	Soil depth
192	2720	35% of the map unit is shallow depth to bedrock	Soil depth
193	4589	Soil permeability is moderately rapid to rapid for the entire map unit and soil drainage is somewhat excessively drained (45%)	Soil permeability and soil drainage
197	886	Soil permeability is rapid in the overburden moderately rapid to rapid below for 20% of the map unit and soil drainage is somewhat excessively drained (80%)	Soil permeability and soil drainage
198	1640	Soil permeability is rapid in the overburden moderately rapid to rapid below and soil drainage is somewhat excessively drained for the map unit.	Soil permeability and soil drainage
199	2194	Soil permeability is moderately rapid to rapid and soil drainage is somewhat excessively drained for the map unit.	Soil permeability and soil drainage
204	50975	15% of map unit is shallow depth to bedrock.	Soil depth
205	23943	15% of map unit is shallow depth to bedrock	Soil depth
206	3416	15% of map unit is considered shallow soils.	Soil depth
207	757	80% of map unit is considered shallow soils.	Soil depth
208	2044	45% of the map unit has soil drainage of somewhat excessively drained and 80% of map	Soil depth and soil drainage

Soil Map Unit	Soil Map Unit Acres within MDF	Comments	Limiting Factors for Herbicide Treatment
		unit is shallow depth to bedrock.	
209	493	Soil permeability is moderately rapid and soil drainage is somewhat excessively drained for the map unit. 45% of map unit shallow depth to bedrock	Soil permeability, drainage and soil depth.
210	7797	Soil drainage is somewhat excessively drained and shallow depth to bedrock for 35% of the map unit.	Soil depth and drainage
211	2015	20% of the map unit is shallow depth to bedrock	Soil depth
212	7348	45% of the map unit is shallow depth to bedrock	Soil depth
213	5077	45% of the map unit is shallow depth to bedrock	Soil depth
214	805	75% of the map unit is shallow depth to bedrock	Soil depth
215	1555	35% of the map unit has soil permeability of moderately rapid , 20% of the map unit shallow depth to bedrock and 20% of the map unit is composed of rubble land.	Soil depth, soil permeability and Rubbleland
216		60% of the map unit has soil permeability of moderately rapid	Soil permeability
219	26619	15% of map unit is composed of rock out crop	Rock out crop
221	2768	80% of the map unit is shallow depth to bedrock	Soil depth
222	33951	40% of the map unit is shallow depth to bedrock and 15% of the map unit is composed of lava flows.	Soil depth and lava flows
223	11519	40% of the map unit is considered to be shallow soils	Soil depth
224	28237	55% of the map unit is considered to be shallow soils.	Soil depth
225	29728	55% of the map unit is considered to be shallow soils.	Soil depth
226	8916	65% of the map unit is considered to be shallow soils.	Soil depth
227	3447	Soil drainage is somewhat excessively drained (35%) and 80% is of the map unit is shallow depth to bedrock	Soil drainage and soil depth
228	33561	45% of the map unit shallow depth to bedrock	Soil depth
229	6601	60% of the map unit is shallow depth to bedrock	Soil depth
230	5858	Soil permeability is moderately rapid for 30% of the map unit.	Soil permeability
233	1534	20% of the map unit is shallow depth to bedrock	Soil depth
236		15% of the map unit is shallow depth to bedrock	Soil depth
237	9883	20% of the map unit is shallow depth to bedrock	Soil depth
238	1602	30% of the map unit is shallow depth to bedrock	Soil depth
239	3976	30% of the map unit has soil permeability and shallow depth to bedrock and 40% of the map unit is composed of rock outcrop.	Soil depth and rock outcrop
240	5088	20% of the map unit has soil permeability and shallow depth to bedrock and 65% of the map unit is composed of rock outcrop and rubbleland.	Soil depth, rock outcrop and rubble lands
241	7095	25% of the map unit has soil permeability and shallow depth to bedrock and 65% of the map unit is composed of rock outcrop and rubbleland.	Soil depth, rock outcrop and rubble lands
242	3881	35% of the map unit is shallow soil	Soil depth

Soil Map Unit	Soil Map Unit Acres within MDF	Comments	Limiting Factors for Herbicide Treatment
243	36276	40% of the map unit is shallow soil	Soil depth
244	4877	45% of the map unit is shallow soil	Soil depth
245	2022	65% of the map unit is shallow soil over basalt and 20% of map unit is composed of rock outcrop.	Soil depth and rock out crop
246	2010	Soil permeability is rapid in the pumice overburden and moderately rapid to moderately slow below the overburden for the map unit.	Soil permeability and drainage
247	6654	25% of the map unit is shallow soil over basalt and 20% of the map unit consists of lava flows.	Soil depth and lava flows
251	14216	25% of the map unit is shallow soil	Soil depth
257	7414	30% of the map unit is shallow soils.	Soil depth
258	8481	25% of the map unit is shallow soils.	Soil depth
259	15981	30% of the map unit is composed of shallow soils.	Soil depth
260	7104	Soil permeability is rapid and soil drainage is somewhat excessively drained for the map unit.	Soil permeability and soil drainage
261	3449	Soil permeability is rapid in the pumice overburden and moderately rapid below the overburden and soil drainage is somewhat excessively drained for 50% of the map unit.	Soil permeability, and soil drainage
262	4889	Soil permeability is moderately rapid and soil drainage is somewhat excessively drained to well drained for 50% of the map unit	Soil permeability, and soil drainage
263	3867	Soil permeability is moderately rapid and soil drainage is somewhat excessively drained to well drained for 55% and shallow soil for 15% of the map unit	Soil permeability, drainage and soil depth
264	3203	Soil permeability is moderately rapid for the map unit, and soil drainage is somewhat excessively (40%).	Soil permeability, and soil drainage
265	2093	Soil permeability is moderately rapid for the map unit and soil drainage is somewhat excessively drained (45%).	Soil permeability, and soil drainage
266	6164	55% of the map unit is shallow soils and 20% of the map unit is composed of lava flows.	Soil depth and lava flows
267	10836	55% of the map unit is considered to be shallow soils due to soil depth.	Soil depth
268	48857	20% of the map unit is shallow soils.	Soil depth
269	5700	20% of the map unit is shallow soils and 20% of the map unit is composed of rock outcrop	Soil depth and rock out crop
270	6113	25% of the map unit is shallow soils and 20% of the map unit is composed of rock outcrop	Soil depth and rock out crop
271	1180	30% of the map unit is shallow soils due to soil depth and 25% of the map unit is composed of rock outcrop.	Soil depth and rock out crop
272	11120	Soil drainage is somewhat excessively drained and shallow soils and 45% of the map unit is composed of rock outcrop.	Soil drainage, soil depth and rock outcrop
273	4855	20% of the map unit is shallow soils	Soil depth
274	5636	70% of the map unit has high water table.	Water Table at or near surface
276	5309	Soil permeability is moderately rapid and shallow	Soil permeability and soil

Soil Map Unit	Soil Map Unit Acres within MDF	Comments	Limiting Factors for Herbicide Treatment
		soils for 20% of map unit.	depth
277	3469	Soil permeability is moderately rapid for 60% of map unit.	Soil permeability
278	3493	Soil permeability is rapid in the pumice overburden to moderately rapid below the overburden for the map unit.	Soil permeability
279	1302	Soil permeability is moderately rapid for the map unit and soil drainage is somewhat excessively drained 30% of the map unit.	Soil permeability and soil drainage
280	839	Soil permeability is moderately rapid and somewhat excessively drained for 40% of the map unit and 25% of the map unit is shallow soils.	Soil permeability, soil drainage and soil depth
281	2849	Soil permeability is moderately rapid and soil drainage is somewhat excessively drained for 55% of the map unit.	Soil permeability and soil drainage
282	6734	Soil permeability is moderately rapid and soil drainage is somewhat excessively drained for 65% of the map unit. 20% of the map unit is shallow soils.	Soil permeability, soil drainage and soil depth

Appendix B – Forestry, Rangeland and ROW Herbicide Applications within Modoc National Forest Counties from 2002-2006

Table 24 Total forestry, rangeland and ROW herbicide applications (total pounds applied) within Modoc National Forest Counties for 2006

2006 Lassen, Modoc and Siskiyou Counties												
Pounds Applied				**# Acres Treated**	Lassen	Modoc	Siskiyou	**Average Rate per Acres (lbs/acre)**		Lassen	Modoc	Siskiyou
Forestry												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	0.0	chlorsulfuron	0.0	0.0	0.0		chlorsulfuron	0.0	0.0	0.0
clopyralid	0.0	0.0	2.5	clopyralid	0.0	0.0	4.0		clopyralid	0.0	0.0	0.6
2,4-D	0.0	0.0	3231.9	2,4-D	0.0	0.0	2285.7		2,4-D	0.0	0.0	1.4
Dicamba	0.0	0.0	0.0	Dicamba	0.0	0.0	0.0		Dicamba	0.0	0.0	0.0
glyphosate	5919.0	0.0	5689.9	glyphosate	1680.0	0.0	3709.6		glyphosate	3.5	0.0	1.5
Triclopyr	0.0	0.0	2184.3	Triclopyr	0.0	0.0	1696.5		Triclopyr	0.0	0.0	1.3
total	**5919.0**	**0.0**	**11108.6**	**total**	**1680.0**	**0.0**	**7695.8**		**total**	**3.5**	**0.0**	**4.9**
Rangeland												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	4.9	chlorsulfuron	0.0	0.0	184.0		chlorsulfuron	0.0	0.0	0.0
clopyralid	0.0	0.0	29.5	clopyralid	0.0	0.0	205.5		clopyralid	0.0	0.0	0.1
2,4-D	0.0	0.0	123.5	2,4-D	0.0	0.0	188.0		2,4-D	0.0	0.0	0.7
Dicamba	0.0	0.0	4.2	Dicamba	0.0	0.0	7.0		Dicamba	0.0	0.0	0.0
glyphosate	0.0	0.0	50.5	glyphosate	0.0	0.0	20.0		glyphosate	0.0	0.0	2.5
Triclopyr	0.0	0.0	0.0	Triclopyr	0.0	0.0	0.0		Triclopyr	0.0	0.0	0.0
total	**0.0**	**0.0**	**212.6**	**total**	**0.0**	**0.0**	**604.5**		**total**	**0.0**	**0.0**	**3.3**

2006 Lassen, Modoc and Siskiyou Counties												
Pounds Applied				**# Acres Treated**	Lassen	Modoc	Siskiyou	**Average Rate per Acres (lbs/acre)**		Lassen	Modoc	Siskiyou
Right of Way												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.8	0.0	41.1	chlorsulfuron	**NR***	NR	NR		chlorsulfuron	**NA****	NA	NA
clopyralid	1.0	31.5	25.4	clopyralid	NR	NR	NR		clopyralid	NA	NA	NA
2,4-D	125.0	622.2	2785.5	2,4-D	NR	NR	NR		2,4-D	NA	NA	NA
Dicamba	5.5	56.5	296.4	Dicamba	NR	NR	NR		Dicamba	NA	NA	NA
glyphosate	50.5	429.4	2605.4	glyphosate	NR	NR	NR		glyphosate	NA	NA	NA
Triclopyr	1.5	0.0	259.9	Triclopyr	NR	NR	NR		Triclopyr	NA	NA	NA
total	**184.3**	**1139.6**	**6013.7**	**total**	**0.0**	**0.0**	**0.0**		**total**			
Forestry, Range and ROW Use (lbs) as % of Total Use (lbs) in the county												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	0.0									
clopyralid	0.0	0.0	0.0									
2,4-D	0.0	0.0	0.1									
Dicamba	0.0	0.0	0.0									
glyphosate	0.1	0.0	0.1									
Triclopyr	0.0	0.0	0.0									

*NR=not reported **NA=not applicable

Table 25. Total forestry, rangeland and ROW herbicide applications (total pounds applied) within Modoc National Forest Counties for 2005

2005 Lassen, Modoc and Siskiyou Counties												
Pounds Applied				**# Acres Treated**	Lassen	Modoc	Siskiyou	**Average Rate per Acres (lbs/acre)**		Lassen	Modoc	Siskiyou
Forestry												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	0.0	chlorsulfuron	0.0	0.0	0.0		chlorsulfuron	0.0	0.0	0.0
clopyralid	0.0	0.0	0.0	clopyralid	0.0	0.0			clopyralid	0.0	0.0	0.0
2,4-D	241.2	542.6	620.0	2,4-D	267.0	192.0	188.0		2,4-D	0.0	0.0	3.3
Dicamba	0.0	0.0	0.0	Dicamba	0.0	0.0	0.0		Dicamba	0.0	0.0	0.0
glyphosate	3849.2	571.4	1452.1	glyphosate	1474.6	399.0	1567.0		glyphosate	2.6	0.0	0.9
Triclopyr	220.3	0.0	735.2	Triclopyr	247.0	0.0	593.0		Triclopyr	0.0	0.0	1.2
total	**4310.7**	**1114.0**	**2807.3**	**total**	**1988.6**	**591.0**	**2348.0**		**total**	**2.6**	**0.0**	**5.5**
Rangeland												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	1.0	chlorsulfuron	0.0	0.0	43.0		chlorsulfuron	0.0	0.0	0.0
clopyralid	0.0	1.6	6.8	clopyralid	0.0	25.0	46.0		clopyralid	0.0	0.0	0.1
2,4-D	1.4	1.1	0.0	2,4-D	1.0	25.0	0.0		2,4-D	0.0	0.0	0.0
Dicamba	0.0	0.0	0.0	Dicamba	0.0	0.0	0.0		Dicamba	0.0	0.0	0.0
glyphosate	0.0	2.0	6.3	glyphosate	0.0	25.0	2.5		glyphosate	0.0	0.0	2.5
Triclopyr	0.0	0.0	0.0	Triclopyr	0.0	0.0	0.0		Triclopyr	0.0	0.0	0.0
total	**1.4**	**4.7**	**14.1**	**total**	**0.0**	**0.0**	**91.5**		**total**	**0.0**	**0.0**	**2.7**

2005 Lassen, Modoc and Siskiyou Counties												
Pounds Applied				**# Acres Treated**	Lassen	Modoc	Siskiyou	**Average Rate per Acres (lbs/acre)**		Lassen	Modoc	Siskiyou
Right of Way												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	1.1	0.3	20.6	chlorsulfuron	NR	NR	NR		chlorsulfuron	NA	NA	NA
clopyralid	1.0	40.3	25.3	clopyralid	NR	NR	NR		clopyralid	NA	NA	NA
2,4-D	193.5	318.2	1288.8	2,4-D	NR	NR	NR		2,4-D	NA	NA	NA
Dicamba	0.8	68.0	79.5	Dicamba	NR	NR	NR		Dicamba	NA	NA	NA
glyphosate	26.7	953.0	1980.6	glyphosate	NR	NR	NR		glyphosate	NA	NA	NA
Triclopyr	1.8	0.0	31.5	Triclopyr	NR	NR	NR		Triclopyr	NA	NA	NA
total	**224.9**	**1379.8**	**3426.3**	**total**	**0.0**	**0.0**	**0.0**		**total**	**0.0**	**0.0**	**0.0**
Forestry, Range and ROW Use (lbs) as % of Total Use (lbs) in the county												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	0.0									
clopyralid	0.0	0.0	0.0									
2,4-D	0.0	0.0	0.0									
Dicamba	0.0	0.0	0.0									
glyphosate	0.0	0.0	0.0									
Triclopyr	0.0	0.0	0.0									

Table 26. Total forestry, rangeland and ROW herbicide applications (total pounds applied) within Modoc National Forest Counties for 2004

2004 Lassen, Modoc and Siskiyou Counties											
Pounds Applied				**# Acres Treated**	Lassen	Modoc	Siskiyou	**Average Rate per Acres (lbs/acre)**	Lassen	Modoc	Siskiyou
Forestry											
	Lassen	Modoc	Siskiyou								
chlorsulfuron	0.0	0.0	0.0	chlorsulfuron	0.0	0.0	0.0	chlorsulfuron	0.0	0.0	0.0
clopyralid	0.0	0.0	0.7	clopyralid	0.0	0.0	6.0	clopyralid	0.0	0.0	0.1
2,4-D	1668.7	0.0	1127.9	2,4-D	580.5	0.0	1875.6	2,4-D	0.0	0.0	0.6
Dicamba	0.0	0.0	0.0	Dicamba	0.0	0.0	0.0	Dicamba	0.0	0.0	0.0
glyphosate	776.4	48.9	1881.4	glyphosate	273.0	72.0	1293.1	glyphosate	2.8	0.0	1.5
Triclopyr	42.2	0.0	1025.1	Triclopyr	75.5	0.0	760.2	Triclopyr	0.0	0.0	1.3
total	**2487.3**	**48.9**	**4035.1**	**total**	**929.0**	**72.0**	**3934.9**	**total**	**2.8**	**0.0**	**3.5**
Rangeland											
	Lassen	Modoc	Siskiyou								
chlorsulfuron	0.0	0.0	0.0	chlorsulfuron	0.0	0.0	0.0	chlorsulfuron	0.0	0.0	0.0
clopyralid	0.0	0.0	91.6	clopyralid	0.0	0.0	494.0	clopyralid	0.0	0.0	0.2
2,4-D	0.0	0.0	134.8	2,4-D	0.0	0.0	148.0	2,4-D	0.0	0.0	0.9
Dicamba	0.0	0.0	14.6	Dicamba	0.0	0.0	98.0	Dicamba	0.0	0.0	0.0
glyphosate	0.0	0.0	0.0	glyphosate	0.0	0.0	0.0	glyphosate	0.0	0.0	0.0
Triclopyr	0.0	0.0	0.0	Triclopyr	0.0	0.0		Triclopyr	0.0	0.0	0.0
total	**0.0**	**0.0**	**241.0**	**total**	**0.0**	**0.0**	**740.0**	**total**	**0.0**	**0.0**	**1.1**

2004 Lassen, Modoc and Siskiyou Counties												
Pounds Applied				**# Acres Treated**	Lassen	Modoc	Siskiyou	**Average Rate per Acres (lbs/acre)**		Lassen	Modoc	Siskiyou
Right of Way												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.5	10.7	25.3	chlorsulfuron	NR	NR	NR		chlorsulfuron	NA	NA	NA
clopyralid	2.6	124.9	14.9	clopyralid	11.0	NR	NR		clopyralid	4.2	NA	NA
2,4-D	94.2	1160.3	1767.9	2,4-D	NR	NR	NR		2,4-D	NA	NA	NA
Dicamba	0.0	393.2	171.8	Dicamba	0.0	NR	NR		Dicamba	NA	NA	NA
glyphosate	41.6	1764.0	3530.3	glyphosate	42.0	NR	NR		glyphosate	1.0	NA	NA
Triclopyr	1.0	17.0	953.4	Triclopyr	NR	NR	NR		Triclopyr	NA	NA	NA
total	**139.9**	**3470.1**	**6463.6**	**total**	**0.0**	**0.0**	**0.0**		**total**	**0.0**	**0.0**	**0.0**
Forestry, Range and ROW Use (lbs) as % of Total Use (lbs) in the county												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	0.0									
clopyralid	0.0	0.0	0.0									
2,4-D	0.0	0.0	0.0									
Dicamba	0.0	0.0	0.0									
glyphosate	0.0	0.0	0.0									
Triclopyr	0.0	0.0	0.0									

Table 27. Total forestry, rangeland and ROW herbicide applications (total pounds applied) within Modoc National Forest Counties for 2003

2003 Lassen, Modoc and Siskiyou Counties												
Pounds Applied				**# Acres Treated**	Lassen	Modoc	Siskiyou	**Average Rate per Acres (lbs/acre)**		Lassen	Modoc	Siskiyou
Forestry												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	0.0	chlorsulfuron	0.0	0.0	0.0		chlorsulfuron	0.0	0.0	0.0
clopyralid	0.0	0.0	3.3	clopyralid	0.0	0.0	14.0		clopyralid	0.0	0.0	0.2
2,4-D	344.8	0.0	382.6	2,4-D	239.0	0.0	944.0		2,4-D	0.0	0.0	0.4
Dicamba	0.0	0.0	0.0	Dicamba	0.0	0.0	0.0		Dicamba	0.0	0.0	0.0
glyphosate	1102.3	376.3	6041.7	glyphosate	389.0	403.2	4369.9		glyphosate	2.8	0.0	1.4
Triclopyr	110.8	0.0	723.2	Triclopyr	40.0	0.0	1032.0		Triclopyr	0.0	0.0	0.7
total	**1557.9**	**376.3**	**7150.8**	**total**	**668.0**	**403.2**	**6359.9**		**total**	**2.8**	**0.0**	**2.7**
Rangeland												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	0.0	chlorsulfuron	0.0	0.0	0.0		chlorsulfuron	0.0	0.0	0.0
clopyralid	0.0	0.0	47.1	clopyralid	0.0	0.0	237.0		clopyralid	0.0	0.0	0.2
2,4-D	0.0	286.6	811.7	2,4-D	0.0	100.0	656.0		2,4-D	0.0	0.0	1.2
Dicamba	0.0	0.0	69.6	Dicamba	0.0	0.0	91.0		Dicamba	0.0	0.0	0.0
glyphosate	0.0	0.0	0.0	glyphosate	0.0	0.0	0.0		glyphosate	0.0	0.0	0.0
Triclopyr	0.0	0.0	0.0	Triclopyr	0.0	0.0	0.0		Triclopyr	0.0	0.0	0.0
total	**0.0**	**286.6**	**928.4**	**total**	**0.0**	**0.0**	**984.0**		**total**	**0.0**	**0.0**	**1.4**

2003 Lassen, Modoc and Siskiyou Counties												
Pounds Applied				**# Acres Treated**	Lassen	Modoc	Siskiyou	**Average Rate per Acres (lbs/acre)**		Lassen	Modoc	Siskiyou
Right of Way												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	1.3	2.9	7.0	chlorsulfuron	NR	NR	NR		chlorsulfuron	NA	NA	NA
clopyralid	11.9	12.7	10.0	clopyralid	15.0	NR	NR		clopyralid	0.8	NA	NA
2,4-D	119.2	675.7	481.5	2,4-D	40.0	NR	NR		2,4-D	3.0	NA	NA
Dicamba	9.6	138.6	741.4	Dicamba	NR	NR	NR		Dicamba	NA	NA	NA
glyphosate	557.8	1140.8	2101.2	glyphosate	20.0	NR	NR		glyphosate	27.9	NA	NA
Triclopyr	2.3	4.2	89.4	Triclopyr	NR	NR	NR		Triclopyr	NA	NA	NA
total	**702.1**	**1974.9**	**3430.5**	**total**	**0.0**	**0.0**	**0.0**		**total**	**0.0**	**0.0**	**0.0**
Forestry, Range and ROW Use (lbs) as % of Total Use (lbs) in the county												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	0.0									
clopyralid	0.0	0.0	0.0									
2,4-D	0.0	0.0	0.0									
Dicamba	0.0	0.0	0.0									
glyphosate	0.0	0.0	0.0									
Triclopyr	0.0	0.0	0.0									

Table 28. Total forestry, rangeland and ROW herbicide applications (total pounds applied) within Modoc National Forest Counties for 2002

2002 Lassen, Modoc and Siskiyou Counties												
Pounds Applied				**# Acres Treated**	Lassen	Modoc	Siskiyou	**Average Rate per Acres (lbs/acre)**		Lassen	Modoc	Siskiyou
Forestry												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	0.0	chlorsulfuron	0.0	0.0	0.0		chlorsulfuron	0.0	0.0	0.0
clopyralid	0.0	0.0	0.0	clopyralid	0.0	0.0	0.0		clopyralid	0.0	0.0	0.0
2,4-D	827.0	1017.4	3072.5	2,4-D	622.0	360.0	3482.0		2,4-D	0.0	0.0	0.9
Dicamba	0.0	0.0	0.0	Dicamba	0.0	0.0	0.0		Dicamba	0.0	0.0	0.0
glyphosate	351.4	3.1	2002.8	glyphosate	322.0	111.0	4605.0		glyphosate	1.1	0.0	0.4
Triclopyr	391.0	0.0	1096.0	Triclopyr	206.0	0.0	768.0		Triclopyr	0.0	0.0	1.4
total	**1569.4**	**1020.5**	**6171.3**	**total**	**1150.0**	**471.0**	**8855.0**		**total**	**1.1**	**0.0**	**2.7**
Rangeland												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	0.0	chlorsulfuron	0.0	0.0	0.0		chlorsulfuron	0.0	0.0	0.0
clopyralid	0.0	0.0	32.0	clopyralid	0.0	0.0	106.2		clopyralid	0.0	0.0	0.3
2,4-D	0.0	0.0	21.1	2,4-D	0.0	0.0	55.0		2,4-D	0.0	0.0	0.4
Dicamba	0.0	0.0	2.2	Dicamba	0.0	0.0	15.0		Dicamba	0.0	0.0	0.0
glyphosate	0.6	0.0	0.0	glyphosate	1.0	0.0	0.0		glyphosate	0.0	0.0	0.0
Triclopyr	0.0	0.0	0.0	Triclopyr	0.0	0.0	0.0		Triclopyr	0.0	0.0	0.0
total	**0.6**	**0.0**	**55.3**	**total**	**0.0**	**0.0**	**176.2**		**total**	**0.0**	**0.0**	**0.7**

2002 Lassen, Modoc and Siskiyou Counties												
Pounds Applied				**# Acres Treated**	Lassen	Modoc	Siskiyou	**Average Rate per Acres (lbs/acre)**		Lassen	Modoc	Siskiyou
Right of Way												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	12.2	6.3	21.7	chlorsulfuron	NR	NR	NR		chlorsulfuron	NA	NA	NA
clopyralid	132.5	473.2	60.3	clopyralid	NR	NR	NR		clopyralid	NA	NA	NA
2,4-D	930.7	1594.8	1057.6	2,4-D	57.0	NR	NR		2,4-D	16.3	NA	NA
Dicamba	1352.0	294.4	652.5	Dicamba	NR	NR	NR		Dicamba	NA	NA	NA
glyphosate	204.8	933.9	2457.4	glyphosate	4.0	NR	NR		glyphosate	51.2	NA	NA
Triclopyr	6.0	7.9	116.8	Triclopyr	NR	NR	NR		Triclopyr	NA	NA	NA
total	**2638.2**	**3310.5**	**4366.3**	**total**	**0.0**	**0.0**	**0.0**		**total**	**0.0**	**0.0**	**0.0**
Forestry, Range and ROW Use (lbs) as % of Total Use (lbs) in the county												
	Lassen	Modoc	Siskiyou									
chlorsulfuron	0.0	0.0	0.0									
clopyralid	0.0	0.0	0.0									
2,4-D	0.0	0.0	0.0									
Dicamba	0.0	0.0	0.0									
glyphosate	0.0	0.0	0.0									
Triclopyr	0.0	0.0	0.0									