USDA United States Department of Agriculture | Forest Service | Lake Tahoe Basin Management Unit | 35 College Drive
South Lake Tahoe, CA 96150
(530) 543-2600
(530) 543-0956 TTY

File Code: 1950
Date: July 13, 2010

Dear Interested Parties:

The US Forest Service, Lake Tahoe Basin Management Unit, has prepared an Environmental Assessment (EA) for the Terrestrial Invasive Plant Species (TIPS) Project. This project proposes to treat TIPS on National Forest System (NFS) lands managed by the LTBMU through manual, mechanical, thermal and chemical treatment.

Summary of Alternatives:

The EA evaluates two alternatives in detail. A summary of these alternatives is described below. A complete description of these alternatives is provided in the EA.

Alternative 1 – *No Action*

Under the No Action Alternative, the LTBMU would treat the 34 currently known TIPS (found in 493 locations and totaling approximately 8.9 acres) with the manual methods traditionally used (hand pulling, pulling using tools, and clipping). This would occur on all future infestations, as well as the currently known infestations. Nearly three-quarters of the infested acres include TIPS that do not respond well to manual treatment; however, there would be no mechanical, thermal, or chemical treatments of any TIPS populations on the Forest, so the current TIPS infestations would be expected to continue to expand.

Alternative 2 – *Proposed action*

Under the proposed action, LTBMU would treat the 34 currently known TIPS by manual, mechanical, thermal, or chemical (herbicides) methods, or by a combination of those methods. Currently, these TIPS are found in 493 locations, which together contain approximately 8.9 infested acres (weeds only) spread throughout 309 gross acres (weeds intermixed with other plants and bare earth). Manual, mechanical, and thermal treatments are proposed for the one-quarter of known infested acres that can be effectively treated by manual methods; these treatments are also proposed for infestations discovered in the future, on as many acres as are feasible with such methods. Chemical treatments are proposed for the TIPS that do not respond well to manual treatments; currently, three-quarters of the known infested acres fall into this category. Chemical treatments are proposed using hand selective, directed spray, or limited broadcast methods, on up to 100 infested acres annually. Only herbicides that have been approved for use in the respective states of California or Nevada would be used (aminopyralid, chlorsulfuron, glyphosate, and aminopyralid/triclopyr pre-mix (Milestone VM Plus)).

In addition to the 34 known TIPS, this project proposes to treat any new species of TIPS found on NFS lands in Lake Tahoe Basin, by manual, mechanical, thermal, or chemical methods.

The EA is available for review at the Lake Tahoe Basin Management Unit, 35 College Drive, South Lake Tahoe, CA 96150 and online at http://fs.usda.gov/ltbmu, under "Land and Resources Management" and search "Projects." Additional information regarding this proposal can be

obtained from Cheryl Beyer at (530) 543-2842.

How to Comment and Timeframe
Written, facsimile, hand-delivered, oral, and electronic comments concerning this action will be accepted for 30 calendar days following publication of the legal notice in the Tahoe Daily Tribune. The publication date in the newspaper of record is the exclusive means for calculating the comment period for this proposal. Those wishing to comment should not rely upon dates or timeframe information provided by any other source. The regulations prohibit extending the length of the comment period.

Written comments must be submitted to: Terri Marceron, Forest Supervisor, re: TIPS Project, 35 College Drive, South Lake Tahoe, CA 96150. The office business hours for those submitting hand-delivered comments are: 8:00 a.m. to 4:30 p.m., Monday through Friday, excluding holidays.

Oral comments must be provided at the Forest Supervisor's office during normal business hours, via telephone (530) 543-2600, or in person, or at an official agency function (i.e. public meeting) that is designed to elicit public comments. No public meetings are planned at this time. Electronic comments must be submitted in a format such as an email message, plain text (.txt), rich text format (.rtf), or Word (.doc) to comments-pacificsouthwest-ltbmu@fs.fed.us using Subject: TIPS Project. In cases where no identifiable name is attached to a comment, a verification of identity will be required for appeal eligibility. If using an electronic message, a scanned signature is one way to provide verification. It is the responsibility of persons providing comments to submit them by the close of the comment period. Individuals and organizations wishing to be eligible to appeal must meet the information requirements of 36 CFR 215.6.

This comment period is intended to provide those interested in or affected by this proposal an opportunity to make their concerns known prior to a decision being made by the Forest Supervisor. Those who provide comments or otherwise express interest in the proposal by the close of the comment period will be eligible to appeal the decision pursuant to 36 CFR part 215 regulations.

Sincerely,

Terri Marceron

TERRI MARCERON
Forest Supervisor

cc: Cheryl Beyer, Joey Keely, Matt Dickinson

United States
Department of
Agriculture

Forest
Service

July 2010

Environmental Assessment

Terrestrial Invasive Plant Species Treatment Project

Lake Tahoe Basin Management Unit, US Forest Service

Legal Description: The Terrestrial Invasive Plant Species Treatment Project is located in Alpine, El Dorado and Placer Counties, California, and Douglas and Washoe Counties, and Carson City Rural Area, Nevada. Township 10-17 North, Range 16-19 East, Mt. Diablo Meridian.

For information, contact:

Cheryl Beyer
USDA Forest Service
35 College Drive
South Lake Tahoe, CA 96150
530-543-2842
http://www.fs.fed.us/r5/ltbmu/

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call toll free (866) 632-9992 (voice). TDD users can contact USDA through local relay or the Federal relay at (800) 877-8339 (TDD) or (866) 377-8642 (relay voice). USDA is an equal opportunity provider and employer.

TABLE OF CONTENTS

1.0 SUMMARY 1

2.0 INTRODUCTION 5

2.1 DOCUMENT STRUCTURE 5

2.2 BACKGROUND 5

2.3 DESIRED CONDITION 7

2.4 PURPOSE AND NEED FOR ACTION 7

2.5 PROPOSED ACTION (MULTI-TREATMENT) 9

2.6 MANAGEMENT DIRECTION 20

2.7 DECISION FRAMEWORK 22

2.8 PUBLIC INVOLVEMENT 23

3.0 COMPARISON OF THE ALTERNATIVES 25

3.1 ALTERNATIVES 25

3.2 DESIGN FEATURES 27

3.3 COMPARISON OF ALTERNATIVES 32

4.0 ENVIRONMENTAL CONSEQUENCES 34

4.1. TERRESTRIAL WILDLIFE SPECIES 35

4.2 AQUATIC SPECIES 47

4.3 WATER QUALITY 71

4.4 SOILS 78

4.5 HERITAGE 88

4.6 RECREATION, RECREATION RESIDENCES, SPECIAL USES 89

4.7 HEALTH AND SAFETY 90

4.8 NATIVE VEGETATION 108

4.9 TERRESTRIAL INVASIVE PLANT SPECIES 119

5.0 AGENCIES AND PERSONS CONSULTED 135

5.1 INTERDISCIPLINARY TEAM MEMBERS 135

5.2 FEDERAL, STATE, AND LOCAL AGENCIES 135

5.3 TRIBES 136

5.4 COORDINATION 137

6.0 REFERENCES 138

APPENDIX A. METHOD FOR ADDING NEW TIPS 154

APPENDIX B. MONITORING STRATEGY 156

APPENDIX C. REGIONAL BMP HANDBOOK* 157

APPENDIX D. GLOSSARY 158

Table of Tables

Table 2a. Treatments Proposed 10

Table 2b. Proposed Action TIPS Summary 13

Table 2c. Maximum Allowable Herbicide Application Rates 15

Table 2d. Herbicides proposed for invasive plant control 16

Table 4a. Terrestrial wildlife species of management concern in or adjacent to the project area, including a brief analysis of habitat suitability and species occurrence 39

Table 4b. Terrestrial management indicator species habitat analysis, in or adjacent to the project area 42

Table 4c. Migratory landbirds of conservation concern in or adjacent to the project area, including a brief analysis of habitat suitability and species occurrence 45

Table 4d. Selection of MIS for Project-Level Habitat Analysis for the TIPS Project. 70

Table 4e. Soil map units with high leaching potential proposed for chemical treatment types. 83

Table 4f. Soil map units with high or very high surface runoff class proposed for chemical treatment types. 84

Table 4h. LTBMU Sensitive Plant Species and their Habitats. 110

Table 4i. Sensitive plant populations occurring within 100 feet of known TIPS populations, including proposed treatment. 115

Table of Figures

FIGURE 1. TIPS PROJECT AREA 4

FIGURE 2. TIPS PROJECT FLOW CHART 19

1.0 Summary

The Lake Tahoe Basin Management Unit (LTBMU) proposes to use mechanical, thermal, and chemical treatments in addition to manual methods to control and/or eradicate Terrestrial Invasive Plant Species (TIPS) on the Forest.

The project area encompasses all National Forest System (NFS) lands managed by the LTBMU. TIPS – or "weeds" – are spreading at an alarming rate, estimated at about 4,600 acres per day on Federal lands in the Western United States (USDI BLM 2009). The LTBMU has had an active invasive plant program for eight consecutive years using manual TIPS treatments; however, some species are difficult to control using only manual methods. This Environmental Assessment analyzes effects using manual, mechanical, thermal and chemical treatments.

This action is needed to ensure natural resources are protected, state and Federal regulations are met, and existing environmental conditions and trends in the area are moving toward desired conditions.

The Proposed Action is expected to lead to a reduction in TIPS and an improvement in native plant species composition. Duncan, et. al. (2004), reported that environmental impacts have been caused by 16 key invasive plants on rangelands and wildlands in the US. Some general observations concerning the impacts of TIPS on the environment include those to community structure (and community function. Impacts to community structure include plant species richness, rare and threatened plants, wildlife habitat modified, soil organic matter and nutrients, soil fungi, litter accumulation and decomposition rates. Impacts to community function include changes to fire frequency, nutrient cycle, soil moisture, soil physical and chemical properties, soil erosion and sediment yield, subsurface hydrology.

<u>Alternatives analyzed include:</u>

No Action Alternative (Manual Treatment Only) – The purpose of the *no action alternative* is to provide "a benchmark, enabling decision-makers to *compare* the magnitude of environmental effects of the action alternatives." Only manual control efforts, as have been utilized in the past (digging and seed head removal), would occur under this alternative. There would be no mechanical, thermal, or chemical treatments.

Under the No Action Alternative, 34 TIPS in 493 known locations (351 General Forest and 142 Urban Lots) would be treated by manual methods. Treatment

would be on approximately 8.9 infested acres[1] within 309 gross acres. Of these, 6.55 infested acres (representing approximately 74% of the total) have species that do not respond well to manual treatment, often producing one or more new plants from rhizome fragments or root buds inadvertently left in the ground when attempts are made to dig out the plant. This means that three quarters of the net acres of TIPS would be treated in such a way that it would allow the infestation to remain or expand in size. Note, also, that the TIPS that resist manual treatment are found currently at only 198 sites, which is only 40% of the total number of weed sites. Rapid and effective treatment of outbreaks of these resistant weeds at the other known weed sites or at new locations is of paramount importance.

Proposed Action (Multi-Treatment)

Treat 34 TIPS in at least 493 known locations (351 General Forest and 142 Urban Lots) on the LTBMU, by manual, mechanical, chemical, or thermal methods, or a combination of those means. There are approximately 8.9 infested acres within 309 gross acres listed in the current LTBMU weeds database. Data from the 2008 field season were used to populate this database for the NFS lands in Lake Tahoe Basin, except for the Angora Fire Burn Area. A detailed weed survey of the Angora Fire Burn Area was completed early in the 2009 field season and the resulting data have been incorporated into the LTBMU weeds database. Other weeds data, from later in 2009, are not yet available for addition to the LTBMU weeds database.

The species that are proposed for possible chemical treatment occupy about 74% of the infested acres and occur at 40% of the known weed sites. By contrast, the species for which only non-chemical treatments are proposed represent little more than one-quarter of the infested acres, but occur at more than half the known weed sites. These include known infestations of bull thistle, and known and future infestations of common/woolly mullein and field bindweed.

Two factors of concern may accelerate the occurrence and growth of weeds in the Basin. One factor is the potential for a large unforeseen event, such as a wildfire similar to the Angora Fire in 2007, or a flood, a landslide, or other large, soil-disturbing event with the potential to spread TIPS. A second factor is the potential for climate conditions favorable to the growth and spread of TIPS. These suggest that it would be prudent to plan for much larger infestations. Given that, and considering an average annual rate-of-spread of 16 to 60 percent as reported by Smith et al 1999, and the 60 percent rate-of-spread that occurred on the LTBMU from 2007 to 2009, our collective professional judgment is that there is a need to

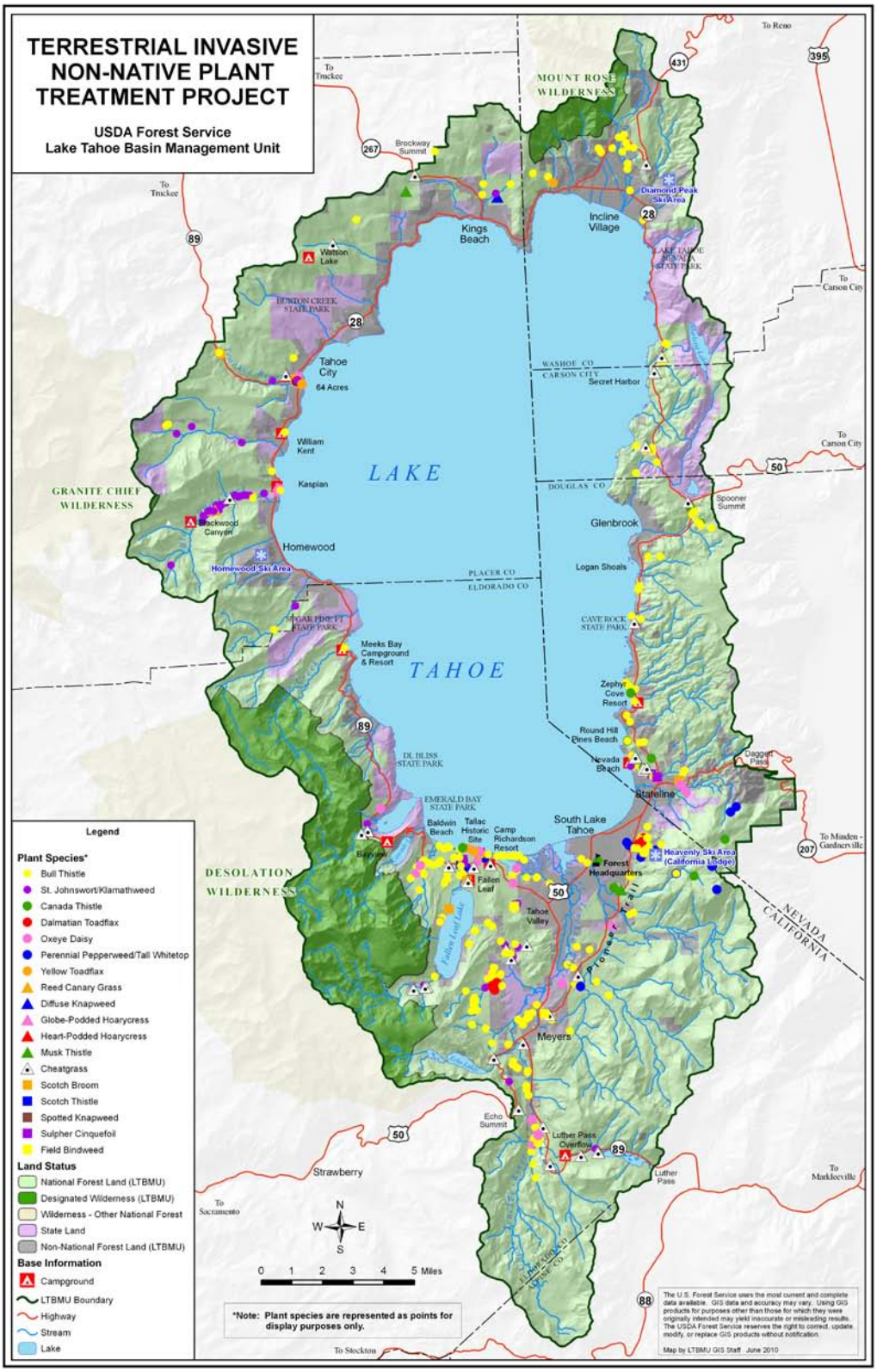
[1] Infested areas (or net areas) refer to the portions of the area that are fully covered by TIPS foliage. Gross area is the larger area that encompasses both the TIPS-foliage-covered areas and areas of bare ground or native plants.

treat up to 100 acres of TIPS annually with chemicals, and to treat as many acres as needed and feasible with mechanical, manual, or thermal methods.

In 2007, there were 5.55 infested acres found within 72.7 gross acres of TIPS on NFS lands in the Basin (Reed 2009), excluding the part of the forest burned by the Angora Fire in June 2007. By 2008, TIPS had emerged within the Angora Fire Burn Area and had begun to generate dramatic increases in gross and infested acres. The most recent data from the Angora Fire Burn Area (acquired early in the 2009 field season) were added to the 2008 data from around the Basin to form the current LTBMU weeds database. The database shows the gross infested acres of TIPS on NFS lands in the Basin to be 323% greater than in 2007, and the infested acres to have increased by 60%.

The Proposed Action includes treating previously-undetected TIPS and new sites or expanded sites using the same methods as for those at known sites. Also known as EDRR, Early Detection Rapid Response, proactively treating infestations before they grow into large and costly environmental threats is one of the most cost-effective approaches for coping with TIPS invasions. By acting early, the environmental and economic damage caused by harmful invaders is efficiently prevented, while using less intrusive techniques than pulling, mowing, etc. (Gluesenkamp 2009).

Figure 1. TIPS Project Area



2.0 Introduction

2.1 Document Structure

The Forest Service (FS) has prepared this Environmental Assessment in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and state laws and regulations. This Environmental Assessment (EA) discloses the direct, indirect, and cumulative environmental impacts that would result from the Proposed Action and No Action alternatives. The document is organized into six parts:

- *Introduction*: The section includes information on the history of the project proposal, the purpose and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- *Comparison of Alternatives, including the Proposed Action*: This section provides a description of the agency's Proposed Action alternative as well as other alternatives considered. This discussion also includes Project Design Features. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- *Environmental Consequences*: This section describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by resource area.
- *Agencies and Persons Consulted*: This section provides a list of preparers and agencies consulted during the development of the environmental assessment.
- *References:* The references section lists sources of information used or referred to in the analysis, such as journal articles, books, Forest Service policy documents, etc.
- *Appendices*: The appendices as a group provide more detailed information to support the analyses presented in this EA.

Additional documentation, including more detailed analyses of project-area resources, is included in the project planning record located at the LTBMU Supervisor's Office.

2.2 Background

The species being considered in this EA are TIPS that possess one or more of the characteristics of an invasive species and are undesirable on the LTBMU (also

referred to as the Forest). Based on Executive Order 13112, issued in 1999, a species is considered invasive if it: a) is non-native to the ecosystem under consideration, and b) its introduction causes or is likely to cause economic or environmental harm or harm to human health (USDA Forest Service 2004b).

As referenced in the Forest Service Manual (FSM 2080), the Federal Noxious Weed Act directs the Secretary of Agriculture to develop and coordinate a management program for control of undesirable plants that are noxious, harmful, injurious, poisonous, or toxic on Federal lands under the agency's jurisdiction. The state agriculture departments of Nevada (NDA) and California (CDFA) both maintain invasive plant lists that are mainly focused on agricultural 'weeds.' The California Invasive Plant Council (Cal-IPC) also maintains a list of exotic pest plants that include many wildland 'weeds' (http://www.cal-ipc.org/ip/inventory/index.php). Some of these TIPS are aggressive invaders of native plant communities and are capable of dominating native habitat types, excluding native vegetation, and reducing site diversity and productivity. Riparian habitats in particular may be especially affected. It has been estimated that, on NFS lands nationwide, at least 6 to 7 million acres are infested with TIPS, and infested acres are increasing at a rate of 8 to 12 percent each year (USDA Forest Service 1999).

Smith, et al., (1999) examined the growth rates of a variety of different invasive weeds in diverse locations around the western United States. Their study found an average expansion rate of 23.7% per year, with relatively high rates in early years and lower growth rates as an infestation matures. Their projected expansion rates for the early years of small infestations are in the range of 60%. Goodwin and Shelley suggested a more conservative annual rate of spread of 14% (2006).

On the LTBMU, infested acres of TIPS increased by 60% from 2007 to 2009, an average of 30 percent each year. Almost one-fifth (1/5th) of this increase occurred in the Angora Fire Burn Area. At roughly 2,600 acres, the Angora Fire Burn Area is less than one *fiftieth* (1/50th) of the more than 150,000 acres of NFS lands in the Basin. The weed increase in the Angora Fire Burn Area was more than 10 times as great, acre for acre, than everywhere else on the Forest.

Similar trends have been observed throughout the Forest, as the number of locations and extent of existing populations of species such as Canada thistle, cheatgrass, perennial pepperweed/tall whitetop, yellow toadflax, oxeye daisy and others have increased over the past several years (Reed 2009), and will likely continue to do so without implementation of additional, more effective control measures.

The Pacific Southwest Region Noxious Weed Management Strategy (R5 Strategy) (USDA Forest Service 2001a) addresses an overall strategy for reducing impacts from TIPS on Forests within Region 5. The R5 Strategy includes: Coordination and Cooperation; Prevention and Education; Control; Inventory, Mapping and Monitoring; Research; and Administration and Planning. Only control and monitoring (Appendix B) will be addressed further in this document.

The region's high priority is to identify and eradicate new infestations and new species on NFS lands. The objectives of the R5 Strategy include:

- Meet the requirements of NEPA on all forests, allowing them to treat 'noxious weed' infestations
- Use an Integrated Pest Management (IPM) approach to 'noxious weed' management that would include prevention, biological control, mechanical, cultural and chemical controls
- Have at least one individual trained in wildland 'weed' ecology and pesticide application on each forest
- Prepare a 'noxious weed' risk assessment for all ground disturbing projects.

This EA includes methods for evaluating new TIPS on the Forest (see Appendix A), and criteria for prioritizing which populations require control (USDA Forest Service 2001a), and provides an assessment of the most appropriate eradication or control methods for different TIPS species (Table 2a). The goal of this project is eradication of the high priority sites and high priority species, including those that currently have limited distributions on the Forest, e.g. perennial pepperweed/tall whitetop and knapweeds. Furthermore, the goal is also to control expansions of known TIPS sites, and control and prevent further spread of species with wider distribution on the Forest, e.g. cheatgrass, woolly mullein/common mullein.

The various control methods evaluated in this document include manual, mechanical, chemical, and thermal methods, and a combination of these methods.

2.3 Desired Condition

The desired condition is that the potential for the establishment and spread of TIPS on the Forest has been reduced, and TIPS infestations on the LTBMU have been eradicated or controlled.

2.4 Purpose and Need for Action

There is a rapid spread of TIPS that threatens to crowd out native plants and compromise wildland values. The purpose of this proposal is to eradicate and/or

control TIPS populations on the Forest to improve ecosystem function, native plant diversity, and wildlife habitat. There are currently 309 gross acres of TIPS identified in the LTBMU database, with 34% found within the Angora Fire area. Detailed information on the individual TIPS can be found in Section 4, Environmental Consequences, in the Affected Environment section of the TIPS portion of the Vegetation analysis.

Mountains provide valuable ecosystem services for lowland human settlements (e.g. water supply, recreation) as well as supporting rare and fragile ecosystems. Yet, because of climate conditions (i.e. changing precipitation patterns) and the rapidly growing use of mountain areas for tourism and other purposes, plant invasions into mountain areas are likely to increase, affecting biodiversity and disrupting important ecosystem services (Pauchard et al). On the LTBMU, TIPS with root systems that make them difficult to control, such as rhizomes and/or root buds, are increasing despite manual treatments. These species include, but are not limited to, oxeye daisy, yellow and Dalmatian toadflax, and tall whitetop.

In accordance with the 1974 Federal Noxious Weed Act, the Forest Service is directed to cooperate with other public and private land agencies and owners through an integrated approach to 'weed' management. This Proposed Action would allow for implementation of the control aspect of the Southwest Region Noxious Weed Management Strategy.

Furthermore, there is a need to cooperate with the Lake Tahoe Basin Weed Coordinating Group (LTBWCG) and other public and private land management agencies in eradication and control of TIPS, and to prevent establishment or spread of TIPS on or off NFS lands. The LTBWCG has been using manual, chemical, and biological methods to eradicate TIPS on non-Forest lands for the past five years. Lack of comparable, appropriate and effective eradication and control on NFS lands could cause a reduction in effectiveness of others' efforts in the Basin (Donaldson Pers. Comm. 2009).

The Forest Service also must comply with Executive Order 13112 of February 3, 1999, by:

- Detecting and responding rapidly to and controlling populations of such species in a cost effective and environmentally sound manner.
- Monitoring invasive species populations accurately and reliably.
- Providing for restoration of native species and habitat conditions in ecosystems that have been invaded.

As part of the restoration of ecosystem integrity on LTBMU lands, there is a need to eradicate or control TIPS. This need is identified at the national level in the National Strategy and Implementation Plan for Invasive Species Management (USDA Forest Service 2004b). This need is identified at the regional level in the Pacific Southwest Region Noxious Weed Management Strategy (2001a), and at the local level in the LTBMU Land and Resource Management Plan (USDA Forest Service 1988) (Forest Plan) and through documented Forest-wide TIPS surveys.

2.5 Proposed Action (Multi-Treatment)

The Forest proposes to treat TIPS[2] sites in at least 493 known locations (351 General Forest and 142 Urban Lots) on the LTBMU, by manual, mechanical, chemical, thermal, or a combination of those means. Chemical treatment of up to[3] 100 infested or net acres annually are proposed, in addition to treatment by mechanical, manual, or thermal methods of many acres as necessary and feasible. These would include existing and new or expanded TIPS sites, plus additional TIPS species if and when they occur.

If TIPS are discovered in the 356-acre Grass Lake Research Natural Area (RNA), approval for treatment will be coordinated with the Pacific Southwest Research Station Director. If herbicide use is proposed to control any infestation of TIPS in any Wilderness Area, Regional Forester approval will be sought. Thermal methods would not be used in wilderness. Currently, there are no known TIPS within any Wilderness, RNA, or Inventoried Roadless Areas on the LTBMU.

This project would be limited to ground-based applications. Project operations would begin in 2010 and would continue into the future. The Forest Service proposes to use the following treatments for any known sites of the 34 TIPS listed, and for new sites and new TIPS that have not yet been discovered (for a full description of treatment methods see Table 2a):

- **Manual treatment** – Treat as many acres as necessary and feasible. In 2009, most of the 8.9 infested acres found were treated manually; this occurred at 475 of the 493 known weed sites within the LTBMU (18 sites could not be treated due either to the potential of dispersing flowered seedtops or other limitations). Manual treatments could include digging, hand pulling, pulling using tools, clipping, mulching, and tarping.

[2] There are 34 TIPS proposed, although not all of these species are currently found on LTBMU lands.

[3] The estimated need to treat 100 acres of TIPS annually was arrived at by professional judgement, after considering an average annual rate-of-spread of 16 to 60 percent from the literature (Smith et al 1999), the 60 percent rate-of-spread that occurred on the LTBMU from 2007 to 2009, and the potential impacts of large soil-disturbing events and climate conditions favorable to weed propogation.

Treatments for woolly/common mullein and current sites of bull thistle consist of non-chemically removing the plants, utilizing volunteer groups where possible. Crews will be instructed to minimize ground disturbance and trampling of native vegetation while working at these sites. TIPS will be disposed of as necessary, minimizing soil contact with potential TIPS propagules. In locations where potential for significant seed dispersal is high from removal operations, manual treatments will be timed to minimize this risk, e.g. pulling plants or cutting and bagging will be completed before seeds are ready for dispersal.

- **Mechanical treatment** –This type of treatment could include such methods as mowing, cutting, brushing, and trimming.
- **Chemical treatment** – Treat up to approximately 100 infested acres annually. Chemicals would be used where manual treatment is ineffective at control or eradication. No aerial application of herbicides is proposed in this project. Chemical treatment would include hand/selective, directed/spot spray, or limited broadcast, and could be used to control such species as Canada thistle, perennial pepperweed/tall whitetop, spotted knapweed, Russian knapweed, Dalmatian toadflax, oxeye daisy, hoary cress, Scotch broom, sulphur cinquefoil, and yellow toadflax.
- **Thermal treatment** - would most likely be used on small plants or emerging rosettes/seedlings. Growth stage, location of growing tips, amount of heat, and duration of exposure all affect the efficacy of thermal methods. The treated acreage would be very small, estimated at 1-5 gross acres annually (about 0.02 % of the current gross acres), but could be expanded depending on degree of success with this method.

Table 2a. Treatments Proposed

Treatment Method	Description
Manual Methods	
Hand Pulling	Pulling or uprooting plants can be effective against some shrubs, tree saplings, and herbaceous invasive plants. Annuals and tap-rooted plants are particularly susceptible to control by hand-pulling. It is not as effective against many perennial invasive plants with deep underground stems and roots that are often left behind to re-sprout. The advantages of pulling include its small ecological impact, minimal damage to neighboring plants, and low (or no) cost for equipment or supplies. The key to effective hand-pulling is to remove as much of the root as possible while minimizing soil disturbance. For many species, any root fragments left behind have the potential to re-sprout, and pulling is not effective on plants with deep and/or easily broken roots.
Pulling Using Tools	Most plant-pulling tools are designed to grip the plant stem and provide the leverage necessary to pull its roots out. Tools vary in their size, weight, and the size of the invasive plant they can extract. Some examples

Treatment Method	Description
	include The Root Talon, which is inexpensive and lightweight, and the Weed Wrench, which is available in a variety of sizes. Both tools can be cumbersome and difficult to carry to remote sites. Both work best on firm ground as opposed to soft, sandy, or muddy substrates.
Clipping	"Clipping" means to cut or remove seed heads and/or fruiting bodies to prevent germination. This method is labor-intensive and effective for small and spotty infestations.
Digging	Using hand tools such as shovels and sharp shooters (shovels with a narrow blade). This is the current method for TIPS treatment.
Mulching	Covering with certified "weed free and plastic free" mulch such as rice straw, grass clippings, wood chips, or newspaper.
Tarping	Placing tarps (visqueen, geocloth or similar material) to shade out weeds or solarize (to injure by long exposure to heat of the sun) them. Tarping is most effective when the soil is damp (Harris 2009).
Mechanical Methods	
Mowing, cutting, brushing, trimming	Mowing and cutting can reduce seed production and restrict invasive plant growth, especially in annuals cut before they flower and set seed. Some species, however, re-sprout vigorously when cut, replacing one or a few stems with many that can quickly flower and set seed. These treatments are used as primary treatments to remove above-ground vegetation in combination with herbicide treatments to prevent re-sprouting, or as follow-up treatments to treat target plants missed by initial herbicide use. Also, mowing and cutting can be used, in conjunction with herbicide treatments, to reduce vegetative materials and to promote vigorous growth in order to decrease the amount of herbicide application needed, and to increase herbicide effectiveness.
Herbicide Methods	
	Herbicide treatments would include use of adjuvants such as surfactants and dyes. Adjuvants are materials that facilitate the activity of herbicides, such as the emulsifying, dispersing, spreading, wetting, or other surface modifying properties of liquids; and dyes assist the applicator in efficiently treating target TIPS and also avoiding contact with herbicide-treated plants by showing which plants have been treated already.
Hand/ Selective	Treatment of individual plants using land-based equipment to avoid other non-target plants. There is a low likelihood of drift or delivery of herbicides away from treatment sites, because with these methods there should be no drift. These methods are used in sensitive areas, such as near water, to avoid getting any herbicide on the soil or in the water. Hand/Selective methods could be done under more variable conditions than spot spraying or broadcast spraying (Tu et al., 2001). Specific methods include: <u>Dip & clip</u> – similar to cut stump, where cutting tool is first dipped in herbicide, then used to cut target TIPS to be treated <u>Hack & Squirt, Cut & Squirt, Cut stump</u> – herbicide is sprayed on cut surfaces to eliminate or greatly reduce re-sprouts; this is an individual target TIPS treatment <u>Wicking & wiping</u> – herbicide is wiped onto the target TIPS with the wick of the applicator
Directed/ spot spray	Accomplished by land-based backpack sprayer with wand with regulated nozzle so that spray is concentrated at the target TIPS
Limited broadcast spray	Hand application with land-based backpack sprayer while wetting more than one target TIPS plant at a time; used for dense occurrences of target TIPS where individual plant application would not be effective.
Other Methods	
Thermal	Thermal methods are based on the systematic increase of plant temperature, reaching diverse thermal death points to eliminate the vegetation. Steaming, flaming, torching, infrared, microwave, and similar methods to be

Treatment Method	Description
	done only when weather conditions permit, such as in a wet season (spring). Equipment for these methods is produced by various companies and may include an open flame. However, flame/fire is not the prerequisite for this method, since temperatures to accomplish cell death are generally 50-70 degrees C, significantly below the temperatures attained by some propane burners (e.g. 1,900 C). Bladders and hand tools such as shovel and Pulaski are required when using this method (see Design Features). This method is especially useful for small plants, plants in the rosette stage, or seedlings. Larger weeds that are removed using other methods often release the seeds in the seed bank to germinate, which results in a flush of seedlings at that location. Thermal treatment would be a possible choice in treating these seedlings. Fuels burning is not part of this project. Thermal would not be used within wilderness.

Herbicide treatment is being considered as an option for control of 31 of the 34 TIPS species in the LTBMU weeds database, and this may occur at 198 sites or more on the Forest (see Table 2b for a summary of treatments for all 34 species). Three of the 34 species in the database were eliminated from further consideration for chemical treatment: bull thistle, field bindweed, and woolly/common mullein. Non-chemical treatments are proposed for bull thistle (found at 293 of the 296 locations in the LTBMU weeds database), and also for both known and future sites of field bindweed and woolly/common mullein (also widespread). Another 14 of the 34 TIPS in the database currently have no known sites on the Forest, because the plants have been removed, and/or are found on adjacent non-Forest lands; 10 of those 14 previously known species were completely removed by 2009, and four new species of TIPS (Rush skeletonweed, Poison hemlock, Dyer's woad, and Himalayan blackberry) were found adjacent to or on the Forest in 2009 at only one location each and were manually removed. Of the remaining 17 TIPS in the LTBMU weeds database, some may be treated effectively by non-chemical methods (see DF-36: manual treatment will be utilized in lieu of chemical treatment where effective). However, where manual treatment is ineffective at control or eradication, herbicides would be used.

Eradication is the goal for those species identified as "high" priority, where feasible, such as when there are few sites of that species, or the sites are small. Control is the goal for the remaining species. For species with priority ratings of "low" or "very low", and for some with priority ratings of "moderate", the goal of control will be met by attempting to eradicate the smaller, isolated infestations while exerting the best control feasible over other infestations through containment, prevention and other integrated pest management measures. TIPS locations can be found in the Project Record (L1-L8). Information on this project can be found at: http://fs.usda.gov/goto/ltbmu/InvasivePlantTreatment.

Table 2b. Proposed Action TIPS Summary

	TIPS Species	Proposed Treatment Methods	Scope* (# locations; net expanded acres[2])	Priority/Goal
1	Russian knapweed (*Acroptilon repens*)	All methods	0 locations/0 ac.	High/Eradicate
2	Tree of Heaven (*Ailanthus altissima*)	All methods	0 locations/0 ac.	High/Eradicate
3	Cheatgrass (*Bromus tectorum*)	All methods	39 locations (but also widespread)/1 ac.	Generally Low/Control
4	Heart-podded hoary cress (*Cardaria draba*)	All methods	1 location/0.000689	High/Eradicate
5	Globe-podded hoary cress (Cardaria pubescens)	All methods	1 location/0.0001	High/Eradicate
6	Musk thistle (Carduus nutans)	All methods	3 locations/ 0.012626ac.	High/Eradicate
7	Purple starthistle/ Centaurea calcitrapa	All methods	0 locations/0 ac.	High/Eradicate
8	Diffuse knapweed (Centaurea diffusa)	All methods	1 location/0.00002	High/Eradicate
9	Yellow starthistle (Centaurea solstitialis)	All methods	0 locations/0 ac.	High/Eradicate
10	Spotted knapweed (Centaurea stoebe ssp. micranthos (aka Centaurea maculosa)	All methods	1 location/0.000045 ac.	High/Eradicate
11	Squarrose knapweed (Centaurea virgata ssp. squarrosa)	All methods	0 locations/0 ac.	High/Eradicate
12	Rush skeletonweed (Chondrilla juncea)	All methods	0 locations/0 ac.	High/Eradicate
13	Canada thistle (Cirsium arvense)	All methods	14 locations/0.080716 ac.	High/Eradicate
14	Bull thistle (Cirsium vulgare)	Manual, mechanical, thermal for current locations. All methods for new and expanded infestations.	293 locations/2.352106 ac.	Moderate/Control
15	Poison hemlock (Conium maculatum)	All methods	0 locations/0 ac.	Moderate/Control
16	Field bindweed (Convolvulus arvensis)	Manual, mechanical, thermal	2 locations/0.001400 ac.	Low/Control
17	Scotch broom (Cytisus scoparius)	All methods	3 locations/0.004591	High/Eradicate
18	Teasel (Dipsacus fullonum)	All methods	0 locations/0 ac.	Moderate/Control
19	Stinkwort (Dittrichia graveolens)	All methods	0 locations/0 ac.	High/Eradicate
20	Quackgrass (Elytrigia repens)	All methods	Unknown number of locations/0 ac.	Generally Low/Control
21	St. Johnswort/Klamathweed (Hypericum perforatum)	All methods	51 locations/0.710093 ac.	Generally Low/Control
22	Dyer's woad (Isatis tinctoria)	All methods	0 locations/0 ac.	High/Eradicate
23	Perennial pepperweed/Tall Whitetop (Lepidium latifolium)	All methods	18 locations/1.084238 ac.	High/Eradicate
24	Oxeye daisy (Leucanthemum vulgare)	All methods	31 locations/3.539962 ac.	Generally Low/Control

	TIPS Species	Proposed Treatment Methods	Scope* (# locations; net expanded acres[2])	Priority/Goal
25	Dalmatian toadflax (Linaria dalmatica)	All methods	14 locations/0.005850 ac.	High/Eradicate
26	Yellow toadflax (Linaria vulgaris)	All methods	13 locations/0.99725 ac.	High/Eradicate
27	Purple loosestrife (Lythrum salicaria)	All methods	0 locations/0 ac.	High/Eradicate
28	Scotch thistle (Onopordum acanthium)	All methods	1 location/0.000115 ac.	High/Eradicate
29	Reed canary grass (Phalaris arundinacea)	All methods	2 locations/0.001905	Generally low/Control
30	Sulfur cinquefoil (Potentilla recta)	All methods	5 locations/0.008019 ac.	High/Eradicate
31	Himalayan blackberry/ Rubus armeniacus	All methods	0 locations/0 ac.	High/Eradicate
32	Medusahead (Taeniatherum caput-medusae)	All methods	0 locations/0 ac.	Generally Low/Control
33	Tamarisk/Salt cedar (Tamarix sp.)	All methods	0 locations/0 ac.	High/Eradicate
34	Woolly mullein/Common mullein (Verbascum thapsus)	Manual, mechanical, thermal	Wide-spread	Generally Low/Control

TOTALS = 34 TIPS; 493 locations; 8.9 acres **24 species eradicated and 10 species controlled[4]**

*TIPS with zero acres have either been treated with no plants remaining, or are found within the Basin but not on NFS lands, or have been found very close to the Basin but have not yet been found within the Basin.

Herbicide Treatments

The Forest is proposing to use the following herbicides to treat invasive plant species: Aminopyralid, Chlorsulfuron, Glyphosate, and Triclopyr. Triclopyr triethylamine salt (TEA) is the formulation of Triclopyr proposed. For ease of application, aquatic formulations of herbicides will be used, when available; currently, only Glyphosate and Triclopyr have aquatic formulations available. These will be used not just near sensitive aquatic environments, but also for weed treatments in drier, non-riparian land. In this way, workers will not have to carry simultaneously two separate formulations (aquatic and non-aquatic) in the field. Maximum allowable application rates are found in Table 2c.

[4] Up to 24 species would be eradicated under the Proposed Action; not all of the known species were found in the LTBMU in recent surveys, due to prior eradications. Up to 10 species would be controlled under the Proposed Action, including teasel, poison hemlock, and medusahead, which also were not found in LTBMU in recent surveys, due to prior eradications.

Table 2c. Maximum Allowable Herbicide Application Rates

Herbicide Formulation	Maximum Allowable Application Rate (pounds/acre)
Aminopyralid	0 .25 lbs (ae)
Chlorsulfuron	0.14 lbs/acre (ai)
Glyphosate	2.7 lbs/acre (ae)
Aminopyralid and Triclopyr premix	0.11 lbs (ae) Aminopyralid + 1.12 lbs (ae) Triclopyr acid

Because herbicides have the potential to adversely affect the environment, the U.S. Environmental Protection Agency (EPA) must register all herbicides prior to their sale, distribution, or use in the United States. In order to register herbicides for outdoor use, the EPA requires the manufacturers to conduct toxicity testing on representative species of birds, mammals, freshwater fish, aquatic invertebrates, and terrestrial and aquatic plants. An ecological risk assessment uses the data collected to evaluate the likelihood that adverse ecological effects may occur as a result of herbicide use. The LTBMU will only use those herbicides registered by the EPA.

The Forest Service conducts its own risk assessments, focusing specifically on the type of herbicide uses in forestry applications. The FS contracts with Syracuse Environmental Research Associates, Inc. (SERA) to conduct human health and ecological risk assessments for herbicides that may be proposed for use on NFS lands (SERA 2007a).

The SERA risk assessments represent the best science available, using peer-reviewed articles from the scientific literature and current US EPA documents, such as Confidential Business Information, to estimate the risk of adverse effects to non-target organisms. The risk assessments consider worst-case scenarios including accidental exposures and application at maximum label rates. Only herbicides that have SERA risk assessments are proposed in this action.

Table 2d. Herbicides proposed for invasive plant control

Common Name	Example Trade names	Mode of Action	Weed Spectrum	Soil residual	Registered in California	Effective timing
Aminopyralid	Milestone®, Milestone Plus®,	Growth regulator	Broadleaf species	Less than 2 weeks	Yes	Postemergence only, from seedling to bolting
Chlorsulfuron	Telar®	Amino acid synthesis inhibitor	Mainly broadleaf species	At least 2 months	Yes	Pre- or post emergence
Glyphosate	Rodeo® and others	Amino acid synthesis inhibitor	Non-selective	None	Yes	Postemergence only, from seedling to early flowering
Aminopyralid and Triclopyr premix	Milestone VM Plus	Growth regulator	Broadleaf species and woody plants	Up to 6 months	Yes	Postemergence when plants are actively growing

In 2003, the Lahontan Regional Water Quality Control Board (LRWQCB) approved Chlorsulfuron and Glyphosate for use in the Tahoe Basin, and in 2009, the LRWQCB approved the use of Aminopyralid and Triclopyr on the LTBMU (LRWQCB 2009) (Project Record Document I2). Aminopyralid and Triclopyr offer many advantages over Chlorsulfuron and Glyphosate, including greater selectivity for invasive plants, less harm to desired vegetation, reduced application rates, and lower toxicity to wildlife and people. The LTBMU would use only those herbicides approved for use by the LRWQCB[5].

All herbicides would be applied with a hand held applicator using one of several methods: “wipe & wick” applied directly to foliage and/or cut stumps, the “hack and squirt” method into tree trunks, “clip & dip”, directed/spot spray, or limited broadcast spray. The herbicide application rates (Table 2c) refer to recommended maximum rates for spraying; actual application rates using dip & clip and a wipe & wick applicator will be lower.

The use of an approved marker dye will visually confirm the location of the herbicide application, in order to ensure that the application is limited to the targeted TIPS and to reduce the risk of exposure to non-target organisms. Signs will be posted to alert the public as to the location and types of treatments being done (DF-27). Subsequently, signs will be removed no sooner than 48 hours after application, but as soon as possible after that period. Herbicide treatments at

[5] Many herbicides can be used legally within the state of Nevada, but the Lahontan Regional Water Quality Control Board has only approved a limited number of herbicides for use on the CA side of the Lake Tahoe Basin. Therefore, the most restrictive regulation is used as a baseline for this project.

administrative sites or trailheads will not be conducted during periods of high public use, e.g. high use summer weekends or holidays.

The total amount of herbicide (active ingredient) that will potentially be used on the Forest is estimated at less than 10 pounds annually. This is 0.002% of the amount used by other agencies in 2007 in Alpine, El Dorado, and Placer counties alone (California Department of Pesticide Regulation (CDPR) http://www.cdpr.ca.gov).

Proposed herbicide treatments would be implemented during the time of the year when chemical application would be most effective for a particular TIPS and its phenology.

Appendix B contains a monitoring strategy for this project to ensure that treatments are effective and the project is being implemented as designed. Monitoring would be accomplished as funding and personnel are available.

At any site on which herbicides are used, any recurrence of the TIPS infestation will be promptly re-treated to ensure successful eradication.

Reseeding with native species may be implemented at some sites to aid the re-establishment of native vegetation (see DF-13).

Herbicides will be applied according to label directions and applied and monitored in accordance with Best Management Practices for water quality (USDA Forest Service 2000) and with direction in the Forest Service Manual (FSM 2080, 2150 and 2200) and Handbook (FSH 2109.14). A Pesticide Use Proposal (PUP) (FS-2100-2) and safety plan (FS-6700-7) will be completed by the project lead prior to any herbicide use. (Herbicides are plant-specific pesticides.) The Regional Forester has delegated signing authority annually of the PUP to the Forest Supervisors, except in Wilderness and Research Natural Areas. The Pesticide Use Spill Plan can be found in the project file.

Of the 34 TIPS currently in the LTBMU weeds database, all but three are proposed for potential chemical treatment. The exceptions are woolly/common mullein and the currently known bull thistle infestations. However, manual, mechanical, or thermal treatment will be utilized in lieu of chemical treatment where effective (DF-36).

Future treatments

This project proposes to treat new infestations, expanded infestations, and new species of TIPS. Methodology to determine new species of TIPS to be treated can be found in Appendix A. New species recommended for treatment are given a “0” or

"1" after each question. A higher score in the final tally would result in a higher priority rating for inclusion in the LTBMU TIPS treatment program.

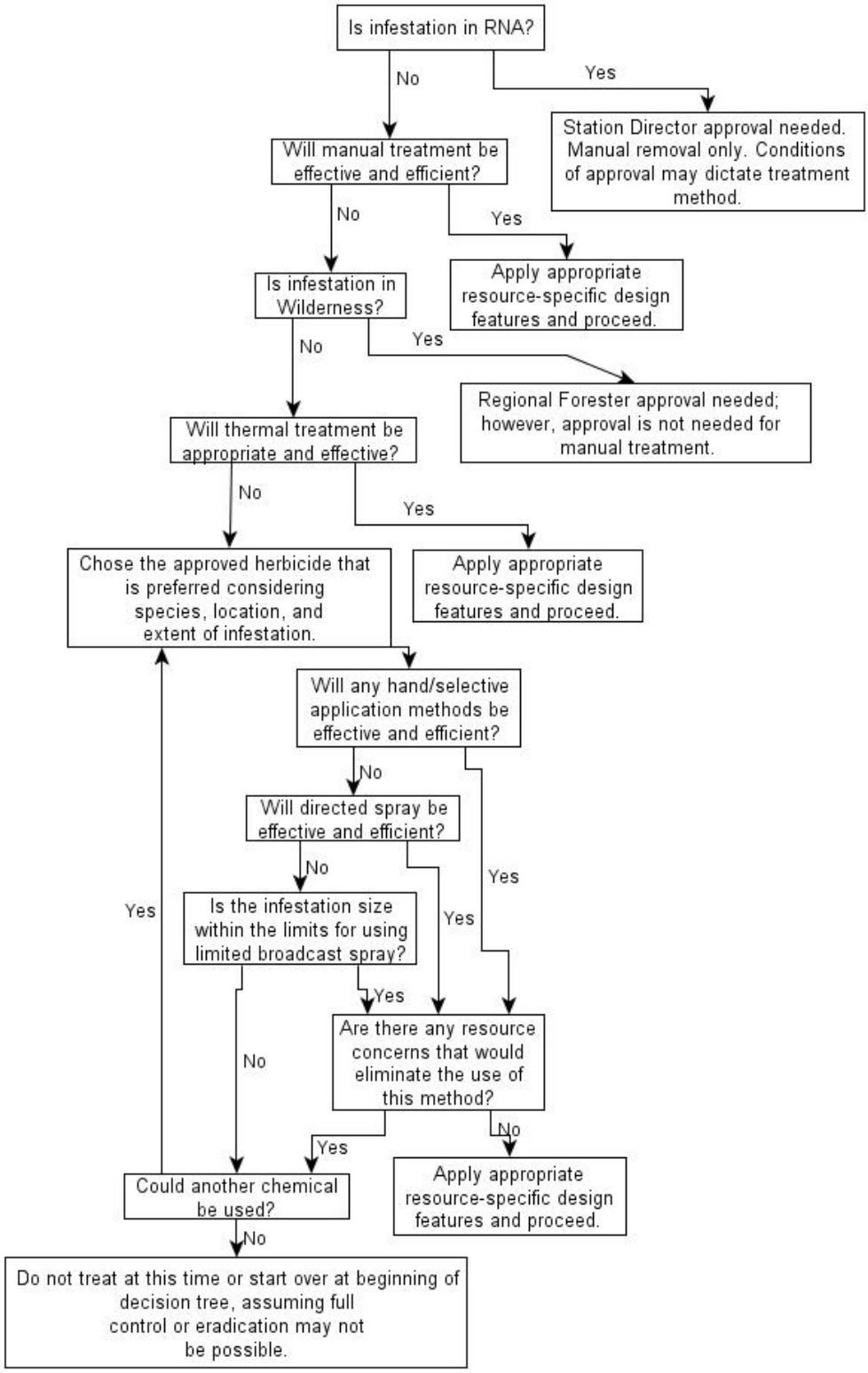
Treatment methods and Design Features for new infestations, expanded infestations, and new species would be the same as those proposed in this project for known infestations (see Table 2a and the section on Design Features). A TIPS Treatment Flow Chart (Fig. 2) explains the decision process for prioritizing future treatments.

Future treatments are a critical component of any effective invasive species management program. A prompt and coordinated containment and eradication response can reduce environmental and economic impacts. This action results in lower cost and less resource damage than implementing a long-term control program after the species is established, and requires vigilance and monitoring of the managed area and surrounding ecosystem. [6]

Each state's laws for pesticide use (Department of Pesticide Regulation for California, and Department of Agriculture for Nevada) will be followed.

[6] The Forest Service is well suited to improve its early detection capabilities through the collaborative and coordinated efforts of the LTBWCG. For more information on this topic, refer to http://www.fs.fed.us/foresthealth/management/fhm-invasives.shtml.

Figure 2. TIPS Project Flow Chart



2.6 Management Direction

The following section summarizes key applicable management direction for this project:

Forest Plan, page IV-44, Forest Pest Management Standards and Guidelines:

> Follow an Integrated Pest Management (IPM) approach during the planning and implementation of resource management activities, particularly those influencing the vegetation. Under this IPM approach, a full range of pest management alternatives, including cultural, biological, mechanical, and chemical methods will be considered and analyzed on a site-specific, project level basis. The treatment method(s) will be selected through the environmental analysis process which will consider the environmental effects, treatment efficacy and cost effectiveness of each alternative. Monitoring and enforcement plans to implement specific measures will be determined during this site and project-specific process. Pest detection, surveillance, evaluation, prevention, suppression, and post-action evaluation are integral components of the integrated pest management approach (36 CFR 219.27 (a) (3)).

The Forest Plan has been reviewed in consideration of this project. This project was designed to be consistent with the Forest Plan. A Forest Plan consistency review for this project was completed (Project Record Document B1).

Sierra Nevada Forest Plan Amendment, Management Direction, ROD page 36:

> Goals for noxious weed management are to manage weeds using an integrated weed management approach according to the priority set forth in FSM 2081.2:
>
> - Priority 1. Prevent the introduction of new invaders.
> - Priority 2. Conduct early treatment of new infestations.
> - Priority 3. Contain and control established infestations.

Provisions for implementing these goals are embodied in the noxious weeds management standards and guidelines.

Sierra Nevada Forest Plan Amendment, Management Standards and Guidelines, ROD page 54-55:

> 37. Work cooperatively with California and Nevada State agencies and individual counties (for example, Cooperative Weed Management Areas) to: (1) prevent the introduction and establishment of noxious weed infestations and (2) control existing infestations.
>
> 40. Minimize weed spread by incorporating weed prevention and control measures into ongoing management or maintenance activities that involve ground disturbance or the possibility of spreading weeds. Refer to weed prevention practices in the Regional Noxious Weed Management Strategy.
>
> 46. Consult with American Indians to determine priority areas for weed prevention and control where traditional gathering areas are threatened by weed infestations.

48. As outlined in the Regional Noxious Weed Management Strategy, when new, small weed infestations are detected, emphasize eradication of these infestations while providing for the safety of field personnel.

49. Routinely monitor noxious weed control projects to determine success and to evaluate the need for follow-up treatments or different control methods. Monitor known weed infestations, as appropriate, to determine changes in weed population density and rate of spread.

Pacific Southwest Region Noxious Weed Management Strategy 2001

(previously explained, see Section 2.2 Background.)

Forest Service Manual 2080:

Outlines agency responsibilities for noxious weed control.

Federal Noxious Weed Act of 1974, as amended (7. U.S. C. 2801 et. seq.)

Established a Federal program to control the spread of noxious weeds.

36 C.F.R. 222.8:

In part, this law states that the Chief of the Forest Service will cooperate with county or other local weed control districts in analyzing noxious farm weed problems and developing control programs in areas of which the National Forests and National Grasslands are a part.

Departmental Regulation 9500-10

Sets forth Departmental policy relating to the management and coordination of noxious weeds activities among the agencies within the USDA and other entities.

Noxious Weeds Executive Order 13112

The intent of Executive Order 13112 is to prevent the introduction of invasive species and provide for their control, and minimize the economic, ecological, and human health impacts that invasive species cause. A 'noxious weed risk assessment' (Project Record Document K1) was completed for the project and design features were included in the proposed action to reduce the potential introduction and/or spread of invasive plant species within the project area.

Other management direction containing goals and objectives for management of TIPS on the LTBMU

Pacific Southwest Region: Noxious Weed Strategy and Plan of 2001;

Regional Water Quality Control Board and Lake Tahoe Basin Weed Coordinating Group (LTBWCG) Agreement Governing Herbicide Applications by the LTBWCG 2003 (update pending);

Lake Tahoe Basin Weed Coordinating Group (LTBWCG) Memorandum of Understanding (2008).

Applicable management direction in all of the above documents, as well as all applicable laws, regulations, and appropriate agency policies are incorporated into the Proposed Action and Alternatives for this project.

2.7 Decision Framework

The decision to be made by the Forest Supervisor is:

1. To implement the proposed action or take no action at this time, and
2. Provide sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement or a Finding of No Significant Impact (Forest Service Handbook 1909.15, Ch. 41).

The decision to implement the proposed action would authorize manual treatment of infestations in wilderness. If it were determined that a new infestation of TIPS had occurred in wilderness areas that would require the use of herbicides, the Regional Forester is the responsible official who would make the decision whether to treat these TIPS with herbicides (FSM 2320). Project Design Feature 20 requires that if new infestations were discovered in any of the three wilderness areas on the LTBMU, coordination and approval by the Regional Forester would be sought before implementing any treatments.

If it were determined that a new infestation of TIPS had occurred in an RNA, the responsible official would be the Pacific Southwest Research Station Director (FSM 4060). Project Design Feature 19 requires that if new infestations were discovered within the Grass Lake RNA, the Forest Supervisor for the LTBMU would need to coordinate and request approval for all corresponding treatments with the Station Director.

Biological controls are not a part of this decision. Funding for this environmental analysis was provided by the Southern Nevada Public Land Management Act (SNPLMA). Funding was obtained for this project to approve only herbicide use on the LTBMU. Adding biological controls as a part of this decision would not be appropriate at this time because they were not approved for inclusion during the request for funding.

This decision does not include the use of borax (a fungicide). Borax is used on cut stumps to control the spread of annosus root fungus. Borax use will be decided upon on a case by case basis during vegetation/fuels project NEPA analyses.

2.8 Public Involvement

This project was listed in the Schedule of Proposed Actions (SOPA) for the LTBMU on April 2, 2009. The Proposed Action was sent out for public comment via a scoping letter on October 16, 2009. In addition to the SOPA and scoping letter, the Proposed Action was posted on the LTBMU website during the scoping period (http://www.fs.fed.us/r5/ltbmu/projects); eleven responses were received.

As a result of comments received during scoping, we have refined the Proposed Action and Design Features.

2.8.1 Issues

The Forest Service separates issues into three groups: (1) Non-Significant Issues, (2) Significant Issues considered but eliminated from detailed study, and (3) Significant Issues.

- **Non-Significant Issues** do not meet the Purpose and Need for the project; are outside the scope of the proposed action; are already decided by law, regulation, or Forest Plan; are not supported by scientific evidence; are addressed by project design features; or are addressed by additional information or clarification of the proposed action. Non-Significant issues also represent opinions and statements which do not present problems or alternatives.
- **Significant Issues considered but eliminated from detailed study** meet the Purpose and Need for the project but were considered in alternatives already studied and eliminated, or additional project design features were developed which reduced or eliminated the effects.
- **Significant Issues** meet the Purpose and Need for the project and are "significant" in the extent of the geographic distribution, the duration of effects, or the intensity of interest or resource conflict and therefore merit consideration for the development of an alternative to the proposed action.

The Council on Environmental Quality (CEQ) NEPA regulations require this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…" A list of non-significant issues and reasons regarding their categorization as non-significant may be found in the Scoping Summary Report (Project Record Document E1).

The Forest Service identified one significant issue raised during scoping:

Issue #1 – The LTBMU should not use additional buffer zones, beyond those listed on the herbicide labels, when using herbicides near waterways. By constraining the areas that herbicides can be utilized, the effectiveness of the LTBMU eradication program could be compromised. By following the label as the legal guide and choosing appropriate herbicide application methods as outlined in the proposed action, herbicides can be the most effective and safe treatment choice in riparian areas.

3.0 Comparison of the Alternatives

This chapter describes and compares the alternatives considered for the Terrestrial Invasive Plant Species Treatment Project. It describes each action alternative considered under Section 3.1.2. This section also presents the alternatives in comparative form, defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public.

3.1 Alternatives

3.1.1 Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives may have been outside the scope of the need for the proposal, duplicative of the alternatives considered in detail, or determined to be components that would cause unnecessary environmental harm. Therefore, a number of alternatives were considered, but eliminated from detailed study for the reasons summarized below:

1. Aerial Application of Herbicides.
Aerial application of herbicides was not considered in detail. The identified project areas are small enough in size to allow for cost-effective manual removal and localized, spot treatments with an appropriate herbicide, limiting the application to target plant species.

2. Prescribed Fire Control Methods.
The use of prescribed fire to control TIPS was not considered in detail. Many of the TIPS considered in this proposal, particularly the more tenacious, deep-rooted perennial species, respond favorably to burning, exacerbating the existing problem. In addition, many of the target TIPS infestations are small and/or scattered, and/or are located in habitats that are not conducive to successful burning.

Utilizing fire to control TIPS will continue to be considered if appropriate situations arise. Appropriate situations may include burning using an integrated approach to control. In California, prescribed burning for the control of shrubs is most widely used on broom species such as Scotch broom (Cytisus scoparius (L]). Like most legumes, they have long-lived seed-banks. In addition, fire scarifies their seeds and stimulates germination in the following season. Consequently, successful

management strategies must be long-term and should integrate methods that can deplete the seedbank (DiTomaso and Brooks 2006). In such cases, separate NEPA analysis would be completed.

3. Herbicide Control Alone

The use of just herbicides without any other control methods was not considered in detail. The Forest recognizes the need to consider alternate treatments, where those treatments are cost effective. The use of herbicides is most applicable on the identified project areas on LTBMU when other eradication methods are not likely to succeed and when used in spot application to individual plants in combination with other methods. Use of other methods will allow for minimizing the amount of herbicide use on the Forest.

4. Use of Alternative Substances to Registered Pesticides

The use of alternatives to registered pesticides was not considered in detail. Alternatives (e.g. substances such as hot foam, hot water, Burn-out, corn gluten, sugar, etc.) were investigated. These approaches have shown the same issues as handpulling alone for those species where herbicide use is proposed (i.e. incomplete effectiveness on deep-rooted sprouting perennials, such as those targeted for treatment (tall whitetop, knapweed, hoary cress, etc.)). In addition, the application of these substances tends to be less specific due to application methods, thereby having a greater effect on non-target species than either hand pulling or herbicide applied with a wick, clip & dip, or directed spray, particularly on native vegetation.

It is highly desirable to retain as much native vegetation as possible while treating TIPS. Available information on other substances (e.g. Burnout (Biocontrol Network 2005; Tu 2004)) indicates limited or unknown effectiveness on perennial species, particularly deep-rooted perennials. Corn gluten is effective when a seedling is just starting to grow, prior to much root elongation, and as such, is not effective in controlling established, aggressive perennials. In addition, corn gluten requires at least 500 lbs/acre, and needs to be watered as part of the application process, making it impractical in many remote field situations.

5. No Additional Buffers over Label Directions

The comment to use only label direction with no additional buffers was not considered in detail. The Proposed Action includes application of certain chemicals using specific application methods (see Design Features #2, 3 and 4) with no additional buffers. It was determined that the LTBMU would apply herbicides in the most conservative manner when environmental concerns are present, such as when there are concerns involving aquatic species.

3.1.2 Alternatives Considered in Detail

Alternative 1 – No Action (Manual Treatment Only)

Treatments of known, new, and expanding TIPS infestations would be done by the current manual methods only: hand pulling, pulling using tools, and clipping.

Alternative 2 - Proposed Action (Multi-Treatment)

The Proposed Action would treat known, new, and expanding TIPS infestations through a combination of manual methods (hand pulling, pulling using tools, and clipping), mechanical methods, thermal methods, and chemical methods. See Section 2.5 for a complete description of the Proposed Action.

3.2 Design Features

The following design features apply to all treatments, as appropriate, and are included as part of this project to minimize environment impacts and ensure Forest Plan consistency. Those Design Features that include criteria for the use of chemicals apply to Alternative 2 only.

3.2.1 Special Status (Threatened, Endangered, Candidate, Forest Sensitive, TRPA[7] Special Interest, Management Indicator, and Migratory Bird Species) Wildlife and Fisheries

1. Where possible, manual weed treatment methods will be utilized within 50 feet of perennial rivers, streams, lakes and other water bodies, including seasonally flooded Stream Environment Zones (SEZs)[8].
2. Chlorsulfuron and Triclopyr will not be applied within 50 feet of perennial rivers, streams, lakes, and other water bodies, including seasonally flooded SEZs.
3. Only dip & clip, wicking & wiping, or spot spraying applications of Glyphosate or Aminopyralid will be used within 50 feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows, including adjacent to occupied Lahontan cutthroat trout and Sierra Nevada yellow-legged frog habitats (consistent with Sierra Nevada Forest Plan Amendment (SNFPA) Standard and Guideline #98). This DF also pertains to Hydrology/Water Quality.
4. Only dip & clip and wicking & wiping applications of Aminopyralid or the aquatic formulation of Glyphosate will be used within 10 feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows. This DF also pertains to Hydrology/Water Quality.

---

[7] Tahoe Regional Planning Agency

[8] Unless otherwise noted, SEZs will be based on the riparian vegetation layer for the Forest, and field checked prior to implementation.

5. When applying aquatic formulations of herbicides near water, a surfactant registered by California Department of Pesticide Regulation for aquatic use will be utilized that does not list as an ingredient Nonylphenol Ethoxylates, “NPE."
6. Herbicide applications will not take place within six hours of predicted rainfall that has a high probability of producing measurable runoff, or as requested by the Aquatics Biologist, and as found in the label directions. Spot weather forecasts will be made available to the applicator. This DF also pertains to Hydrology/Water Quality.
7. Streams or other surface waters must not be used for washing herbicide application equipment or personnel, unless required in an emergency situation. However, Pesticide Worker Safety Regulations require that water, soap and a towel be available within ¼ mile of field workers and at mixing sites (Project Record L30). This DF also pertains to Hydrology/Water Quality.
8. Mixing of herbicides for application will take place more than 100 feet from perennial rivers, streams, lakes and other water bodies, and outside of SEZs. This DF also pertains to Hydrology/Water Quality/Soils and is consistent with SNFPA Standard and Guideline #99.
9. The noxious weed coordinator will inform the project or staff biologists for fisheries and wildlife of new infestations before each treatment season, to verify that treatments would not disturb nesting or denning activity of any special status wildlife species. This information will be used to verify that treatments will not impact Lahontan cutthroat trout, yellow-legged frog, or other species habitat or populations. Limited operating periods for all special status wildlife species will be implemented as necessary, based on the most current wildlife data from pre-project field surveys, or habitat suitability as determined by the project biologist. Most vegetation management activities are prohibited during limited operating periods (LOP), unless surveys confirm that nests are uninhabited (SNFPA 2004).
10. Any incidental sightings of special status fish and wildlife species will be reported to the project or staff biologists. Active nests or dens will be protected according to management direction found in the LTBMU Forest Plan and Sierra Nevada Forest Plan Amendment code of ordinances. Species identification, known locations, and protection procedures will be discussed during a pre-treatment meeting.
11. TIPS occur within 0.25 mile of osprey nests designated as Fallen Leaf Lake 04 and South Lake Tahoe 06. Both nests were active in 2008. A limited operating period of March 1 through August 15 applies, unless surveys confirm that osprey are not nesting.

3.2.2 Hydrology/Water Quality/Soils

12. State and Regional Water Quality Control Board certified Best Management Practices will be implemented. BMPs applied to all Forest projects are outlined in the Water Quality Management for Forest System Lands in California, BMP handbook. See Appendix C for BMPs appropriate for this project and references to the associated design features outlined in section

3.2. Referenced design features provide additional information as to how these BMPs will be applied on this project. Weed infestation size and density criteria will be used to delineate degree of LRWQCB notification and involvement, as below (Project Record I5).

- Where infestations are less than one acre in size and rapid action is required to prevent impending seed production, notify LRWQCB with request for "return in 48-hour" response. The LRWQCB will notify the Forest within two days if anything more is needed prior to treatment. If the LRWQCB does not respond, it can be interpreted that the agency does not need anything additional (Bruce Warden, personal communication 3/18/2010).
- Where infestation areas are greater than one acre, or are within 25 feet of a water surface, or infestation areas are from ¼ to 1 acre and so do not require rapid consultation for seed production control, full consultation with LRWQCB is required prior to treatment.

13. Rehabilitation of disturbed sites will be accomplished using local native plant species. Areas with greater than 0.1 acre of bare soil created by the treatment of TIPS would be evaluated for rehabilitation and revegetation. Temporary Best Management Practices, such as use of rice grass mulch, will be implemented as needed.

3.2.3 Heritage Resources

14. Weed treatments will be coordinated with the Forest Heritage Resource specialist to protect resources such as traditional plant gathering areas, rock art, and historic structures in both Nevada and California. In California, soil disturbance will be limited to one cubic meter per acre, without prior authorization from the heritage resources specialist. (R5 Programmatic Agreement for minimum disturbance activities with State Historic Preservation Officer)
15. Herbicides will not be used to treat TIPS in any Area of Concern or gathering site for the Washoe Tribe without consultation with the Tribe. If weeds become established in the future, consult with the Tribe on suitable treatment methods.
16. Cultural surveys will be conducted as needed and evaluation will occur on a case by case basis. Existing properties will be considered with each treatment of weeds.

3.2.4 Forest Service Sensitive and Special Interest Plant Species

17. The project or staff Botanist will be consulted prior to chemical treatment of new TIPS occurrences or expanding occurrences, to ensure that Threatened, Endangered, Proposed, Candidate, and Sensitive (TEPCS) plant species are not affected.
18. Only wicking & wiping, dip & clip, and non-chemical treatments may take place within 100 feet of sensitive plants.

3.2.5 Management Areas and Adjacent Non-Forest Areas

19. If TIPS are discovered in the Grass Lake RNA, approval for treatment will be coordinated with the Pacific Southwest Research Station Director. Refer to FSM 4060.
20. If herbicide use is proposed to control an infestation of TIPS in any Wilderness Area (Desolation, Granite Chief, Mt. Rose), Regional Forester approval will be sought. Refer to FSM 2320.
21. Property boundary locations will be confirmed before all TIPS treatments.

3.2.6 Recreation, Special Uses and Recreation Residences

22. The Recreation Department will be consulted prior to treatment near public developed recreation sites, areas of concentrated public use such as trailheads, and publicly and privately operated water systems and facilities, to reduce conflicts with operational needs. Application of herbicides in recreation areas would ideally occur before Memorial Day or after Labor Day, or during the week.
23. For domestic water system sources, chemical applications shall be avoided within areas where movement into drinking water is possible. For surface water and groundwater sources, a buffer of 50 feet is required from the point of diversion.
24. Prior to herbicide applications within special use permitted areas, the Special Uses Department will be contacted for any necessary coordination with permit holders.

3.2.7 Health and Safety

25. Chemicals will be stored in designated storage facilities according to the manufacturer's labels and is consistent with SNFPA Standard and Guideline #99.
26. All Personal Protective Equipment (PPE) will be used in accordance with the Material Safety Data Sheet (MSDS) and product label for the specific type of chemical being applied during field operations.
27. Cautionary notice signs regarding herbicide use will be placed at access points to treatment areas prior to initiating treatment. These signs will identify the herbicide(s) to be used, the date of application and date of expiration of the cautionary notice (at least 48 hours after application), name and phone number of Forest contact, and phone number for the County Health Department. They will be removed as soon as possible after the expiration date of the cautionary notice.
28. Herbicides will only be applied by trained and/or certified applicators in accordance with label instructions and applicable Federal and state pesticide laws. Label instructions include constraints on application under certain wind, temperature, precipitation and other weather conditions to eliminate drift, volatilization, leaching, or runoff.

29. Any hazardous materials spills will be reported to the LTBMU Forest Spill Coordinator and treated in accordance with the LTBMU Hazardous Materials Response and Spill Safety Plan (Project Record Document L10). If a spill is threatening or has occurred, and requires emergency containment, staff will call 911, and radio or call Camino Dispatch. Dispatch will notify the appropriate agencies according to the Lake Tahoe Geographic Response Plan (September 2007). If material is determined to be of the type that may be handled by local refuse companies (such as oil and gas), staff will call refuse companies first to see if they are capable of retrieving and disposing. If material is beyond the capability of local refuse companies, staff will call a hazardous waste contractor to arrange retrieval and disposal.
30. Unused herbicides will be disposed of in accordance with the manufacturer's label.
31. Bladder bag and hand tools such as shovel and Pulaski shall be on site when using an open flame to thermally treat TIPS. Although this method does not utilize *burning per se*, but rather heats to boiling the cells of plants (and not necessarily with an open flame),if any fires result from this treatment, they will be put dead-out before personnel leave the area. Fire-trained personnel will be available on site as required.

3.2.8 Herbicides

32. All appropriate laws and regulations governing the use of pesticides, as required by the U.S. Environmental Protection Agency, the California Department of Pesticide Regulation, and Nevada Division of Environmental Protection, and Forest Service policy pertaining to pesticide use, will be followed.
33. Coordination with the appropriate County Agricultural Commissioners will occur, and all required licenses and permits will be obtained prior to any pesticide application.
34. All herbicide spray tanks will be equipped with a pressure gauge to ensure that herbicides are applied with low pressure.
35. For control of drift, all herbicide application will follow EPA approved *label directions* 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 ensure droplets do not travel outside of the targeted zone.

3.2.9 TIPS

36. Manual, mechanical, or thermal treatment will be utilized in lieu of chemical treatment where effective.
37. Any cut TIPS will be disposed of in a manner to preclude spread of propagative parts or contact with soils likely to encourage re-sprouting. Disposal will be as follows: If no flowers or seeds are present, pull the weed and place it on the ground to dry out if species is not rhizomatous or if there is no potential for re-sprouting. If flowers or seeds are present or there is resprouting potential, pull the weed carefully to prevent seeds from falling and

to prevent roots from breaking and leaving segments in the ground, and place in an appropriate container for disposal; or separate the flowers and seedheads from the plant if vegetative reproduction is not a concern and dispose of separately as above.

38. The Forest will continue to inventory and monitor current TIPS populations and use this information to direct activities to reduce the spread and establishment of TIPS.
39. All off-road equipment used will be washed before moving into the project area to ensure that the equipment is free of soil, seeds, vegetative material, or other debris that could contain or hold seeds of noxious weeds. "Off-road equipment" – in this case, potentially ATVs - does not include vehicles not intended for off-road use. Equipment will be considered clean when visual inspection does not reveal soil, seeds, plant material, or other such debris.
40. When working in known weed-infested areas, the equipment will be cleaned before moving to other NFS lands that do not contain noxious weeds, such as monitored/inventoried sites that have not had TIPS for the past consecutive three years.
41. Use weed-free mulches and seed sources. All activities that require seeding or planting must utilize locally collected native seed sources when possible. Plant and seed material should be collected from or near the project area, from within the same watershed, and at a similar elevation when possible. Seed mixes must be approved by a LTBMU botanist, noxious weed coordinator, or ecologist.
42. Staging areas for equipment, materials, or crews will be prohibited within the actual area of TIPS infestations.

3.3 Comparison of Alternatives

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

Table 3b. Alternative Effects Comparison Summary

	Alternative 1 **No Action (Manual Only)**	**Alternative 2** **Proposed Action (Multi-Treatment)**
Treatment type	Manual	Manual, Mechanical, Thermal, Chemical
Acres	Currently known 8.9 net acres and as many new and expanded infestation acres as are feasible.	Currently known 2.35 net acres and as many acres as feasible for manual, mechanical, and thermal, and 6.55 net acres and up to 100 infested acres annually for potential chemical treatment.
Expansion	TIPS will expand and spread to new sites, possibly infesting adjacent land.	Of the 34 TIPS currently in LTBMU's weeds database, expect to eradicate 24 and control 10.
Wildlife and Aquatics	No risk of chemical exposure to Threatened and Endangered Species or TRPA species of interest.	Risk is low to none for Threatened and Endangered Species or TRPA species of interest to chemicals. Low risk of chemical exposure to other wildlife and

	Alternative 1 **No Action (Manual Only)**	**Alternative 2** **Proposed Action (Multi-Treatment)**
	Diminishment of habitat for non-target animals, due to expansion of difficult-to-control TIPS.	aquatic species. Improvement of habitat, particularly riparian, over the long run.
Water Quality	No risk of chemical exposure to water quality. Potential decrease in water quality over the long term due to TIPS expansion and erosion.	Minor short term risk to water quality during application. Improved water quality over the long term, compared with No Action.
Soils	Impacts to soils from manual treatments would be minor under current and expected future infestation levels. No risk to soils from chemical exposure. Potential increase in soil erosion over the long term due to TIPS expansion.	Impacts to soils from manual and mechanical treatments would be minor under current and expected future infestation levels. The proposed chemicals are non-persistent to moderately persistent in soil, and risks to soil organisms would be negligible for the current proposed treatment acres. Low potential increase in soil erosion over the long term due to TIPS expansion.
Heritage Resources	No risk of chemical exposure to traditionally important plant species.	Minor risk of effects from chemical exposure to traditionally important plant species. Project design features which stipulate coordination and consultation with the Washoe Tribe would reduce or eliminate those risks.
Recreation and Special Uses	No risk of chemical exposure.	Minor risk of effects from chemical exposure. Project design features, such as signage; applying only during low recreation use; and following label directions would reduce or eliminate those risks.
Human Health and Safety	No risk of chemical exposure.	Low risk of chemical exposure, primarily to applicators when using dip & clip and wick & wipe methods. Project design features, such as signage; applying only during low recreation use; and following label directions would reduce or eliminate those risks.
Native Vegetation	No risk of chemical exposure to non-target plants or sensitive species. Potential diminishment of habitat for species of concern and other native plants as difficult-to-control TIPS expand.	Low risk of chemical exposure to non-target species, including sensitive species because species would be buffered by 50 feet. Improvement of native plant habitat where TIPS are eliminated.
TIPS	Infestations of difficult to control TIPS will continue to expand. *Possible* eradication of only those TIPS sites that respond to manual treatments. Expected eradication of six TIPS and control of six species known in the Basin in 2008.	TIPS, including those that are difficult to control, are weakened or killed by chemicals. Of 34 TIPS in LTBMU's weeds database, expect to eradicate 24 TIPS and control 10 using the multiple methods of treatment available.

4.0 Environmental Consequences

This section summarizes aspects of the environment likely to be affected by the proposed action and no action alternatives. Also described are the environmental effects (direct, indirect, and cumulative) that would result from undertaking each alternative. Together, these descriptions form the scientific and analytical basis for the comparison of effects in the previous section.

Direct Effects are caused by the action and occur at the same time and place.

Indirect Effects are caused by the action and occur later in time or farther removed in distance.

Cumulative Effects are effects on the environment which result from incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.

The cumulative effects discussion will focus on the relevant past, present, and reasonably foreseeable actions. These relevant actions are based on the direction contained in the June 24, 2005, memo from the Council on Environmental Quality.

In terms of past actions, historic grazing and mining, road construction and utilization, hydroelectric power generation (Echo Lake 97-052 Dam), water diversion and/or impoundments, recreation activities (hiking, camping, hunting, etc.), special use facilities, and pesticide use for timber management have all occurred in the project area. These are represented by the present environment.

Reasonably foreseeable actions are activities on the Schedule of Proposed Actions that are funded and relevant to this project. The use of pesticides such as 2, 4-D, Atrazine, and Dalapon for timber management purposes was discontinued in 1979. Jeffrey pine stumps are currently treated with Borax to control the spread of annosus root fungus, and will likely continue to be treated on a site-specific basis. Borax use is not a component of this project.

Herbicides are used by other agencies and entities such as county agricultural and transportation departments, and by private citizens, within the Lake Tahoe Basin. Although figures are available (and presented in this document) for public land in the three California counties, the amount of herbicides applied to the portions of those counties that are within the Basin is not available. Amounts of herbicides applied in Nevada in the Basin are not available, and neither are the amounts applied on private property.

4.1. Terrestrial Wildlife Species

Overview

This section discloses the existing conditions and the potential effects of the TIPS treatment project on:

- Terrestrial wildlife species listed as endangered, threatened, candidate, or proposed under the Endangered Species Act of 1973, as amended.
- Terrestrial wildlife species designated as sensitive by the Regional Forester of the Pacific Southwest Region 5.
- Terrestrial wildlife species designated as special interest by the TRPA.
- Habitats of terrestrial Management Indicator Species (MIS) that occur on the LTBMU.
- Migratory landbird species, designated as of conservation concern by the US Fish and Wildlife Service (USFWS).

Affected Environment

Through SERA, risk assessments all of the proposed herbicides were shown to be practically non-toxic to birds, mammals, honey bees, earthworms, and soil microorganisms. These herbicides are practically non-toxic to terrestrial wildlife species, because they are designed to kill most plants or a specific group of plants only. These herbicides mimic plant growth hormones, occupy cellular binding sites of plant enzymes, and interfere with photosynthesis, respiration, amino acid synthesis, or cell division. These synthetic plant growth hormone analogs are inert when they are consumed by terrestrial wildlife species, because no plant enzymes are involved in wildlife metabolism. However, urine excreted by wildlife that has consumed herbicides may kill plants.

The peer-reviewed risk assessments are available online at http://www.fs.fed.us/foresthealth/pesticide/risk.shtml These reports assess the acute and chronic effects of herbicides on biological resources, range between 231 and 281 pages in length, and well exceed US Environmental Protection Agency regulatory requirements. Risk assessments identify the hazard or toxicity, assess the exposure, assess the dose-response, and characterize the risk of each herbicide. Worst-case exposure scenarios include workers and the public, terrestrial and aquatic organisms, and eating or drinking contaminated material. Worst-case exposure scenarios for representative groups of wildlife include direct spray of small mammals, birds and mammals eating vegetation or insects sprayed

with herbicide, predatory birds and mammals eating fish or small mammals, small mammals drinking contaminated water, and small mammals brushing against contaminated vegetation followed by grooming.

Dose-response for wildlife uses the lowest no observable adverse effect level, which uses the most sensitive response from the most sensitive species. Risk characterization uses a hazard quotient, which is a ratio of exposure to toxicity. If the hazard quotient is less than one (1), then the risk is acceptably low. Worksheets are used to customize application rates for each project, quantify dose estimates for each exposure scenario, and generate hazard quotients to evaluate alternative pesticides. The risk assessments are very conservative, in that they assume application at the recommended rates with no buffers from sensitive biological resources. Actual application rates using hand/selective, directed spray, or limited broadcast spray would be much lower.

The results of the Aminopyralid and Triclopyr analysis conclude that birds and mammals consuming vegetation or insects that have been sprayed with herbicides at the highest application rates have the most potential to receive doses that are above the toxicity index. The exposure scenarios are not plausible, because herbicides will not be applied at high application rates. Herbivorous birds and mammals would have to chronically eat only contaminated vegetation for 90 days to receive a dose that exceeded the toxicity index. Herbivores are unlikely to eat non-native invasive species that are often spiny, prickly, and unpalatable. Herbivores are even more unlikely to eat dead or dying TIPS.

Predatory birds and mammals would have to consume an entire day's diet worth of directly sprayed insects to receive a dose that exceeded the toxicity index. Direct spray of a honey bee only exceeded the toxicity index for Glyphosate and Triclopyr at the highest application rate. Since these scenarios are unlikely to occur, they are not used to evaluate the differences between alternatives.

Threatened, Endangered, Sensitive, and Special Interest Terrestrial Wildlife Species

Species Addressed

No terrestrial wildlife species are currently proposed for listing by the USFWS (2009). No critical habitat for threatened or endangered species is designated on the LTBMU. The Pacific Southwest Region of the US Forest Service lists Regional Forester Sensitive Species, and lists MIS in the Sierra Nevada MIS amendment. The TRPA lists special interest species in the regional plan for the Lake Tahoe Basin, code of ordinances. There have been no occurrences of the Pacific fisher or

great gray owl on the LTBMU. Therefore, these species will not be addressed further.

Species Not Affected by Any Alternative

The following species are not known to occur in the project area, or do not have suitable habitat within 0.5 mile of the currently proposed treatment areas. Design Features will protect these species in cases where new infestations and expanding infestations occur. Therefore, a determination of "No Effect" for all alternatives has been found for:

- California wolverine: No suitable habitat consisting of subalpine forest with low human disturbance, in or adjacent to TIPS treatment areas. Not known to occur in the Lake Tahoe Basin.
- Sierra Nevada red fox: No suitable habitat consisting of subalpine forest with interspersed meadows over 7,000 feet, in or adjacent to TIPS treatment areas. Unknown population distribution in the Lake Tahoe Basin.

Species Potentially Affected by Any Alternative

Forest-wide surveys during 2007 and 2008 are summarized below, followed by the determination of project effects on each wildlife species of management concern.

The annual 2008 mid-winter bald eagle count detected 10 bald eagles at 26 survey points around the Basin, up 83% from 2007. Protocol-level bald eagle nest surveys were completed in conjunction with osprey nest surveys. The bald eagle nest at Emerald Bay fledged two juveniles in 2008. No TIPS occur within 0.5 mile of the bald eagle nests at Emerald Bay or Marlette Lake. There are 10 TIPS locations within 0.25 mile of bald eagle wintering areas. Disturbance is unlikely, because there would be no treatments or habitat manipulation during the winter.

Protocol-level surveys of osprey nests were completed on 15,171 acres within 0.25 mile of the shorelines of Lake Tahoe, Fallen Leaf Lake, and Cascade Lake during 2008. All known osprey nest sites were visited once a month over five months to determine occupancy, pair status, nesting status, and reproductive success. TIPS occur within 0.25 mile of osprey nests designated as Fallen Leaf Lake 04 and South Lake Tahoe 06. Both nests were active in 2008. A limited operating period of March 1 through August 15 applies within 0.25 mile of the nest, unless surveys confirm that osprey are not nesting.

Protocol-level northern goshawk surveys were completed on 14,465 acres during 2008. Dawn acoustical surveys were conducted at historic nest stands for goshawk contact calls, from 45 minutes before sunrise to 1.5 hours after sunrise during March. Broadcast acoustical surveys used an MP3 player and megaphone

to broadcast goshawk alarm calls during the nesting period. Begging, food delivery, adult wail, and alarm calls were broadcast during the post-fledging period. When goshawks were detected, stand search surveys were conducted to locate the nest. Surveys detected 15 northern goshawks, down 4% from 2007; two nests fledged two juveniles, down 22% from 2007.

TIPS occur on 0.24 acre within 0.25 mile of the Cascade, East Blackwood, First Creek, Floating Island, Griff Creek, Lower Saxon Creek, Marlette Creek, Seneca Pond, Spring Creek, and Tahoe Mountain northern goshawk protected activity centers. Protocol-level surveys did not detect any active nests in these protected activity centers during 2007 and 2008. No TIPS occur within 0.25 mile of nests active during 2009.

Protocol-level California spotted owl surveys were completed on 17,911 acres during 2008. Historic nest locations were checked within 0.25 mile of projects planned within the next two years. Spot calling surveys along forest roads and trails at night were conducted at least three times during the breeding season. Eleven spotted owls were detected, down 26% from 2007. No active nests were detected. TIPS occur on 0.14 acre within 0.25 mile of the Blackwood Creek, Griff Creek, Hawley Grade, Hellhole, Mount Pluto, Spring Creek, and Tahoe Mountain California spotted owl protected activity centers. Protocol-level surveys did not detect any active nests in these protected activity centers during 2007 and 2008. No TIPS occurred within 0.25 mile of nests active during 2009.

Protocol-level peregrine falcon surveys were completed at Luther Rock, South Maggie's Peak, and Angora Peak during 2009. Each site was surveyed once a month from April through September. Two biologists scanned the cliff face for four hours using binoculars and spotting scopes. Surveys were discontinued if no detections were made after two visits. Two peregrine falcons were detected at Luther Rock. The nest fledged two juveniles. This is the first time that peregrine falcons have successfully fledged at this moderately popular rock climbing destination since 1985. A limited operating period of April 1 through September 30 applies within 0.25 mile of the nest, unless surveys confirm that peregrine falcons are not nesting. No TIPS occurred within 0.25 mile of nests active during 2009.

Protocol-level willow flycatcher surveys were completed on 266 acres during 2008. Willow flycatcher songs were broadcast every 50 meters in suitable habitat, from one hour before sunrise to 10:00 a.m. Each route was surveyed three times during the breeding season. Seven willow flycatchers were detected, up 17% from 2007. Three active nests fledged eight juveniles, up 100% from 2007. No TIPS occurred

within 150 feet of active nests in 2008. No willow flycatcher nests were active in 2009.

Protocol-level Townsend's big-eared bat surveys were completed at the Tahoe Treasure/Noonchester I and II mines, the Mountain Top mine, and the abandoned Newhall house at Skunk Harbor during 2009. Each site was surveyed three times at least one week apart from July through August. Two biologists surveyed each entrance for 2.5 hours at dusk using night vision binoculars, dim red lights, and Pettersson ultrasonic detectors that were triggered by bat calls. Recordings of bat calls were converted to sonograms that depicted the call frequency, amplitude, timing, resonance, and harmonics. Sonograms that had a quality of 0.8 or greater were analyzed by Mike Morrison, PhD, professor and Caesar Kleberg chair in wildlife ecology and conservation at the Texas A&M University. Identified bat species include the silver-haired, Mexican free-tailed, hoary, Yuma myotis, little brown, and Townsend's big-eared bat. A limited operating period of May 1 through August 31 applies within 300 feet (Linda Angerer, Region 5 bat coordinator) of the Tahoe Treasure/Noonchester II mine and abandoned Newhall house. No TIPS occur within 300 feet of the Tahoe Treasure/Noonchester II mine and the Newhall house. However, future TIPS infestation is likely at the Newhall house, because the historic fieldstone resort is at the end of a 1.5 mile long gated road, and Skunk Harbor is a popular beach for boaters. If TIPS occur within 300 feet of the Newhall house, the limited operating period would apply.

Disturbance from the project activity is limited to existing road traffic, commercial, residential, and recreational activity.

Table 4a. Terrestrial wildlife species of management concern in or adjacent to the project area, including a brief analysis of habitat suitability and species occurrence

Terrestrial wildlife *(genus and species)*	**Legal status[1]**	**Suitable habitat**	**Known to occur**	**Determination[2]**	**Rationale for determination**
Birds					
Bald eagle *(Haliaeetus leucocephalus)*	D, S, SI	yes	yes	NLAA	Suitable habitat consisting of dense forest with super-canopy trees, within one mile of large lakes and streams with abundant fish prey. 10 bald eagles detected, and one active nest fledged 2 juveniles during 2008 surveys. No TIPS occur within 0.5 mile of the bald eagle nest. The nest was not active in 2009. TIPS within 0.25 mile of bald eagle wintering habitat would not be treated during the winter. Delisted July 9, 2007. Monitor for 5 years.
Golden eagle *(Aquila chrysaetos)*	SI	yes	yes	NLAA	Suitable habitat consisting of open coniferous forest, especially in mountainous regions, with abundant medium-sized mammal prey. No detections or nests during 2008 surveys. No TIPS occur within the 0.25 mile golden eagle threshold buffers.
Osprey	SI	yes	yes	NLAA	Suitable habitat consisting of dense forest with super-

Terrestrial wildlife *(genus and species)*	**Legal status[1]**	**Suitable habitat**	**Known to occur**	**Determination[2]**	**Rationale for determination**
(Pandion haliaeetus)					canopy trees, within one mile of large lakes and streams with abundant fish prey. 22 active nests fledged 20 juveniles during 2008 surveys. TIPS occur within 0.25 mile of osprey nests designated as Fallen Leaf Lake 04 and South Lake Tahoe 06. Both nests were active in 2008. A limited operating period of March 1 through August 15 applies, unless surveys confirm that osprey are not nesting.
Peregrine falcon *(Falco peregrinus anatum)*	D, SI	yes	yes	NLAA	Suitable habitat consisting of cliffs near meadows or wetlands with abundant avian prey, in or adjacent to TIPS treatment areas. 5 peregrine falcons detected during 2008 surveys. One active nest fledged 2 juveniles during 2009 surveys, which last occurred in 1985. No TIPS occur within 0.25 mile of the nest. Delisted in 1999.
Northern goshawk *(Accipiter gentiles)*	S, SI	yes	yes	NLAA	Suitable habitat consisting of large tracts of mature, closed canopy, deciduous, coniferous, or mixed forest with an open understory, in or adjacent to the project area. 15 northern goshawks detected, and 2 nests fledged 2 juveniles during 2008 surveys. TIPS occur within 0.25 mile of protected activity centers. No TIPS occur within 0.25 mile of nests active during 2009.
California spotted owl *(Strix occidentalis)*	S, MIS	yes	yes	NLAA	Suitable habitat consisting of old, dense, and layered mixed conifer forest. 11 spotted owls detected, but no nests during 2008 surveys. TIPS occur within 0.25 mile of protected activity centers. No TIPS occur within 0.25 mile of nests active during 2009.
Willow flycatcher *(Empidonax traillii)*	S	yes	yes	NLAA	Suitable habitat consisting of meadows larger than 15 acres, usually below 8,000 feet, with standing water on June 1, and a deciduous shrub component. 7 willow flycatchers detected, and 3 active nests fledged 8 juveniles during 2008. No TIPS occur within 150 feet of active nests in 2008. No nests were active during 2009.
Waterfowl species	SI	yes	yes	NLAA	Suitable wetland habitat in or adjacent to the project area. TIPS occur in wetlands. Disturbance from project activity is not beyond existing road traffic, commercial, residential, and recreational activity.
Mammals					
California wolverine *(Gulo gulo luteus)*	S	no	no	No effect	No suitable habitat consisting of subalpine forest with low human disturbance, in or adjacent to TIPS treatment areas. Not known to occur in the Lake Tahoe Basin. DNA was analyzed of the non-sensitive male wolverine *(Gulo gulo luscus)* that dispersed from the northern Rocky Mountains to the Tahoe National Forest in February 2008.
Sierra Nevada red fox *(Vulpes vulpes necator)*	S	no	no	No effect	No suitable habitat consisting of subalpine forest with interspersed meadows over 7,000 feet, in or adjacent to TIPS treatment areas. Domestic pets present. Unknown population distribution in the Lake Tahoe Basin.
American marten	S,	yes	yes	NLAA	Suitable habitat consisting of dense late successional

Terrestrial wildlife *(genus and species)*	**Legal status[1]**	**Suitable habitat**	**Known to occur**	**Determination[2]**	**Rationale for determination**
(Martes americana)	MIS				coniferous forest with snags, down logs, debris piles, and abundant squirrel prey. No TIPS occur within 0.25 mile of a den site that was active in 2009.
Townsend's big-eared bat *(Corynorhinus townsendii)*	S	yes	yes	NLAA	Suitable habitat consisting of caves, mines, tunnels, under bridges, and abandoned buildings near wetlands or forest edges, in or adjacent to TIPS treatment areas. No TIPS occur within 300 feet of known roost sites.
Mule deer *(Odocoileus hemionus)*	SI	yes	yes	NLAA	Suitable habitat consisting of meadows, shrubs, and riparian areas with low human disturbance during the fawning season. TIPS occur in riparian areas. Disturbance from project activity is not beyond existing road traffic, commercial, residential, and recreational activity.

[1]Legal status:

E = Endangered species listed by the USFWS under the Endangered Species Act.

T = Threatened species listed by the USFWS under the Endangered Species Act.

C = Candidate species listed by the USFWS under the Endangered Species Act. The Pacific fisher *(Martes pennanti)* is a candidate species for the LTBMU. The fisher does not occur on the LTBMU, and would not be affected by this project. No federally listed terrestrial wildlife species would require technical assistance from the USFWS, and are not considered further in this document.

D = Delisted species by the USFWS under the Endangered Species Act. Species will be monitored for 5 years.

S = Sensitive species listed by Region 5, US Forest Service. Regional Forester sensitive species list was revised on October 15, 2007.

MIS = Management indicator species listed by Region 5, US Forest Service. Sierra Nevada MIS amendment on December 14, 2007

SI = Special interest species listed by the TRPA. Regional plan of Lake Tahoe Basin, code of ordinances, 1987

[2]NLAA = The project may affect individuals, but is not likely to result in a trend toward Federal listing or a loss of viability. Project activities may result in some loss of habitat, reduction of habitat quality, or timing of nesting, denning, and foraging for the species. However, the scale of this reduction is small, and design features and mitigation measures would reduce both direct and indirect impacts.

No effect = The project area is outside the range of the species or lacks suitable habitat or habitat components; the species have not been detected during recent Forest Service, California Department of Parks and Recreation, Nevada Department of Wildlife, California Tahoe Conservancy, TRPA, or private contractor surveys; the species are probably absent from their historical range, or the project would not harm individuals or alter the species habitat.

Terrestrial Management Indicator Species

The purpose of management indicator species analysis is to evaluate and disclose the impacts of the project on the species' habitat. Habitat effects are analyzed at the project scale, and habitat or population trends are monitored at the bioregional scale of the Sierra Nevada mountain range. Habitat status is the current amount of habitat in the Sierra Nevada. Habitat trend is the direction of change in habitat quantity or quality over time.

Direct effects during treatment of TIPS include short term displacement of individuals to suitable habitat adjacent to the project area. Indirect effects after treatment would be beneficial as native plants are reestablished. There would be no long-term adverse cumulative effects from all past, present, and reasonably

foreseeable future actions across all ownerships within +/- 5 years and a 0.5 mile radius of the project area.

Table 4b. Terrestrial management indicator species habitat analysis, in or adjacent to the project area

Habitat or ecosystem component	California wildlife habitat relationship types that define the habitat component[1]	Sierra Nevada Forests management indicator species	Analysis category [2]
Riparian	Riparian, montane, and valley foothill, open canopy deciduous woodland with shrubs.	Yellow warbler (Dendroica petechia)	3
Early seral coniferous forest	Ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine. Tree sizes 1, 2, and 3.	Mountain quail (Oreortyx pictus)	3
Mid seral coniferous forest	Ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine. Tree size 4.	Mountain quail (Oreortyx pictus)	3
Late seral open canopy coniferous Forest	Ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine. Tree size 5. Sparse to open canopy.	Blue grouse (Dendragapus obscurus)	1
Late seral closed canopy coniferous forest	Ponderosa pine, Sierran mixed conifer, white fir, and red fir. Tree size 5 and 6. Moderate to dense canopy closures.	California spotted owl (Strix occidentalis)	1
		American marten (Martes americana)	
		Northern flying squirrel (Glaucomys sabrinus)	
Snags in green forest	Medium and large snags in green forest.	Hairy woodpecker (Picoides villosus)	2
Snags in burned forest	Medium and large snags in forest burned by a stand-replacing fire.	Black-backed woodpecker (Picoides arcticus)	2

[1] All California wildlife habitat relationship size classes and canopy closures are included (Mayer & Laudenslayer, 1988). dbh = diameter at breast height. Tree size classes and canopy closure classifications are:

1 = seedling less than 1" dbh.
2 = sapling from 1" to 5.9" dbh.
3 = pole from 6" to 10.9" dbh.
4 = small tree from 11" to 23.9" dbh.
5 = medium to large tree over 24" dbh.
6 = multi-layered tree in pine and Sierran mixed conifer.

S = sparse cover, 10% to 24% canopy closure.
P = open cover, 25% to 39% canopy closure.
M = moderate cover, 40% to 59% canopy closure.
D = dense cover, 60% to 100% canopy closure.

[2] Category of management indicator species habitat for project analysis:

1 = habitat is not in or adjacent to the project area, and would not be affected by the project.
2 = habitat is in or adjacent to project area, but would not be directly or indirectly affected by the project.
3 = habitat would be directly or indirectly affected by the project.

[3] Aquatic macroinvertebrates include worms, clams, snails, shrimp, crayfish, caddisflies, stoneflies, diving beetles, and other invertebrates that are highly sensitive to changes in water quality and condition of aquatic habitat. The index of biotic integrity was last monitored at 17 sites in the Lake Tahoe Basin from 2000-2001. The ratio of observed to expected macroinvertebrate species = 0.89, which is a very good score of aquatic sensitive species richness (Sierra Nevada Forests bioregional management indicator species report, January 2008). The management indicator species list was last revised in August 2006.

Riparian / Yellow Warbler Status and Trend at the Bioregional Scale

Affected environment: The yellow warbler nests in wet meadows with a tall willow shrub component, along stream corridors, and in riparian forest. Suitable

habitat consists of montane riparian habitat, typed (characterized) by the California wildlife habitat relationship system. Most nesting habitat is between 6,600 and 9,200 feet in elevation.

Direct and indirect effects: The yellow warbler may brush its feathers up against cut stems or foliage containing herbicide, and then ingest some herbicide while preening. The yellow warbler may also prey on insects that pick up herbicide residue. The SERA risk assessments found that none of the four herbicides is likely to pose a toxic threat to birds at the recommended application rates. Chemical treatment on up to 100 acres annually of TIPS would affect less than 3% of the 3,432 acres of suitable montane riparian habitat in the Basin, and would likely result in a minor effect in yellow warbler habitat condition and trend.

Bioregional status and trend: There are currently 29,000 acres of montane riparian habitat on NFS lands in the Sierra Nevada. The trend has been stable within the last decade. Survey data indicate that yellow warblers continue to be present at sample sites. Current data at the rangewide, California, and Sierra Nevada scales indicate that the distribution of yellow warbler populations is stable. Changes in shrub cover on up to 100 acres out of 3,432 acres of montane riparian habitat in the project area will not alter the existing trend in habitat, nor will it lead to a change in the distribution of yellow warblers across the Sierra Nevada bioregion.

Early and Mid Seral Coniferous Forest / Mountain Quail Status and Trend at the Bioregional Scale

Affected environment: The mountain quail is found particularly on steep slopes in open brushy stands of conifer, deciduous forest, and chaparral. Suitable habitat in the Basin consists of Sierran mixed conifer, white fir, and red fir forest. Early seral coniferous forest is composed of seedlings, saplings, and pole-sized trees that are less than 11 inches mean diameter at breast height (dbh). Mid seral coniferous forest is composed of small trees that are between 11 to 23.9 inches mean dbh. This game bird gathers at water sources in the summer.

Direct and indirect effects: Same as for the yellow warbler. Chemical treatment on up to 100 acres annually of TIPS would affect less than 0.3% of 42,030 acres of suitable early seral coniferous habitat, and less than 0.6% of 15,623 acres of suitable mid seral coniferous habitat in the Basin. Chemical treatments would likely result in a negligible effect in mountain quail habitat condition and trend.

Bioregional status and trend: There are currently 546,000 acres of early seral coniferous forest, and 2,766,000 acres of mid seral coniferous forest on National Forest System lands in the Sierra Nevada. The trend for early seral coniferous

forest has slightly decreased from 9% to 5% within the last decade. The trend for mid seral coniferous forest has slightly increased from 21% to 25% on NFS lands. Survey data indicate that mountain quail continue to be present at sample sites. Current data at the rangewide, California, and Sierra Nevada scales indicate that the distribution of mountain quail populations is stable. Changes in shrub cover on up to 100 acres out of 57,653 acres of early and mid seral coniferous forest in the project area will not alter the existing trend in habitat, nor will it lead to a change in the distribution of mountain quail across the Sierra Nevada bioregion.

Cumulative Effects for all Terrestrial Management Indicator Species

Terrestrial management indicator species and their habitats are affected by past, present, and reasonably foreseeable future actions in the Lake Tahoe Basin. Activities have included road construction and maintenance, mining, grazing, fuel treatments, timber harvest, impoundments, ditches, recreation developments, dispersed recreation, special uses, commercial, and residential development. Most of these activities will continue to occur in the foreseeable future.

Current management using only manual methods under Alternative 1 would allow existing TIPS to spread, and have a negative effect on the habitat of terrestrial wildlife species. Alternative 2, using manual, mechanical, thermal, and chemical methods, would eventually eradicate TIPS, and have a beneficial effect on the habitat of terrestrial wildlife species. Project design features would minimize the risk of new TIPS infestations.

No herbicides are currently used on NFS land in the Tahoe Basin. A small amount of borax fungicide is used on cut tree stumps to prevent the spread of annosus root disease. Herbicide use is far more common on non-NFS land in the Basin. The Proposed Action would contribute a negligible amount of herbicides to the Basin, compared to what is currently being used on other ownerships.

Migratory Landbird Species

The Forest Service and the USFWS signed a memorandum of understanding to promote the conservation of migratory birds in 2008. A Migratory Bird Report was prepared for this project (Project Record Document K4). Migratory bird conservation focuses on providing a diversity of habitat conditions at multiple spatial scales. Partners in Flight is a coalition of government agencies and non-governmental organizations that identified conservation issues in the North American landbird conservation plan. Relevant conservation recommendations were made for the Pacific and Intermountain West avifaunal biomes. California Partners in Flight prepared conservation plans to recommend and prioritize

adaptive management in coniferous forest, riparian, scrub and chaparral, and the Sierra Nevada bioregions. Riparian habitat is the most important to California landbirds. The purpose of stream restoration is to repair channel incision, reduce erosion, improve water quality, raise the level of groundwater, and rewet meadow vegetation. Audubon California has designated 145 important bird areas in California that provide essential habitat for vulnerable species or support unusually large concentrations of birds. The nearest high priority area is located three miles northwest of the Lake Tahoe Basin at Alpine Meadows on the Tahoe National Forest. Geographic information system data layers, site summaries, ornithological significance, and conservation issues of Alpine Meadows are available online at http://www.ca.audubon.org/iba/.

USFWS bird conservation regions encompass landscapes with similar bird communities, habitats, and resource issues. The USFWS identified bird species in each region that are in greatest need of proactive management, to prevent the need to list them as threatened or endangered in the future. The Lake Tahoe Basin is located in portions of bird conservation region 9-Great Basin, and 15-Sierra Nevada. The following migratory landbirds of conservation concern are known to occur in the Lake Tahoe Basin.

Table 4c. Migratory landbirds of conservation concern in or adjacent to the project area, including a brief analysis of habitat suitability and species occurrence

Migratory Landbirds *(genus and species)*	**Legal status**	**Suitable habitat**	**Determination**	**Rationale for determination**
Eared grebe *(Podiceps nigricollis)*	none	yes	NLAA	Suitable habitat consisting of marshy lakes and ponds.
Bald eagle *(Haliaeetus leucocephalus)*	D, S, SI	yes	NLAA	Suitable habitat consisting of dense forest with super-canopy trees, within one mile of large lakes and streams with abundant fish prey. 10 bald eagles detected, and one active nest fledged 2 juveniles during 2008 surveys. No TIPS occur within 0.5 mile of the bald eagle nest. The nest was not active in 2009. TIPS within 0.25 mile of bald eagle wintering habitat would not be treated during the winter. Delisted July 9, 2007. Monitor for 5 years.
Golden eagle *(Aquila chrysaetos)*	SI	yes	NLAA	Suitable habitat consisting of open coniferous forest, especially in mountainous regions, with abundant medium-sized mammal prey. No detections or nests during 2008 surveys. No TIPS occur within the 0.25 mile golden eagle threshold buffers.
Peregrine falcon *(Falco peregrinus anatum)*	D, SI	yes	NLAA	Suitable habitat consisting of cliffs near meadows or wetlands with abundant avian prey, in or adjacent to TIPS treatment areas. 5 peregrine falcons detected, but no nests during 2008 surveys. No TIPS occur

Migratory Landbirds *(genus and species)*	**Legal status**	**Suitable habitat**	**Determination**	**Rationale for determination**
				within 0.25 mile of the nest that was active during 2009. Delisted in 1999.
Long-billed curlew *(Numenius americanus)*	none	yes	NLAA	Suitable habitat consisting of lake and river shores.
Marbled godwit *(Limosa fedoa)*	none	yes	NLAA	Marginal habitat consisting of meadows adjacent to marsh and lake shorelines with little emergent vegetation for wintering shorebird flocks.
Flammulated owl *(Otus flammeolus)*	none	yes	NLAA	Suitable habitat consisting of coniferous woodlands and forest edges.
Black swift *(Cypseloides niger)*	none	yes	NLAA	Suitable habitat consisting of mountains or coastal cliffs, in or adjacent to the project area.
Calliope hummingbird *(Stellula calliope)*	none	yes	NLAA	Suitable habitat consisting of montane and subalpine clearings, brushy edges, and alpine meadows, in or adjacent to the project area.
Olive-sided flycatcher *(Contopus borealis)*	none	yes	NLAA	Suitable habitat consisting of boreal spruce and fir forests near openings, burns, ponds, and bogs.
Willow flycatcher *(Empidonax traillii)*	S	yes	NLAA	Suitable habitat consisting of meadows larger than 15 acres, usually below 8,000 feet, with standing water on June 1, and a deciduous shrub component. 7 willow flycatchers detected, and 3 active nests fledged 8 juveniles during 2008. No TIPS occur within 150 feet of active nests in 2008. No nests were active during 2009.
Loggerhead shrike *(Lanius ludovicianus)*	none	yes	NLAA	Suitable habitat consisting of open grassy woodlands.
Virginia's warbler *(Vermivora virginiae)*	none	yes	NLAA	Suitable habitat consisting of chaparral, and pinyon-juniper brushland.
Green-tailed towhee *(Pipilo chlorurus)*	none	yes	NLAA	Suitable habitat consisting of sagebrush, mountain chaparral, pinyon-juniper brushland, and thickets bordering alpine meadows.
Brewer's sparrow *(Spizella breweri)*	none	yes	NLAA	Suitable habitat consisting of sagebrush.
Cassin's finch *(Carpodacus cassinii)*	none	yes	NLAA	Suitable habitat consisting of open conifer stands at high elevations.

The project is expected to have negative short-term impacts associated with human disturbance during the nesting season. Short-term impacts occur during a brief definitive period of time, whereas long-term impacts endure well into the future. Disturbance from the project activity would be limited to existing road traffic, commercial, residential, and recreational activity. Domestic pets and feral cats are present. The project design features for terrestrial wildlife would minimize impacts to migratory landbird species and their habitats. The project is expected to improve long-term habitat conditions for all migratory landbird species of conservation concern.

The main cause of migratory landbird population decline is the degradation or destruction of native habitats. Management recommendations to enhance habitat include removing TIPS, encouraging a clustered mosaic of native plants, removing ladder fuels and high loads of down woody debris, retaining snags, returning frequent low intensity surface fire to the landscape, avoiding brushing during the breeding season, managing grazing in the spring to preserve understory shrubs, limiting brown-headed cowbirds, keeping cats indoors during the breeding season, removing garbage to limit native nest predators such as raccoons and skunks, using birdfeeders that exclude squirrels and jays, and encouraging insect-eating birds rather than using pesticides.

The eradication of TIPS would improve the native biodiversity in which migratory landbirds evolved. The maintenance of biodiversity requires community and ecosystem management rather than focusing on a single species. Although individual species may attract special interest, ecosystems are too complex and resources are too limited to manage separately for each species. Native plant communities and their historic disturbance patterns are the fundamental building blocks that shape faunal communities. The diversity of biological components is best maintained by managing the land within the range of natural variability under which the species adapted and evolved.

4.2 Aquatic Species

Species lists are based on the January 29, 2009, list of federally threatened, endangered, proposed, and candidate species for the LTBMU from the USFWS; (http://sacramento.fws.gov/es/spp_list.htm). The Forest Service's Regional Forester's sensitive species list is based on the Pacific Southwest Region's revised list of March 3, 2008.

The analysis presented here discloses the effects of the two alternatives for the project on the following threatened (T), endangered (E), proposed (P), candidate (C), and Forest Service Sensitive (FSS) aquatic species that are known or suspected to occur in the project area:

FWS Threatened:

Lahontan cutthroat trout (*Oncorhuynchus clarki henshawi*)

Forest Service Sensitive:

Lahontan Lake tui chub (*Gila bicolor pectinifer*)

Great Basin rams-horn (*Helisoma (Carninifex) newberryi*)

Sierra Nevada (Mountain) yellow-legged frog (Rana *sierra (=muscosa*))

Of the species that are being considered further, only the Lahontan cutthroat trout (LCT) requires consultation with the USFWS. On October 20, 2009, a meeting occurred between Richard Vacirca and Maura Santora (LTBMU Forest Fish Biologists), Cheryl Beyer (LTBMU Forest Botanist), and Chad Mellison (USFWS Consultation Biologist). The meeting notes are summarized in the Aquatics BA/BE (Project Record Document K2). The purpose of the meeting was to review this project with the USFWS and discuss project level effects for Lahontan cutthroat trout. Treatment units of concern (with regard to LCT) are those that occur adjacent to and downstream of the Upper Truckee River. It was determined that current fish surveys in the Upper Truckee River did observe LCT residing in the project area, and there is potential for the species to occupy more downstream habitat in the future when TIPS treatment activities commence. Therefore, it was agreed that informal consultation would be requested with the USFWS for the project so that any recommendations can be incorporated into the Final EA.

No critical habitat for the federally listed endangered, threatened, proposed, or candidate species has been designated by the FWS on the LTBMU. However, the LTBMU Forest Plan, as amended by the Sierra Nevada Forest Plan Amendment (SNFPA) (USDA 2004a), allocates a critical aquatic refuge (CAR) in the Upper Truckee River watershed that extends into the project area. The Upper Truckee River CAR was established to protect critical aquatic resources for LCT.

Management direction specific to LCT in the LTBMU comes primarily from the 1995 LCT Recovery Plan (FWS 1995). This plan identified the western Lahontan Basin (composed of the Truckee, Walker and Carson Rivers) as one of the three distinct population segments (DPS). The Recovery Plan acknowledged that historic and current lacustrine LCT populations in the Western DPS are important to the recovery of the species. The Recovery Plan also identified the need for basin-specific Recovery Implementation Teams (RITs) to be formed to develop action plans and implement strategies for LCT. In 2007, the Tahoe Basin Recovery Implementation Team (TBRIT) was formed. TBRIT is currently in the process of developing the Recovery Action Plan for Lake Tahoe, which will assess the species historic and current population status, summarize aquatic habitat conditions and Basin-wide threats to LCT persistence, and identify conservation elements and opportunities for recovery. Conservation activities in the Upper Truckee River and Fallen Leaf Lake began prior to the formation of the TBRIT.

During the October 20, 2009, meeting between the FWS biologist and FS biologists, it was discussed whether technical assistance should be requested for the candidate species, Sierra Nevada yellow-legged frog (SNYLF). Both FWS and LTBMU agreed that although SNYLF habitat exists within the project area, recent

amphibian surveys support that the species does not occur within the currently identified treatment sites and design criteria stipulated as part of the proposed action specifically for SNYLF are adequate to protect known populations if future treatment sites are found in or adjacent to occupied habitats. Therefore, technical assistance would not be required.

The concern for aquatic species is to maintain high quality habitat. Indicators of aquatic habitat quality include stream shading, water temperatures, bank stability, and water quality. Specific management direction for aquatic ecosystems is tied to riparian conservation objectives (RCOs), riparian conservation areas (RCAs) and CARs. The SNFPA provided specific Forest-wide standards and guidelines for RCAs and CARs and addressed conservation needs for species of concern (threatened, endangered, candidate and sensitive).

The following indicators are used as measures of project effects on aquatic habitat and species:

A. Sediment

B. Stream shade and water temperature

C. Species trends and distributions

Existing Conditions

A. Sediment

The current surface discharge limitations in Lake Tahoe for suspended sediment are 250 mg/L set by the TRPA and for turbidity is 20 Nephelometric Turbidity Units (NTU) set by the Lahontan Regional Water Quality Control Board (TRPA 2006). The amount and type of sediment within a fluvial system influences aquatic habitat and species diversity. For instance, the amount of fine sediment input into a gravel bed-dominated stream can decrease the level of fish productivity (spawning and egg hatching).

Sediment delivery to streams can originate from two sources: hill slopes and channel banks. The amount and extent of erosion from hill slopes and channel banks is variable and influenced by both natural processes and anthropogenic impacts. Hill slope erosion, where human caused, can impact critical aspects of aquatic habitat, such as spawning habitat (Eaglin and Hubert 1993). Influences on contemporary hill slope and bank erosion processes include roads, channelization, urban encroachment into SEZs, and past livestock grazing legacy effects.

Stream surveys and stream condition assessments have been conducted for the LTBMU from 1995 to the present. Based on gathered information and the LTBMU

Watershed Condition Assessment (2001), watersheds in the Forest are hydrologically stable, with isolated stream reaches that have bank erosion, due to the effects of activities related to Forest management. In addition, review of the assessment indicates that most streams are considered to be in proper functioning condition (Brady and Weil 1999). Channel bank erosion within the project area is occurring in drainages such as Saxon Creek, Angora Creek, and Upper Truckee River and is related to channel incision and/or aggradation.

Potential fine sediment sources may originate from TIPS treatments where methods disturb soils or leave behind patches of bare soil. But in the long term, native riparian vegetation plays a role in preventing accelerated bank erosion and stabilizing stream banks.

B. Stream Shading and Water Temperature

The SNFPA (USDA 2004a) standard and guideline number 96 directs forests to "Ensure that management activities do not adversely affect water temperatures necessary for local aquatic-and riparian-dependent species assemblages." Native vegetation, including conifers and riparian shrubs, that occur in valley bottoms and along margins of streams, provides shade and influence water temperatures by buffering solar radiation (Beschta 1997, Quigley 1981). Decreases in shade provided by vegetation can affect stream temperature. In general, with reductions greater than 50% in the riparian canopy cover, there are increases in stream temperature.

The best data sets collected on temperature in the LTBMU (collected between 1988 and 1996) reveal that stream temperatures in the Basin range from 48-76°F. These temperatures closely match stream temperatures taken from USGS gauges between 1999-2002 on Trout Creek and the Upper Truckee River and correlate to habitat data collected by the FS between 1988 -1996.

It appears that mean and minimum daily temperatures are not influenced by stream shading but there are differences when it comes to maximum daily temperatures (e.g. Trout Creek). Streams with the least amount of shade (percentage) have the highest maximum temperatures. Johnson (2004) found similar results in streams that were artificially shaded when compared to clear-cut sections of riparian forest. Forest harvest in riparian areas has been shown to produce increases in stream temperatures, and the magnitude of these increases varies among sites and regions (Swift and Messer 1971). Sites where only the understory (little canopy affect) was removed generally have exhibited small effects on stream temperatures compared to sites where both over-story and understory were removed or burned (Lynch et al. 1984).

Native riparian vegetation plays a key role in forming aquatic habitat for fish and other aquatic species. Roots help stabilize stream banks, providing for the formation of undercut banks, which are important cover for juvenile and adult fish. 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.

C. Species Accounts and Status

1. Lahontan cutthroat trout (LCT)

Lake Tahoe's fishery pre-1900 was dominated by a single predator, Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*, LCT). LCT grew to a large size (14 kg), utilizing primarily pelagic chubs (*Siphatales bicolor pectinifer*) and native zooplankton as their food source, and used the tributaries to the lake as spawning grounds (Vander Zanden et al 2003, Chandra et al 2005). LCT are obligatory stream spawners with spawning occurring during the spring months depending on stream flow and water temperatures.

During the last 130 years, numerous nonnative species have been introduced intentionally and unintentionally to the Tahoe Basin altering its biological assemblage. The first series of introductions occurred at the end of the 19th century. Only rainbow trout (*Oncorhynchus mykis*), brown trout (*Salmo trutta*), lake trout (*Salvelinus namaycush*), and brook trout (*Salvelinus fontinalis*) survived and persist in the Basin today. Predatory impacts from lake trout and brook trout combined with over fishing, hybridization, and siltation of spawning streams contributed to the extirpation of LCT from Lake Tahoe by 1939 (Cordone and Frantz 1968, Moyle 2002).

Lahontan cutthroat trout was listed as an endangered species in 1970 (Federal Register Vol. 35, p.13520). In 1975, under the Endangered Species Act of 1973 as amended (ESA), LCT was reclassified as threatened to facilitate management and to allow for regulated angling (Federal Register Vol. 40, p.29864). In 1995, the USFWS released its recovery plan for LCT, encompassing six river basins within LCT historic range. In 2007, the TBRIT was formed, and is currently in the process of developing the Recovery Action Plan for Lake Tahoe. Today, due to the restoration efforts of local, state, and federal agencies, a reproducing population of LCT exists in the upper headwaters of the Truckee River.

Fisheries information has been derived from several resources, including: Basinwide Non-game Native Fish Survey (2007-2009), Upper Truckee River LCT Restoration Project (2006 -2009), Upper Truckee River Watershed Assessment

(2000), Lake Tahoe Watershed Assessment (2000), and project level surveys conducted throughout the Basin. Non-native salmonids dominate the streams in the LTBMU, and have essentially replaced LCT as the top predator in the lotic (stream) systems of the Lake Tahoe Basin. Brown trout and brook trout display a high degree of niche overlap; they are both fall spawning salmonids that feed primarily on macroinvertebrates. In general, brown trout out-compete brook trout and displace them upstream (Fausch and White 1981) and we see similar patterns within the Lake Tahoe Basin and within the project area. Lower stream reaches with lower gradients and more available habitat (pools, cover, substrate), are dominated by the fall spawning brown trout and the spring spawning rainbow trout. Brown trout and rainbow trout can coexist without much aggressive interaction due to their different life histories and habitat utilization.

LCT were introduced to the headwaters of the Upper Truckee River in Meiss Meadows in the late 1980s and early 1990s through a cooperative effort between the California Department of Fish and Game (CDFG), USFS and USFWS. Nonnative brook trout were initially removed from the Upper Truckee River prior to the LCT introduction by means of rotenone application. It was suspected that brook trout were illegally introduced back into the Meiss Meadow area post-chemical treatment from downstream adjacent source populations. Since that time brook trout removal has occurred by utilizing manual electrofishing methods. The Meiss Meadow population is one of the only high-elevation meadow populations of LCT in the Sierra-Nevada Mountain Range and also functions as a source population for LCT in lower river segments of the Upper Truckee. Snorkel surveys in the Upper Truckee River above Christmas Valley conducted in 2006 and 2007 discovered LCT had occupied stream reaches as much as 1.5 miles below Meiss Meadows. This tendency of LCT downstream migration in the Upper Truckee River is expected to occur more frequently within the next 2-5 years.

LCT have been stocked into Fallen Leaf Lake as part of a USFWS pilot research project to examine their interactions with nonnative lake trout. The TBRIT will also continue to plan and implement recovery activities in Fallen Leaf Lake, but it is not yet determined what the recovery goals are. Recovery actions in Fallen Leaf Lake may range from stocking larger size LCT (10 inches or greater) to adjusting harvest regulations to manually removing non-native fish.

LCT has also been stocked in Echo, Cascade, and Marlette Lakes, but it has not been determined how these stockings contribute to the recovery objectives in the LCT Recovery Action Plan for Lake Tahoe. These lakes were stocked to satisfy sport fishing goals. They are not managed for self-sustaining populations and reproduction has not been documented in these lakes. Marlette Lake is on Nevada

State Parks land, but LCT may potentially migrate downstream into Marlette Creek, which is located on the LTBMU.

Additional LCT habitat is present within the project area but the widespread distribution of non-native salmonids would make their persistence unlikely. However, it is anticipated that other waterbodies will eventually be used as recovery streams to build source populations. As for Lake Tahoe, it has not yet been determined the role it will play in the LCT recovery in the Basin.

2. Lahontan tui chub

Tui chub occur in wide range of habitats in temperatures ranging from 35 – 86°F from the Columbia River drainage in the north to central Nevada and California. Their typical habitat is quiet water with well developed beds of aquatic vegetation and bottoms of fines (Moyle 2002). Tui Chub have been only documented in McKinney Creek, Griff Creek, and Upper Truckee River marsh. Preliminary results from a warm water fish project suggest that non-native bass may be preying upon Tui chub within their preferred habitats (Kamerath et al. 2008).

3. Great Basin rams-horn

Great Basin rams-horn is native to California and other parts of the western US. The species are known to occur in large lakes and slow flowing rivers (Furnish 2005). The snails characteristically burrow in soft mud and may be almost invisible to detect even when abundant. In Eagle Lake, California, snails were only observed on the top of sand substrate, but only in deeper water (Furnish 2005). The species is known to occur in Lake Tahoe and the larger adjacent slow water stream segments, such as the outflow of the Truckee River (Furnish 2005).

4. Sierra Nevada Yellow Legged Frog (SNYLF)

Rana muscosa (southern mountain yellow-legged frog) is found in southern California and in the Sierra Nevada range south of Mather Pass. *Rana sierrae* (Sierra Nevada yellow-legged frog) is found in the Sierra Nevada range north of Mather Pass. The two species are referred to collectively as "mountain yellow-legged frogs". Sierra Nevada yellow-legged frog (*Rana sierrae*) is a candidate species for listing under the ESA. On June 24, 2007, the USFWS published a 12-month finding on a petition to list the Sierra Nevada distinct population segment of the Mountain yellow-legged frog (Federal Register Vol. 72, No. 121). In its finding, the FWS determined that it was warranted for listing, but precluded due to higher priority listing determinations for other candidate species.

The Sierra Nevada yellow-legged frog (SNYLF) is listed as Sensitive on the Region 5 Regional Forester's Sensitive Species List (USDA Forest Service 1998). Because

SNYLF has been extirpated from over 90% of its historic range, there is a need to restore the species habitat and prevent its range-wide extinction. To date, range-wide conservation activities for SNYLF have been accomplished in a multi-agency format involving the USFWS, National Park Service (NPS), US Forest Service, CDFG and academic institutions such as the University of California, Berkeley and Sierra Nevada Aquatic Research Laboratory.

This species is highly aquatic, rarely found outside of 2 m from water (AmphibiaWeb 2009), and is usually associated with streams, lakes and ponds in montane riparian, lodgepole pine, subalpine conifer, and wet meadow habitats at altitudes ranging from 4,500 – 12,000 ft (Zweifel 1955; Vredenburg et al 2005). SNYLF lay eggs in globular clumps encased in firm jelly-like transparent envelopes. Breeding occurs in shallow water areas of ponds, lakes or inlets of streams between April and June depending on elevation. Larvae can take 2 – 4 years or more to reach metamorphosis (Knapp and Matthews 2000). Both adults and larvae generally overwinter for up to 9 months on the bottom of lakes (Bradford 1983). Adults emerge from overwintering sites immediately following snowmelt and move over ice to get to breeding sites (Pope 1999).

Currently, there are only two remnant populations of Sierra Nevada yellow-legged frogs located in the Tahoe Basin, in the headwaters of Trout Creek (Hellhole) and in Desolation Wilderness. It is suspected that SNYLF could have historically occupied lake habitats within the Round, Showers, Dardanelles and Four Lakes region (Upper Truckee River headwaters), however since the 1950s these lakes were stocked with brook trout which it is assumed that these introductions were the primary factor contributing to the species local extirpation (Knapp and Matthews 2000).

Historically, SNYLF were found in numerous watersheds within the project area. However, loss of habitat and introduction of non-native aquatic species have eliminated them from these historic habitats.

The Multi-Species Inventory and Monitoring program was implemented across the LTBMU over a 3 year period (2002, 2004-2005). Data from the project was intended to provide baseline status and distribution data for wildlife, plants and their habitats within the LTBMU and aid in the development of a comprehensive biological resource monitoring program at the forest-wide scale (Roth et al. 2007). A total of 148 lentic monitoring sites (lakes and meadows) were selected across the Lake Tahoe basin. Amphibian species detected included tree frogs, Western toad (*Bufo boreas*), long-toed salamander (Ambystoma macrodactylum) and bull frogs (*Rana catesbeiana*). SNYLF were not detected anywhere in these 148 sites.

4.2.1. General Effects to Aquatic Habitats

Environmental Consequences

Analysis of direct, indirect, and cumulative effects for the TIPS treatment project for aquatic species and their habitats are presented for the Proposed Action and No Action alternatives. Effects are bounded in time and space. To avoid unnecessary repetition regarding analysis of effects to aquatic species, the following generalized effects analyses for the Proposed Action and No Action alternatives apply to all species considered in the aquatic BE/BA unless otherwise stated in the species-specific analyses presented afterward.

Alternative 1 - No Action

Direct and Indirect Effects: Under the No Action alternative, existing sediment levels contributed from hill slope processes and channel bank erosion may be locally impacted, but may not measurably change at the watershed level. The amount of shade provided by riparian vegetation also may not change significantly from current levels along stream reaches within the project area. Although the persistence of some TIPS infestations could alter localized riparian habitat by out-competing native vegetation, it is not likely to cause significant changes in sedimentation or water temperature at a watershed level.

Cumulative Effects: Compared to past, present, and future land management activities, non-treatment of TIPS would contribute very little to changes in sedimentation, stream shade, and water temperatures because of the very small amount of riparian TIPS on the LTBMU.

Alternative 2 - Proposed Action

Direct and Indirect Effects: The proposed TIPS treatments are not expected to cause a measurable increase in sedimentation, decrease in riparian cover, or increase in water temperatures on a watershed level, because of the small area of total riparian TIPS on the LTBMU. Most of the TIPS treatment areas are alongside previously disturbed roadways and trails, and where riparian infestations do occur, they are sporadic. The current estimate of TIPS present within 50 feet of perennial rivers, streams, lakes and other water bodies is 1.4 acres, with the average infestation within this 50-foot range being 0.06 acre of TIPS per site. No 5th-field watershed has more than 1.0 percent proposed for treatment and most have well under 0.1 percent. The proposed TIPS Treatment Plan also includes conducting early treatment on future TIPS infestations that are currently unknown, to prevent establishment over a large area.

There is potential for increased localized sediment input where bare soil is created from the removal of TIPS. However, effects are not expected to be measurable due to implementation of design features that require revegetation and rehabilitation when greater than 0.1 acre of bare soil is created from TIPS treatment. TIPS removal treatments occurring in areas smaller than 0.1 acre could produce short-term and localized sediment input to the stream but this would diminish as native vegetation reoccupies the treated site within two to three years.

TIPS removals are not expected to produce measurable changes in riparian shade or water temperatures. When riparian TIPS are present on the LTBMU, they are not tall or dense enough to be the primary source of riparian shade. One of the tallest and densest riparian TIPS infestations occurs in Blackwood Canyon, where reed canarygrass makes up only 2% of the canopy cover in the area. Removal of this infestation is not enough to cause measurable changes to riparian shade or stream temperatures.

Cumulative Effects: The Water Quality section of this EA discusses the cumulative watershed effects (CWE) model which can be defined as the total impact on runoff, erosion, water yield, floods, and/or water quality that results 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 or watershed (CEQ 1997). Analysis of the proposed activities indicate that little if any cumulative effects would occur in any of the 47 watersheds in the Lake Tahoe Basin.

Other land management activities to be considered in this analysis include: fire, SEZ and species-specific restoration activities, fuel reductions in the wildland/urban interface, urban influences, road and trail building and maintenance, and recreation facility maintenance and use. Compared to these past, present and future land management activities, TIPS treatment would not measurably contribute to undesired changes in the overall quality of aquatic habitat from current levels (i.e. sedimentation rates, riparian cover, stream temperature). This is due to the small acreage of riparian TIPS sites relative to the total riparian area throughout the LTBMU, and the application of design features that have objectives of conserving aquatic resources. TIPS removal may actually improve streambank stability and stream cover in the long term by allowing native riparian vegetation to grow back.

Species-Specific Effects

Alternative 1 - No Action

Direct and Indirect Effects: There will be no direct or indirect effects to LCT, Lahontan tui chub, Great Basin rams-horn, or SNYLF by implementation of the No Action alternative, because there will be no potential disturbance or toxicological impact without treatment activities, and the invasive plant populations on the LTBMU are not extensive enough to alter sediment loading, surface runoff, canopy cover, bank stability, or organic biomass.

Cumulative Effects: Because there would be no direct or indirect effects to LCT, Lahontan tui chub, Great Basin rams-horn, or SNYLF under the No Action alternative, there would be no cumulative effects.

Alternative 2 - Proposed Action

Lahontan Cutthroat Trout (LCT)

Direct and Indirect Effects: Proposed TIPS treatments would not cause direct mortality to LCT because they are likely to swim away when treatment crews are present due to their general avoidance reaction to predators. These behavior changes in individual LCT would be temporary in duration and would be limited to individuals in an extremely localized section of stream, occurring only when and where treatment crews are present. There would be no measurable impact to LCT populations within a watershed due to the presence of treatment crews.

Spawning LCT would likely not be disturbed by TIPS treatment activities because LCT spawn in the spring, while most of the treatments occur in the summer during the field season. Redds are present in streams occupied by LCT in the summertime, but the likelihood of TIPS treatment crews disturbing a redd is low because of low LCT population numbers and the limited distribution of LCT Basin-wide, along with the limited and sporadic distribution of riparian TIPS in the LTBMU.

Results of the risk assessment analyses and information reviewed in the literature indicate that the proposed chemical treatments and application rates will not likely cause measurable changes to LCT status and populations. Currently, LCT have a limited distribution across the LTBMU. Because of this, along with the limited and sporadic distribution of riparian TIPS being proposed for chemical treatment (1.7 acres within 50 feet of waterbodies on the whole LTBMU), there is a small likelihood that herbicides will come in contact with LCT overall. Although aquatic TIPS are not proposed for treatment in this project, in the event that herbicide reaches LCT, the SERA risk assessments calculate estimated water concentrations

for the proposed application rates and the potential that these concentrations may produce dosages greater than established toxicity indices. Most toxicity data is reported as a time concentration relationship, where a test organism is subjected to a given concentration of a chemical over a period of time. The typical endpoint is the death of 50% of the test organisms (LC_{50} = lethal concentration of 50%), or the concentration that does not produce effects (NOEC = no observable effect).

Results of the Aminopyralid risk assessment analysis conclude that sensitive fish species exposed to the proposed concentrations have an extremely low potential to receive doses that are above the toxicity index. The US EPA Pesticide Fact Sheet for Aminopyralid states that it has been shown to be practically non-toxic to fish and is not expected to bio-accumulate in fish tissue (http://www.epa.gov/opprd001/factsheets/aminopyralid.htm). This same fact sheet gives a 96-hour LC_{50} dosage of 100 mg/L for rainbow trout and a NOEC of 1.3mg/L for young fathead minnows. while the highest concentration estimated from the proposed application rate is only 0.15 mg/L.

Results of the Aminopyralid/Triclopyr mixture (Milestone VM plus) risk assessment analysis conclude that sensitive fish species exposed to the proposed concentrations have an extremely small potential to receive doses that are above the toxicity index. The US EPA Reregistration Eligibility Document for Triclopyr states that it is practically non-toxic to fish (http://www.epa.gov/oppsrrd1/REDs/factsheets/2710fact.pdf). Tu et al. (2001) found a 96-hour LC_{50} dosage of 117 mg/L for rainbow trout, while the highest Triclopyr concentration estimated from the proposed application rate is only 0.66 mg/L. Triclopyr is being proposed only for use with Aminopyralid (Milestone VM Plus). Design features (in section 3.2) decrease the likelihood that even this concentration will reach LCT because Triclopyr will not be applied within 50 feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows. The 0.66 mg/L concentration estimated in the risk analysis assumes no buffers.

Results of the Chlorsulfuron risk assessment analysis conclude that sensitive fish species exposed to the proposed concentrations have an extremely small potential to receive doses that are above the toxicity index. The US EPA Reregistration Eligibility Document for Chlorsulfuron states that it is practically non-toxic to fish on an acute exposure basis (http://www.epa.gov/oppsrrd1/reregistration/REDs/factsheets/chlorsulfuron_factsheet.pdf). Kegley et al. (2009) found a 96-hour LC_{50} dosage of 39 mg/L for brown trout, while the highest concentration estimated from the proposed application rate is only 0.13 mg/L. Design features (in section 3.2) decrease the likelihood that even this concentration will reach water bodies because Chlorsulfuron will not be

applied within 50 feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows. The 0.13 mg/L concentration estimated in the risk analysis assumes no buffers.

The risk assessment for the most toxic form of Glyphosate (such as Accord XRT) calculated a potential to receive doses that are above the toxicity index, only at the highest estimated dosage. The US EPA Technical Fact Sheet for Glyphosate states that it is not expected to bioconcentrate in aquatic organisms, and is minimally retained and rapidly eliminated in fish (http://www.epa.gov/ogwdw000/pdfs/factsheets/soc/tech/glyphosa.pdf). For the most toxic formulation of Glyphosate, Tu et al. (2001) found a 96-hour LC_{50} dosage of 13 mg/L for aquatic species, while the highest concentration estimated from the proposed application rate is only 1.5 mg/L. Design features (in section 3.2) decrease the likelihood that even this concentration will reach water bodies because this type of Glyphosate formulation will not be applied within 50 feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows. The 13 mg/L concentration estimated in the risk analysis assumes no buffers. However, the aquatic formulation will be applied within the 50-foot buffer. Results of the aquatic formulation of Glyphosate risk assessment analysis conclude that sensitive fish species exposed to the proposed concentrations have an extremely small potential to receive doses that are above the toxicity index. For the aquatic formulation of Glyphosate, Tu et al. (2001) found a LC_{50} dosage of 900 mg/L for aquatic species, while the highest concentration estimated from the proposed application rate is only 0.80 mg/L.

In reality, the risk potentials to LCT would be even smaller than those calculated in the risk assessments because the exposure scenarios used in the risk assessments are not likely to occur. The risk assessments assume the fish is sitting in the estimated herbicide concentration for 24 hours. River flow and larger bodies of water will begin diluting the initial concentration of herbicide in the water within minutes. Design features (in section 3.2) decrease the likelihood that the full dosage of herbicide being applied reaches the water bodies where LCT may be found. For instance, within 50 feet of waterbodies, the application methods that will be used are dip & clip, wick & wipe, and directed spray. These application methods are far more conservative than the broadcast spraying application used in calculating risk assessment results.

Cumulative Effects: Other land management activities to be considered in this analysis are LCT recovery activities, fuel reduction treatments, stream restoration activities, and road and trail maintenance.

LCT habitat reclamation is occurring in the Upper Truckee River below Meiss Meadows and involves manual methods to remove brook trout from 10 miles of stream and 85 acres of lake systems. The purpose of this LCT recovery project is to expand upon the current LCT population in the Upper Truckee River and provide a more robust source population for downstream segments and Lake Tahoe. The TBRIT will also continue to plan and implement recovery activities in Fallen Leaf Lake. It is estimated that recovery actions in Fallen Leaf Lake may range from stocking larger size LCT (10 inches or greater), to adjusting harvest regulations, to manually removing non-native fish. It is foreseeable that other LCT recovery activities will eventually occur, but the specifics are unknown at this time.

Additionally, restoring riparian ecosystem function and maintaining meadow integrity is consistent with achieving channel form and function, which is important to the future success of LCT. Stream and watershed restoration efforts are expected to occur in the Upper Truckee River and its tributaries, Meeks Creek, and Blackwood Creek. Therefore, available aquatic habitat where future recovery efforts could take place for LCT is expected to be enhanced over the long-term (> 5 years) as stream and watershed restoration efforts continue to move streams, wetlands and meadows to desired conditions within the LTBMU.

When considering effects from past, present and future foreseeable actions and the Proposed Action, LCT populations in the Upper Truckee River and Fallen Leaf Lake are expected to continue to expand in size and distribution. However, competition with non-native salmonids would continue to be a limiting factor of population growth.

Lahontan Tui Chub

Direct and Indirect Effects: Proposed TIPS treatments would not cause direct mortality to Lahontan tui chub because they are likely to swim away when treatment crews are present due to their general avoidance reaction to predators. These behavior changes in individual tui chub would be temporary in duration and would be limited to individuals in an extremely localized section of stream, occurring only when and where treatment crews are present. There would be no measurable impact to tui chub populations within a watershed due to the presence of treatment crews.

Spawning tui chub and eggs may be present in streams in the summer, but the likelihood of TIPS treatment crews disturbing them is low because of low detections and limited distribution of tui chub in the Basin, along with the limited and sporadic distribution of riparian TIPS in the LTBMU.

Results of the risk assessment analyses and information reviewed in the literature indicate that the proposed chemical treatments and application rates will not likely cause measurable changes to tui chub status and populations. Currently, the known detections of tui chub in the LTBMU are limited. Because of this, along with the limited and sporadic distribution of riparian TIPS being proposed for chemical treatment (1.7 acres within 50 feet of waterbodies on the whole LTBMU), there is a small likelihood that herbicides will come in contact with tui chub overall. However, in the event that herbicide is applied near tui chub, the SERA risk assessments calculate estimated water concentrations for the proposed application rates and the potential that these concentrations may produce dosages greater than established toxicity indices. Most toxicity data is reported as a time concentration relationship, where a test organism is subjected to a given concentration of a chemical over a period of time. The typical endpoint is the death of 50% of the test organisms (LC_{50} = lethal concentration of 50%).

The LCT effects analysis (above) examined risk assessment results and literature reviews of dose response studies for the most sensitive fish species. This effects analysis applies to Lahontan tui chub also.

Cumulative Effects: Other land management activities to be considered in this analysis are stream restoration activities and road/trail maintenance.

Prior to large scale stocking of non-native salmonids and illegal introductions of warm-water fishes, it is likely that tui chub occupied much of the lower gradient habitats in LTBMU. Introduced game fishes compete with tui chub for food and cover. Tui chub have also become a prey species within this altered ecology. Due to low detection of tui chub throughout the LTBMU, it is likely that non-native fish introductions have had adverse impacts on the population.

The future persistence of tui chub will be influenced by fisheries management practices such as non-native fish removal, adjustments in non-native trout harvest regulations, prevention of future non-native aquatic species invasions, and continued watershed restoration efforts. Tui chub habitat is expected to be enhanced over the long term (>5 years).

When considering effects from past, present and future foreseeable actions and the Proposed Action, there are no measurable cumulative effects to Lahontan tui chub. However, competition with non-native fish would continue to be a limiting factor of population growth.

Great Basin rams-horn

Direct and Indirect Effects: Great Basin rams-horn may be present in the project area, but the likelihood of TIPS treatment crews disturbing them is low because of low detections and limited distribution of rams-horn in the basin, along with the limited and sporadic distribution of riparian TIPS in the LTBMU. Also, treatment crews are not likely to walk in streams and ponds. However, if they do, disturbance would be temporary in duration and would be limited to individuals in an extremely localized section of stream, occurring only when and where treatment crews are present. There would be no measurable impact to rams-horn populations within a watershed due to the presence of treatment crews.

Results of the risk assessment analyses and information reviewed in the literature indicate that the proposed chemical treatments and application rates will not likely cause measurable changes to rams-horn status and populations. Currently, the known detections of rams-horn in the LTBMU are limited. Because of this, along with the limited and sporadic distribution of riparian TIPS being proposed for chemical treatment (1.7 acres within 50 feet of waterbodies on the whole LTBMU), there is a small likelihood that herbicides will come in contact with rams-horn overall. However, in the event that herbicide is applied near rams-horn, the SERA risk assessments calculate estimated water concentrations for the proposed application rates and the potential that these concentrations may produce dosages greater than established toxicity indices. Most toxicity data is reported as a time concentration relationship, where a test organism is subjected to a given concentration of a chemical over a period of time. The typical endpoint is the concentration which produces a specified response in 50% of the individuals (EC_{50} = effective concentration of 50%). The SERA risk assessments do not have aquatic invertebrate data to analyze Glyphosate.

Results of the Aminopyralid risk assessment analysis conclude that sensitive aquatic invertebrate species exposed to the proposed concentrations have an extremely small potential to receive doses that are above the toxicity index. The US EPA Pesticide Fact Sheet for Aminopyralid states that it has been shown to be practically non-toxic to aquatic invertebrates (http://www.epa.gov/opprd001/factsheets/aminopyralid.htm). This same fact sheet gives a 48-hour EC_{50} dosage of 8.6 mg/L for *Daphnia magna*, while the highest concentration estimated from the proposed application rate is only 0.15 mg/L.

Results of the Aminopyralid/Triclopyr mixture (Milestone VM plus) risk assessment analysis conclude that sensitive invertebrate species exposed to the proposed

concentrations have an extremely small potential to receive doses that are above the toxicity index. The US EPA Reregistration Eligibility Document for Triclopyr states that it is practically non-toxic to freshwater invertebrates (http://www.epa.gov/oppsrrd1/REDs/factsheets/2710fact.pdf). Antunes-Kenyon and Kennedy. (2004) found a 48-hour LC_{50} dosage of 1,030 mg/L for Daphnia magna, while the highest Triclopyr concentration estimated from the proposed application rate is only 0.66 mg/L. Triclopyr is being proposed for use only with Aminopyralid (Milestone VM Plus). Design features (in section 3.2) decrease the likelihood that even this concentration will reach rams-horn because Triclopyr will not be applied within 50 feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows. The 0.66 mg/L concentration estimated in the risk analysis assumes no buffers.

Results of the Chlorsulfuron risk assessment analysis conclude that sensitive aquatic invertebrate species exposed to the proposed concentrations have an extremely small potential to receive doses that are above the toxicity index. The US EPA Reregistration Eligibility Document for Chlorsulfuron states that it is slightly toxic to marine invertebrates but practically non-toxic to honeybees on an acute contact basis (http://www.epa.gov/oppsrrd1/reregistration/REDs/factsheets/chlorsulfuron_factsheet.pdf). Kegley et al. (2009) found a 48-hour LC_{50} dosage of 10 mg/L for juvenile *Daphnia pulex*, while the highest concentration estimated from the proposed application rate is only 0.13 mg/L. Design features (in section 3.2) decrease the likelihood that even this concentration will reach water bodies because Chlorsulfuron will not be applied within 50 feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows. The 0.13 mg/L concentration estimated in the risk analysis assumes no buffers.

The US EPA Technical Fact Sheet for Glyphosate states that it is not expected to bioconcentrate in aquatic organisms (http://www.epa.gov/ogwdw000/pdfs/factsheets/soc/tech/glyphosa.pdf). For the most toxic formulation of Glyphosate, Servizi et al. (1987) found a 96-hour LC_{50} dosage of 25 mg/L for *Daphnia*, while the highest concentration estimated from the proposed application rate is only 1.5 mg/L. Design features (in section 3.2) decrease the likelihood that even this concentration will reach water bodies because this type of Glyphosate formulation will not be applied within 50 feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows. The 13 mg/L concentration estimated in the risk analysis assumes no buffers. However, the aquatic formulation will be applied within the 50-foot buffer. For the aquatic formulation of Glyphosate, Servizi et al. (1987) found a 96-hour LC_{50} dosage of 962

mg/L for aquatic species, while the highest concentration estimated from the proposed application rate is only 0.80 mg/L.

In reality, the risk potentials to rams-horn would be even smaller than those calculated in the risk assessments because the exposure scenarios used in the risk assessments are not likely to occur. The risk assessments assume the organism is sitting in the estimated herbicide concentration for 24 hours. River flow and larger bodies of water will begin diluting the initial concentration of herbicide in the water within minutes. Design features (in section 3.2) decrease the likelihood that the full dosage of herbicide being applied reaches the water bodies where rams-horn may be found. For instance, within 50 feet of waterbodies, the application methods that will be used are dip & clip, wick & wipe, and directed spray. These application methods are far more conservative than the broadcast spraying application used in calculating risk assessment results.

Cumulative Effects: Other land management activities to be considered in this analysis are stream restoration activities and road/trail maintenance.

Urbanization associated impacts (for example, channelization of streams and dredging of Tahoe Keys) and impacts from introduced non-native aquatic species have altered native mollusk habitat. It is not known if any of these impacts have led to local extirpation of Great Basin rams-horn in LTBMU. The greatest threat to native mollusks in the Lake Tahoe Basin are from invasive mussels, such as quagga mussel (*Dreissena rostrifomis bugensis*), zebra mussel (*Dreissena polymorpha*), and New Zealand mudsnail (*Potamopyrgus antiposarum*). The recent discovery of invasive Asian clam (*Corbicula fluminea*) is currently being researched to understand impacts to the aquatic ecosystem. It is assumed the Asian clam will compete for resources with native mollusks.

The future persistence of rams-horn will be influenced by fisheries management practices such as non-native fish removal, adjustments in non-native trout harvest regulations, prevention of future non-native aquatic species invasions, and continued watershed restoration efforts. Native mollusk habitat is expected to be enhanced over the long term (>5 years).

When considering effects from past, present and future foreseeable actions and the Proposed Action, there are no measurable cumulative effects to Great Basin rams-horn. However competition with non-native mollusks could continue to be a limiting factor of population growth.

Sierra Nevada Yellow-legged Frog (SNYLF)

Direct and Indirect Effects: Proposed TIPS treatments would not likely cause direct mortality to SNYLF because tadpoles and adults are likely to swim or hop away when people are present due to their general avoidance reaction to predators. These behavior changes in individual SNYLF would be temporary in duration and would be limited to individuals in an extremely localized section of stream or pond, occurring only when and where treatment crews are present. There would be no measurable impact to SNYLF populations within a watershed to the presence of treatment crews.

Mating SNYLF would likely not be disturbed by TIPS treatment activities because SNYLF mate after the snow has melted in the spring or early summer, while conditions are still wet. Most of the treatments occur in the summer during the drier season. Eggs may be present in the water in the summer, but the likelihood of TIPS treatment crews disturbing SNYLF eggs is low because of low SNYLF population numbers and their limited distribution of in the basin along with the limited distribution of riparian TIPS. There are no TIPS currently documented in areas where SNYLF are currently known to occur (headwaters of Trout Creek and Desolation Wilderness).

Results of the risk assessment analyses and information reviewed in the literature indicate that the proposed chemical treatments and application rates will not likely cause measurable changes to SNYLF status and populations. Currently, SNYLF have a limited distribution in LTBMU. Because of this, along with the limited and sporadic distribution of riparian TIPS being proposed for chemical treatment (1.7 acres within 50 feet of waterbodies on the whole LTBMU), there is a small likelihood that herbicides will come in contact with SNYLF overall. However, in the event that herbicide is applied near SNYLF, the SERA risk assessments calculate estimated water concentrations for the proposed application rates and the potential that these concentrations may produce dosages greater than established toxicity indices. Most toxicity data is reported as a time concentration relationship, where a test organism is subjected to a given concentration of a chemical over a period of time. The typical endpoint is the death of 50% of the test organisms (LC_{50} = lethal concentration of 50%). The SERA risk assessments have amphibian data to only analyze Aminopyralid and Aminopyralid/Triclopyr mixture.

Results of the Aminopyralid risk assessment analysis conclude that sensitive amphibian species exposed to the proposed concentrations have an extremely small potential to receive doses that are above the toxicity index. The US EPA Pesticide Fact Sheet for Aminopyralid

(http://www.epa.gov/opprd001/factsheets/aminopyralid.htm) gives a 96-hour LC_{50} dosage of 95 mg/L for northern leopard frog, while the highest concentration estimated from the proposed application rate is only 0.15 mg/L.

Results of the Aminopyralid/Triclopyr mixture (Milestone VM plus) risk assessment analysis conclude that sensitive amphibian species exposed to the proposed concentrations have an extremely small potential to receive doses that are above the toxicity index. The most sensitive 96 hour LC_{50} dosage Perkins et al. (2000) found was 159 mg/L for African clawed frogs, while the highest concentration estimated from the proposed application rate is only 0.66 mg/L. Triclopyr is being proposed only for use with Aminopyralid (Milestone VM). Design features (in section 3.2) decrease the likelihood that even this concentration will reach SNYLF because Triclopyr will not be applied within 50 feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows. The 0.66 mg/L concentration estimated in the risk analysis assumes no buffers.

No Chlorsulfuron toxicity information on amphibians was identified in a review of literature. Toxicity information may exist in unpublished sources or privately supported research that was not identified in our reviews of standard ecological toxicity data sources. The highest concentration estimated from the proposed application rate is only 0.013 mg/L. Design features (in section 3.2) decrease the likelihood that even this concentration will reach water bodies because Chlorsulfuron will not be applied within 50 feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows. The 0.13 mg/L concentration estimated in the risk analysis assumes no buffers, and since SNYLF are mainly found within 10 ft of water (http://amphibiaweb.org/), they would likely not be exposed to the estimated maximum concentration of 0.013 mg/L.

The US EPA Technical Fact Sheet for Glyphosate states that it is not expected to bioconcentrate in aquatic organisms, and is minimally retained and rapidly eliminated in fish, birds, and mammals (http://www.epa.gov/ogwdw000/pdfs/factsheets/soc/tech/glyphosa.pdf). Relyea and Jones (2009) found that the proposed application rate of 1.5 mg/L is well within the range of LC_50 dosages for amphibian species. Design features (in section 3.2) decrease the likelihood that this concentration will reach water bodies because the more toxic form of Glyphosate will not be applied within 50 feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows. The 1.5 mg/L concentration estimated in the risk analysis assumes no buffers, and since SNYLF are mainly found within 10 feet of water (http://amphibiaweb.org/), they would likely not be exposed to the estimated maximum concentration of 1.5 mg/L. However, the aquatic formulation will be applied within the 50 foot buffer. Trumbo

(2005) found a 96-hour LC_{50} value for Glyphosate without surfactant (i.e. Rodeo®) on larval Northern leopard frog to be 6.5 mg/L, while the highest concentration estimated from the proposed application rate is only 0.80 mg/L.

In reality, the risk potentials to SNYLF would be even smaller than those calculated in the risk assessments because the exposure scenarios used in the risk assessments are not likely to occur. The risk assessments assume the amphibian is sitting in the estimated herbicide concentration for 24 hours. River flow and larger bodies of water will begin diluting the initial concentration of herbicide in the water within minutes. Design features (in section 3.2) decrease the likelihood that the full dosage of herbicide being applied reaches the water bodies and meadow where SNYLF may be found. For instance, within 50 feet of waterbodies and seasonally flooded meadows, the application methods that will be used are dip & clip, wick & wipe, and directed spray. These application methods are far more conservative than the broadcast spraying application used in calculating risk assessment results.

Cumulative Effects: Other land management activities to be considered in this analysis are SNYLF habitat reclamation activities, and stream/meadow restoration activities.

SNYLF habitat reclamation is occurring in Desolation Wilderness and involves manual methods to remove non-native salmonids from some small ponds and 5 of the lake systems (Tamarack, Ralston, Cagwin, Lucielle, and Marjorie Lakes) within the LTBMU boundary. The purpose of this improvement project is to increase suitable habitat area for native mountain yellow-legged frogs, restoring habitat connectivity in this alpine ecosystem to improve their future population viability in Desolation Wilderness area. It is foreseeable that additional SNYLF habitat reclamation will eventually occur in more undetermined lakes in the wilderness. It is also possible that re-introductions of SNYLF into some of these reclaimed lakes may occur in the future. Currently, there are no known TIPS within Desolation Wilderness. If herbicide use is proposed to control any infestation of TIPS in any Wilderness Area, Regional Forester approval will be sought.

Additionally, meadow restoration efforts are expected to occur in High Meadows in the upper Cold Creek watershed. Restoring meadow ecosystem function and maintaining meadow integrity will promote healthy aquatic, riparian, and wet meadow habitats. Quality habitat (wetland hydrology, vegetative cover, soil moisture) for SNYLF is expected to increase over the long-term (> 5 years) as stream and watershed restoration efforts continue to move streams, wetlands, and meadows to desired conditions within the LTBMU. Therefore, there will be more

available habitat for potential future SNYLF recovery efforts. Currently, there are no SNYLF in High Meadows.

When considering effects from past, present and future foreseeable actions and the Proposed Action, SNYLF populations in Desolation Wilderness are expected to expand in size and distribution. However, competition with non-native salmonids would continue to be a limiting factor of population growth. Interestingly, Relyea (2005) found the Roundup® LC_{50} dosage for wood frogs decreased from 1.32 mg/L to 0.55 mg/L (2.5 times smaller) when a predator was present. Currently, there are no known TIPS within Desolation Wilderness or Hellhole meadow, where SNYLF are found. The Project or Staff Aquatic Biologist will be consulted prior to chemical treatment of new TIPS occurrences or expanding occurrences, to verify that FS Sensitive aquatic species, such as SNYLF, would not be impacted.

Determinations

Threatened, Endangered, and Sensitive Aquatic Species

The most recent list of threatened, endangered, proposed, and candidate wildlife species was obtained from the USFWS on January 29, 2009 (http://sacramento.fws.gov/es/spp_list.htm). This list fulfills the requirements of the USFWS to provide a current species list pursuant to Section 7 of the ESA. The Forest Service Regional Forester's Sensitive Species list is based on the Pacific Southwest Region's revised list of March 3, 2008.

Potentially affected species were determined through an evaluation of whether each threatened, endangered or sensitive (TES) species was either (1) known to occur in the project action area, or (2) the project area contained suitable habitat within the current range of the species. The following table (Table 4c) summarizes species considered in the effects analysis for the project. There is no proposed or designated critical habitat for any species on the LTBMU.

Species Not Affected by either Alternative

The following species will not be addressed further in the analysis of effects because they are not known to occur in the project area and/or do not have suitable habitat in or within 0.5 mile of the project area. Therefore, a determination of "No Effect" for both alternatives is found for:

Delta Smelt and Central Valley Steelhead (FWS threatened): The LTBMU is outside the historical and current range of the threatened Delta smelt and the Central Valley steelhead

Yosemite Toad (FWS candidate): The project area is not in the historic range of Yosemite toad.

Northern Leopard Frog (FS sensitive): This species is not known to currently occur in the Lake Tahoe basin. In addition, the project area is not considered suitable habitat because recent research suggests the Lake Tahoe basin in general is not in the historic range of northern leopard frog (Jennings et al 2004).

Species Potentially Affected by one or both Alternatives

Table 4c: Potentially Affected Threatened, Endangered, and Sensitive Species in LTBMU, and effect determinations for TIPS Treatment project.

Species	Special Status	Known to Occur in the Project Area	Suitable Habitat in the Project Area	Determination and Rationale – No Action Alternative	Determination and Rationale – Proposed Alternative
Lahontan cutthroat trout (*Oncorhuynchus clarki henshawi)*	FWS Threatened Species	Yes	Yes	NA – current conditions would continue to occur	NLAA – design features reduce the potential for toxic levels of herbicides reaching waterbodies
Lahontan lake tui chub (*Gila bicolor pectinifer*)	FS Sensitive Species	Yes	Yes	NE – current conditions would continue to occur	MANL – design features reduce the potential for toxic levels of herbicides reaching waterbodies
Great Basin rams-horn (*Helisoma (Carninifex) newberryi*)	FS Sensitive Species	Yes	Yes	NE – current conditions would continue to occur	MANL – design features reduce the potential for toxic levels of herbicides reaching waterbodies
Sierra Nevada (Mountain) yellow-legged frog (*Rana sierrae (=muscosa)*)	FS Sensitive Species	Yes	Yes	NE – current conditions would continue to occur	MANL – design features reduce the potential for toxic levels of herbicides reaching waterbodies and meadows

USFWS Listed Species

NA - Will not affect the species or its designated critical habitat.

NLAA - May Affect Not Likely to Adversely Affect the species or its designated critical habitat.

LAA - May affect and is likely to adversely affect the [name of species] or its designated critical habitat

FS Sensitive Species

NE – Will not affect the species.

MANL – May affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability.

MALT - May affect individuals, and is likely to result in a trend toward Federal listing or loss of viability.

Management Indicator Species

Management Indicator Species (MIS) for the LTBMU are identified in the 2007 Sierra Nevada Forests Management Indicator Species (SNF MIS) Amendment (USDA Forest Service 2007a). The habitats and ecosystem components and

associated MIS analyzed for the project were selected from this list of MIS, as indicated in Table 4d. In addition to identifying the habitat or ecosystem components (1st column), the CWHR type(s) defining each habitat/ecosystem component (2nd column), and the associated MIS (3rd column), the table discloses whether or not the habitat of the MIS is potentially affected by the TIPS Project (4th column). Refer to the project's MIS report (Project Record Document K7) for a full analysis of the effects on the project to MIS habitats.

Table 4d. Selection of MIS for Project-Level Habitat Analysis for the TIPS Project.

Habitat or Ecosystem Component	CWHR Type(s) defining the habitat or ecosystem component	Sierra Nevada Forests Management Indicator Species *Scientific Name*	Category for Project Analysis [1]
Riverine & Lacustrine	Lacustrine (LAC) and Riverine (RIV)	aquatic macroinvertebrates	2
Wet Meadow	Wet meadow (WTM), Freshwater Emergent Wetland (FEW)	Pacific tree frog *(Pseudacris regilla)*	2

[1]**Category 1:** MIS whose habitat is not in or adjacent to the project area and would not be affected by the project.
Category 2: MIS whose habitat is in or adjacent to project area, but would not be either directly or indirectly affected by the project.
Category 3: MIS whose habitat would be either directly or indirectly affected by the project

For both Alternative 1 and 2

Summary of Riverine & Lacustrine / Aquatic Macroinvertebrates Status and Trend at the Bioregional Scale

The data collected at the bioregional scale indicate that the metrics for macroinvertebrates are stable. Changes in flow, sedimentation, and water surface shading as a result of the proposed project are not likely to impact existing riverine and lacustrine habitat within the Sierra Nevada. Therefore, the effects of the TIPS Project will not alter the existing stable trend in the habitat for aquatic macroinvertebrates across the Sierra Nevada bioregion.

Summary of Wet Meadow / Pacific Tree Frog Status and Trend at the Bioregional Scale

The California Wildlife Habitat Relationships (CWHR) analysis does not define any meadows in the project area. There will not be a measurable change in acres of wet meadow habitat, herbaceous height, herbaceous ground cover, or meadow hydrology. Therefore, this project would not alter the existing stable trend for wet meadow habitat for Pacific tree frog across the Sierra Nevada bioregion.

4.3 Water Quality

Overview

Water Resources Law and Policy

Federal Legislation

Federal and state laws, policies and regulations that control the use of herbicides on NFS lands include the Clean Water Act, The Safe Drinking Water Act and the Federal Water Pollution Control Act.

- 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 California, the Regional Water Board (RWB) compiles this information for each region. The information is then combined into a single report by the RWB.
- Section 208 of the 1972 amendments to the Water Pollution Control Act (Public Law 92-500) specifically mandated identification and control of non-point source pollution.
- 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 will comply with the standards and criteria determined by the RWB

Forest Service-related Regulation

- The regulatory framework of the LTBMU is guided by Federal laws and regulations as well as direction from the Forest Plan. Forest Plan direction is found in the Sierra Nevada Forest Plan Amendment (SNFPA) of 2004. Management direction for soils focuses on maintaining soil productivity and the restoration and maintenance of the physical, chemical, and biological integrity of the Basin's waters, as directed by the Clean Water Act. For consistency in the TIPS Treatment Project, the Forest Supervisor determined that the Sierra Nevada Forest Plan Amendment Record of Decision direction for riparian-area management will be followed Basin 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 Basin'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.

Analysis

Water quality risk factors are identified by assessing three potential contaminant pathways:

1. Herbicides directly entering water bodies by heavy storm runoff, accidental spill and fugitive drift from spray application.
2. Localized erosion and transport of soil to water bodies due to loss of vegetation cover.
3. Leaching of herbicides through specific soil types (soil types are identified in the Soils section 4.4).

Analysis of risk factor #1 occurs in this section. Analysis of water quality risk factors #2 & #3 occurs in section 4.4, Soils.

Risk assessments and monitoring studies of herbicide use in forested areas were used to substantiate design features that protect water bodies from potential adverse effects of the proposed treatments. Design Features are outlined in Section 3.2.

Risk Assessment

- Risk assessments, described in Proposed Action, section 2.5, are considered worst-case scenarios, including accidental exposures and applications at maximum reported rates. They are considered by the Forest Service to represent the best science available. SERA worksheets were adjusted for the application rates to be used for this project. This method of assessing risk to water quality is considered conservative because actual conditions are less conducive to herbicides reaching water bodies. The infestations are scattered, streams are buffered from herbicide application and broadcast applications are not allowed. All herbicides proposed by this EA have SERA risk assessments.
- EPA risk assessments are performed on all herbicides prior to their sale, distribution or use in the United States. EPA labels are placed on all herbicide containers which include proper use related to protection of water quality. (DF 28) This analysis assumes that the EPA label instructions will be strictly followed for all herbicides proposed in this action.

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/m3. Buffers for herbicides proposed in this EA are designed to be protective of the most sensitive aquatic species and are therefore very conservative with regard to water quality.
- 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. 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. Design Feature # 6 states that herbicide application shall not take place within six hours of a forecast rainfall event that has a high probability of occurring and of producing measurable runoff.
- 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 National Forest monitoring included an invasive weed project within riparian areas (USDA Forest Service 2001b). 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). 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 2001b). Control of aquatic TIPS is not part of this project. Buffers for herbicides proposed in this EA are designed to be protective of the most sensitive aquatic species and are therefore very conservative with regard to water quality. (see design features)
- Triclopyr was used on five projects on three Forests. Where Triclopyr was used with buffers of 10-15 feet, there were three 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 2001b). Buffers for herbicides proposed in this action are designed to be protective of the most sensitive aquatic species and are therefore very conservative with regard to water quality. (see design features)

Affected Environment

Water Resources

Stream surveys and stream condition assessments have been conducted for the LTBMU from 1995 to the present, both at the project level and cumulative effects levels. Based on gathered information, and the completion of the LTBMU 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 (Brady and Weil 1999).

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.

Municipal supply watersheds serve as public water systems as defined in Public Law 93-523 (Safe Drinking Water Act) or as defined in State safe drinking water regulations. There are several domestic water users scattered throughout or downstream from NFS land on numerous streams. While developing the design standards for the Proposed Action and the No Action alternatives the following water quality characteristics were considered:

- Distance to high water mark of streams, lakes, ponds, springs and meadows from the application of herbicides
- Mobility of herbicides considering the method of application within 25 feet of high water mark of streams, lakes, ponds, springs and meadows.

Hydrologic Cycle in the Analysis Area

Mean annual precipitation ranges from over 55 in (1,400 mm) in watersheds on the west side of the Basin to about 26 inches (660 mm) near the lake on the east side of the Basin. Most of the precipitation falls as snow between November and April, although rainstorms combined with rapid snow melt account for the largest floods. There is a pronounced annual runoff of snowmelt in late spring and early summer,

the timing of which varies from year to year. In some years, summertime monsoon storms from the Great Basin bring intense rainfall, especially to high elevations on the east side of the Basin.

Water Quantity and Timing

Within the 47 watersheds in the Lake Tahoe Basin, there are approximately 1,836 miles of stream. Of these, 1,383 miles are ephemeral, which equates to 75 percent of the total stream miles. Approximately 3 percent, or 69 miles, are intermittent. Approximately 20 percent of the stream miles, or 385 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; however, application would not take place within six hours of predicted rainfall. (DF-6)

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, which has greater potential to transport sediment to water bodies.

BMPs

BMPs, designed to protect water quality, shall be implemented and maintained during project activities as outlined in the design features and in accordance with referenced Forest Service guidance documents. This project will also be included in the pool of forest projects for random selection and evaluation under Region 5's Best Management Practices Evaluation Program (BMPEP).

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 (Norton et al.2004).

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

Comparison of Alternatives

4.3.1 Alternative 1 – No Action

Direct and Indirect Effects: Under this alternative, only manual and mechanical treatments of TIPS would occur. Invasive plants would continue to grow on sites where only manual and mechanical treatments are authorized; populations of weed species resistant to manual and mechanical treatments would expand. Stream bank stabilization will be diminished as TIPS replace deeper rooted native plants. Stream shading will be diminished as native hardwoods and conifers are outcompeted by weeds. TIPS have been identified in all 47 watersheds of the Lake Tahoe Basin.

Cumulative Effects: Populations of weed species resistant to manual and mechanical treatments would expand, creating localized reductions in streambank stability and shading, adding to the watershed disturbances that affect riparian vegetation diversity and reduce the quality of aquatic habitat.

4.3.2 Alternative 2 - Proposed Action

Direct and Indirect Effects: It is proposed to chemically treat up to 100 acres infested with TIPS; some or all of these treatments could potentially take place in or near stream RCAs. In reality, such TIPS infestations are typically discontinuous and interspersed with native plants; however, because infestations change from year to year, a worst-case analysis was done that assumes TIPS infestations in or near RCAs are dense and continuous.

Chlorsulfuron and Triclopyr would not be applied within 50 feet of perennial rivers, streams, lakes, and other water bodies, including seasonally flooded SEZs. Only dip & clip, wicking & wiping, or spot spraying applications of Glyphosate or Aminopyralid would be used within 50 feet of perennial rivers, streams, lakes, and waterbodies within seasonally flooded SEZs and meadows. Only dip & clip and wicking & wiping applications of Aminopyralid or the aquatic formulation of Glyphosate would be used within ten feet of perennial rivers, streams, lakes, seasonally flooded SEZs, and meadows. Aquatic Glyphosate, licensed for use in water, would be used within RCAs for intermittent and 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 water quality small. Spot treatments would also remove less vegetation than broadcast treatments so there is less potential for erosion. There are approximately ten acres of treatment within ten feet of water scattered

across the Forest (Project Record L31). Under this alternative, only the non-rhizomatous acres would be treated with manual methods.

None of the treatments are extensive enough under this alternative to affect peak flows, low flows, or water yield. Methods used for treatment would have negligible effect on surface runoff. No watershed has more than 1.0 percent proposed for treatment and most have well under 0.1 percent. This amount is much too small an area to show any effects to water quality from treatment. Further, near water bodies, only small areas would generally be treated. Treatment would be discontinuous and limited at any specific site.

Herbicides other than aquatic Glyphosate would not be used within RCAs. Design buffers on perennial streams are protective of water quality. These buffers are considered adequate to minimize herbicide concentrations in water, because they are designed to be protective of the most sensitive aquatic species.

Project design standards also minimize the chance of herbicides reaching streams or wetlands through fugitive drift and heavy storm runoff.

The total amount of herbicide used by this project will undoubtedly be a tiny fraction of total herbicide used in the five counties and the Carson City Rural Area over a period of ten years. Both Glyphosate and Triclopyr are sold over the counter and used extensively in home and commercial landscaping, golf and park maintenance, and other similar applications nationwide. Such uses, occurring Basinwide, have not led to identifiable risks to water quality.

Cumulative Effects: The use of the small amount of herbicides proposed in this project for currently known and future infestations would occur over a brief period of time and would not contribute to a cumulative degradation of water quality.

Cumulative Watershed Effects (CWE): 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). Analysis of the proposed activities indicate that little if any cumulative effects would occur in any of the 47 watersheds forming Lake Tahoe Basin. Only the land and roads within the National Forest System would be treated in the Proposed Alternative. The Forest, however, is intermingled with other Federal, state, county, and private ownerships. Management activities and actions on neighboring lands may contribute to the spread of invasive plants on NFS lands, and vice versa. However, with the suite of treatments proposed in this project the

cumulative effects on NFS lands would be negligible; because, as new infestations occur, they would be treated effectively.

4.4 Soils

Overview

Law and Policy Governing the Soil Resource

The maintenance of productivity and the need to protect and improve the quality of the soil resource, and avoid permanent impairment of productive capability of NFS lands is governed by the Multiple Use and Sustained Yield Act of 1960, the National Environmental Policy Act of 1969, the Forest and Rangeland Renewable Resources Planning Act of 1974, and the National Forest Management Act of 1976.

- The Organic Administration Act of 1897 was enacted "to improve and protect the forest within the boundaries..."
- The Multiple-Use Sustained-Yield Act set forth the secondary purposes of National Forest establishment "for outdoor recreation, range, timber, watershed, and wildlife and fish purposes."
- The Forest and Rangeland Renewable Resources Planning Act (RPA) requires an assessment of the present and potential productivity of the land. This act provides guidelines for land management plans developed to "...insure that timber will be harvested from NFS land only where ... soil, slope, or other watershed conditions will not be irreversibly damaged."
- The National Forest Management Act (NFMA) amended RPA by adding sections that stressed the maintenance of productivity, the need to protect and improve soil and water resources, and avoidance of permanent impairment of the productive capability of the land.

The LTBMU Forest Plan provides guidance specific to the Lake Tahoe Basin. Standards and guidelines in Forest Land and Resource Management Plans provide the relevant substantive standards to comply with NFMA (USDA Forest Service 2007). Standards for maintaining soil productivity are found on page IV- 39. Soil function in Riparian Conservation Areas (RCAs) is addressed by standards 103, 111, and 122 in the Sierra Nevada Forest Plan Amendment (USDA Forest Service 2004a). The policies that guide management practices in order to sustain soil quality are found in the national and regional Forest Service Manuals and Handbooks.

Basis for Analysis

This analysis considers three indicators:

- Risk of soil loss from erosion.
- Potential for herbicide application to alter soil biology (microbial community, soil animals).
- Soil properties affecting water quality risk related to chemical application.

Analytical conclusions are provided for the first two indicators. The interactions between soil type and herbicide properties are discussed and relative risks are disclosed, but analytical conclusions about impacts to water quality are found in the hydrology section.

Affected Environment

Soils in the Analysis Area

Soils in the project area developed from glacial and alluvial materials derived primarily from granitic rocks, but with some metamorphic and volcanic rocks (Saucedo 2004). Soils are generally coarse textured, with most having coarse sand, loamy coarse sand, and sandy loam surface layers. Hellhole and Watah are organic soils primarily derived from decomposed peat. The Tahoe and Bidart soils have organic surface layers derived from decomposed plants, underlain by silt loam mineral soil layers. The Shakespeare soil also has a silt loam surface layer. Slope steepness ranges from 0-75%.

The analysis area includes 130 soil map units (Downie 2010). Each map unit usually includes two or more individual soil types, or components. Soil map units with high leaching potential where chemical treatment is proposed can be found in the table below.

Stream Environment Zone Soils

For planning purposes, Stream Environment Zones (SEZ) may be estimated using soil mapping, vegetation mapping, or a combination of the two. The acres of SEZ will vary depending on what kind of mapping is used.

For the purpose of this analysis, the Tahoe, Watah, Marla, Bidart, Hellhole, and Celio soils and the Beaches miscellaneous areas are considered Stream Environment Zone (SEZ) soils. This list was compiled in consultation with the TRPA and the Natural Resources Conservation Service (NRCS).

Tahoe, Watah, Bidart, and Hellhole soils and beaches are nearly always found in SEZs, while Marla and Celio soils are often, but not always found in SEZs. Beaches are associated with the shorelines of Lake Tahoe. Hellhole is a peat soil,

commonly found in fens and marshes. Watah has an organic surface layer and is found in marsh and wet meadow settings, while the Tahoe and Bidart soils are most commonly found in moist to dry meadows. Marla soils are most often associated with lodgepole forest grading into meadows. Celio soils are generally found in a lodgepole forest setting and have a seasonally high water table.

While the composition of soil map units is highly accurate over the entire soil survey area, the relative proportion of soil components in any given delineation (mapped polygon) may or may not match the map unit composition. For example, a soil map unit may have an estimate of 20% SEZ soils, but the composition of soil map units is an average, therefore an individual delineation of that map unit on the ground may have a different percentage of SEZ soils. However, over the entire soil survey area, the map unit composition will be very close to 20% SEZ soils. Note that, while map unit boundaries are generally very good, they may not be entirely accurate due to the scale of the soil mapping; the acreages given in this section are best estimates.

Environmental Consequences

4.4.1 Alternative 1 – No Action

Direct and Indirect Effects: Manual treatments are proposed on the known 8.9 acres of TIPS infestations in LTBMU's weeds database currently, and on as many new and expanded acres of TIPS infestations as are feasible.

Current treatment methods are limited to manual methods: hand pulling, pulling using tools, clipping, mulching, and tarping. The impacts from hand pulling and pulling using tools are limited to minor surface disturbances with negligible and temporary increases in erosion potential; these usually last no more than one year as new litter and vegetation provide surface cover.

Mulching provides potential minor and short-term beneficial effects from organic matter addition, soil cover, and temperature and moisture regulation. The extent of mulched areas is not great enough to alter carbon/nitrogen ratios significantly. Tarping may increase soil temperatures enough to kill soil organisms, but the extent and duration of this impact are minor. Tarping also constitutes a temporary creation of impermeable surface, but not enough to alter surface runoff patterns in a meaningful way.

The manual methods currently in use have not proved adequate to eradicate or control the spread of invasive plants. The No Action alternative would likely result in continued spread of TIPS, with accompanying impacts to soils.

TIPS can change soil biology (microbial communities and other soil organisms) as well as soil nutrient and carbon status, usually with negative effects to native plant communities. Both spotted and diffuse knapweed release chemicals into soil that suppress soil microbes and native plant growth in American but not European soils (Vivanco et al 2004).

There is evidence that cheat grass may alter soil microbial community composition, decreasing mycorrhizae that some native plants depend on for optimal nutrient uptake and growth, improved water relations and other benefits (Belnap & Philips 2001). Invasive species can destabilize native plant communities through their impacts on nitrogen dynamics, changing N availability by changing litter quantity and quality, rates of N^2-fixation, or rates of N loss (Evans et al 2001). Changes in nitrogen dynamics may also change soil pH (Ehrenfield et al 2001).

Cheat grass may alter nitrogen availability to its advantage and the detriment of native plants (Rowe et al 2008). Soil organisms that decompose organic matter have demonstrated preferences for particular substrates, so altering the soil organism community may affect below-ground carbon storage (Ekschmitt et al 2008). Since soil structure is partially dependent on soil biology, disrupting the soil biological community may eventually result in changes to soil structure (Young et al 1998).

Cumulative Effects: Since no additional actions would be undertaken, there would be no cumulative effects.

4.4.2 Alternative 2 - Proposed Action

Direct and Indirect Effects: This analysis describes potential effects of chemical treatment on up to 100 infested acres per year, over a 10-year period.

Manual and Mechanical Treatments

Effects from manual treatment methods would be similar to those described under No Action; these effects would be present on the currently-known 8.9 acres of TIPS infestations and new and expanded TIPS infestations, except where these treatment methods are shown to be ineffective. Chemical treatments would be used on TIPS infestations found to be resistant to treatment by manual methods. Erosion potential due to soil disturbance would be controlled through the design feature that specifies evaluation of disturbed, bare areas greater than 0.1 acre, with subsequent erosion control measures prescribed as needed.

Mechanical methods (mowing, cutting, brushing, trimming, weed eating) would cause little soil disturbance. If the cut material were left on site, minor short-term benefits from additional soil cover and organic matter addition would be provided.

Thermal treatments would not increase soil temperatures enough to impact soils or soil biota (microorganisms and soil invertebrates).

Impacts to soils from manual and mechanical treatments would be minor under current and expected future infestation levels. Risk of soil loss from erosion would be controlled by the design feature that prescribes evaluation and potential erosion control treatment on disturbed bare areas greater than 0.1 acre.

Chemical Treatments

The magnitude of potential effects from chemical treatments would vary with the specific chemical applied as well as with the amount of chemical applied. The amount of chemical applied would be dependent on the size of the infestation and the method of application; hand/selective application methods would deliver the least amount of chemical to the soil, followed by directed spray, with limited broadcast spray delivering the greatest amount of chemical to the soil, of these application methods.

The soils section describes the soil properties related to potential water quality impacts and the interactions between soil type and the proposed herbicides. However, the amount of chemical applied is often the most important factor in determining the potential for water quality impacts. This factor is discussed in the hydrology section.

Soil Properties Related to Water Quality Risk

Herbicides can reach surface or ground water by three major routes: drift from spray, leaching through soil to groundwater, and surface runoff to surface waters. Drift is addressed in the hydrology section; leaching and runoff potential are discussed here.

It is important to note that the ratings for leaching potential and runoff potential represent only relative risk that compares the risk among different soil types. The actual risk to water quality depends not only on the soil type, but also on the interactions between soil type and the specific chemical, and most importantly, the amount of chemical applied. Thus a soil with a high leaching potential and a high runoff potential (e.g. Tahoe series) would have the greatest potential for water quality impacts as compared to a soil with a low leaching potential and low surface runoff rating (e.g. Jorge series), but if a very small amount of chemical is applied, the risk to water quality may be negligible on either soil type.

It is also important to note that only a small part of the herbicide applied would have the potential to impact water quality: herbicides are taken up by plants, ingested by animals, insects, worms or microorganisms in the soil, and broken

down through a variety of chemical processes. The water quality risk related to the amount of chemical applied and other factors is discussed in the hydrology section.

Leaching potential is dependent on depth to water table, the rate at which water moves through the soil, and the soil's ability to bind (adsorb) pesticides. Using these criteria, a leaching potential rating was developed in collaboration with the local NRCS office (Woody Loftis, personal communication); the soils were rated Low, Moderate, or High. The rating for the dominant component in a map unit was used; if the dominant component was rock or other non-soil material, the rating for the second component was used. Some of the TIPS infestations that need to be treated with chemicals occur on soils with a high leachate potential. Chemical treatment is proposed on a total of about 3.7 acres of soils with a high leaching potential rating (Table 4e).

Table 4e. Soil map units with high leaching potential proposed for chemical treatment types.

Mapunit Symbol	Mapunit Name	Total LTBMU Acres	Chemical Treatment (Meters ^{2})	Leaching Potential
7011	Beaches	135.6	305.3	High
7041	Tahoe complex, 0 to 2 percent slopes	1,139.9	12,008.4	High
7042	Tahoe complex, 0 to 5 percent slopes, gravelly	506.9	748.7	High
7071	Watah peat, 0 to 2 percent slopes	570.3	112.2	High
7431	Celio loamy coarse sand, 0 to 5 percent slopes	266.8	113.2	High
7461	Jabu coarse sandy loam, 0 to 9 percent slopes	575.0	279.4	High
7462	Jabu coarse sandy loam, 9 to 30 percent slopes	836.2	166.4	High
7471	Marla loamy coarse sand, 0 to 5 percent slopes	488.7	135.0	High
7491	Oneidas coarse sandy loam, 0 to 5 percent slopes	201.7	119.1	High
7521	Tallac gravelly coarse sandy loam, 5 to 15 percent slopes, very stony	1,156.0	367.6	High
7524	Tallac gravelly coarse sandy loam, moderately well drained, 0 to 5 percent slopes	990.4	561.6	High
7525	Tallac gravelly coarse sandy loam, moderately well drained, 5 to 9 percent slopes	892.8	124.9	High
9011	Oxyaquic Cryorthents-Aquic Xerorthents-Tahoe complex, 0 to 15 percent slopes	1,128.2	1.9	High

Surface runoff is dependent on slope and the ability of the soil to accept and transmit water. The rating classes from the soil survey (USDA NRCS 2007) were used. The rating for the dominant component in a map unit was used; if the dominant component was rock or other non-soil material, the rating for the second component was used.

Some of the infestations that need to be treated with chemicals occur in soils with high runoff characteristics; chemical treatment is proposed on a total of about 3.5 acres of soils with a high or very high surface runoff class (Table 4f). Design features to lower the risk of water quality impacts on these soils consist of buffers, avoiding chemical application when precipitation is imminent, and prescribing application methods that use limited amounts of herbicide, such as dip and clip.

Table 4f. Soil map units with high or very high surface runoff class proposed for chemical treatment types.

Mapunit Symbol	Mapunit Name	Total LTBMU Acres	Chemical Treatment (Meters ^{2})	Surface Runoff Class
7041	Tahoe complex, 0 to 2 percent slopes	1,139.9	12,008.4	Very High
7042	Tahoe complex, 0 to 5 percent slopes, gravelly	506.9	748.7	Very High
7101	Caverock sandy loam, 9 to 50 percent slopes	437.4	23.2	Very High
7156	Jorge-Tahoma complex, 15 to 30 percent slopes	3,032.3	210.0	High
7241	Zephyrcove-Southcamp-Genoapeak complex, 9 to 30 percent slopes	242.1	5.6	High
7481	Meeks gravelly loamy coarse sand, 0 to 5 percent slopes, stony	86.5	103.9	Very High
7501	Rock Outcrop-Rockbound complex, 5 to 30 percent slopes	6,446.6	289.9	Very High
7502	Rock Outcrop-Rockbound complex, 30 to 70 percent slopes	5,895.5	103.9	Very High
7521	Tallac gravelly coarse sandy loam, 5 to 15 percent slopes, very stony	1,156.0	367.6	High
7541	Ubaj sandy loam, 0 to 9 percent slopes	116.7	0.1	High
9101	Callat very gravelly coarse sandy loam, 9 to 30 percent slopes, very stony	2,056.5	103.9	High
9401	Dagget very gravelly loamy coarse sand, 15 to 30 percent slopes, extremely bouldery	2,197.0	1.4	High
9421	Jobsis-Whittell-Rock outcrop complex, cool, 8 to 30 percent slopes	2,773.4	27.9	High

All of the SEZ soils have high leaching potential ratings, primarily due to their relatively shallow water tables. Initially, about 3.3 acres of SEZ soils are proposed for chemical treatment (Table 4g). Design features to lower the risk of water quality impacts on these soils consist of buffers, avoiding chemical application when precipitation is imminent, and prescribing application methods that use limited amounts of herbicide, such as dip & clip.

Table 4g. SEZ soil map units proposed for chemical treatment types.

Mapunit Symbol	Mapunit Name	Total LTBMU Acres	Chemical Treatment (Meters ^{2})
7011	Beaches	135.6	305.3
7041	Tahoe complex, 0 to 2 percent slopes	1,139.9	12,008.4
7042	Tahoe complex, 0 to 5 percent slopes, gravelly	506.9	748.7
7071	Watah peat, 0 to 2 percent slopes	570.3	112.2
7471	Marla loamy coarse sand, 0 to 5 percent slopes	488.7	135.0
7491	Oneidas coarse sandy loam, 0 to 5 percent slopes	201.7	119.1
9011	Oxyaquic Cryorthents-Aquic Xerorthents-Tahoe complex, 0 to 15 percent slopes	1,128.2	1.9

Leaching potential and surface runoff classes for all soils on NFS lands in the Lake Tahoe Basin are displayed in Project Record Document K6.

Herbicide-Soil Interactions

Solubility in water is an important characteristic of herbicides in considering potential impacts to water quality. Highly soluble herbicides have a tendency to be carried in surface runoff and to be leached from the soil to groundwater; relatively insoluble herbicides are unlikely to move in a dissolved state but may be adsorbed to clays and fine organic matter particles, and move as erosion. Herbicides with water solubility greater than 30 milligrams per liter (or parts per million) can be considered soluble (Berg, 2004); based on this criterion, Aminopyralid, Chlorsulfuron, and Triclopyr would be considered soluble, while Glyphosate would be considered relatively insoluble.

Solubility varies with factors such as temperature and water pH, so a wide range of solubility values may be reported for a given chemical. Cooler temperatures and more acid pH values are associated with lower solubility values. Solubility at pH 5 usually represents conditions in the Lake Tahoe Basin better than solubility at pH 7, given pH values in the soil survey.

Herbicide molecules that are positively charged can bind with negatively charged clay particles. Many herbicides do not leach because they are adsorbed, or tightly held, by soil particles. Herbicides that are weakly adsorbed will leach in varying degrees depending on their solubility. However, strongly adsorbed herbicides can be carried with eroded soil particles in surface runoff. In general, highly soluble herbicides are weakly adsorbed and pose a greater threat of groundwater contamination (Berg, 2004).

Considering the interactions between solubility and leaching and runoff potential, applications of Aminopyralid, Chlorsulfuron, and Triclopyr on soils with high leaching and runoff potential would have the greatest potential for water quality impacts while applications of Glyphosate on soils with low leaching and runoff potential would have the least potential for water quality impacts.

Herbicide Degradation Rate (Half-life)

The length of time it takes an herbicide to degrade is also relevant to the potential for water quality impacts when the herbicide comes in contact with soil. Degradation is generally expressed as half-life – the length of time it takes for a chemical to degrade to one-half the original activity level. Herbicides may be classified by half-life as

- Non-persistent (half-life less than 30 days).
- Moderately persistent (half-life of 30-100 days).
- Persistent (half-life greater than 100 days) (Mahler et al. 2002).

Based on these categories, Glyphosate and Triclopyr would be considered non-persistent to moderately persistent, and Aminopyralid and Chlorsulfuron would be considered moderately persistent.

The half-life of a given herbicide varies with soil texture and moisture. Coarse textured soils with aerobic (non-saturated) soil moisture conditions yield shorter half-lives than fine-textured soils under saturated conditions (Project Record L17-L22). Thus, for summer and fall applications in the Lake Tahoe Basin, half-lives would tend to be more toward the shorter end of the ranges given for a specific chemical because most of the soils are coarse-textured and surface soils would be non-saturated. (Design features prescribe avoiding seasonally flooded SEZs.)

The proposed chemicals are non-persistent to moderately persistent in soil, which limits the risk to water quality. Given proposed application seasons, soil types and design features, herbicide half-lives would tend to the shorter end of the ranges in scientific literature.

Soil Organisms

The limited information available suggests that soil invertebrates such as earthworms are not sensitive to Aminopyralid at concentrations of 5,000 parts per million (ppm), and no substantial effects on soil microorganisms would be expected at concentrations of up to 8.4 ppm (SERA, 2004). Relatively little information is available on the toxicity of Chlorsulfuron to soil invertebrates.

In two species of nematodes, no effects were observed on movement, reproductive success, or mortality at Chlorsulfuron concentrations up to 10,000 ppm in soil, which is thousands of times greater than the recommended use rate. Results of several laboratory and field studies suggest that Chlorsulfuron is only mildly toxic to terrestrial microorganisms (SERA 2004a). There is very little information suggesting that Glyphosate will be harmful to soil microorganisms under field conditions; on the contrary, a substantial body of information exists that suggests that Glyphosate is likely to enhance or have no effect on soil microorganisms.

Glyphosate is readily metabolized by soil bacteria and many species of soil microorganisms can use Glyphosate as a carbon source (SERA 2003). Only laboratory studies on the effects of Triclopyr on soil microorganisms are available. Based on these, the growth of some bacteria or fungi might be inhibited as a transient effect, but this effect would not likely be large enough to shift the population structure of microbial soil communities such that the capacity of soil to support vegetation would be impacted. These laboratory findings are consistent with field observations on the effects of Triclopyr on vegetation (SERA 2003a).

Based on the proposed application rates, risks to soil organisms would be negligible for the current proposed treatment acres and for chemical treatment of up to 100 acres per year. Given the known impacts of some species of TIPS, impacts to some soil organisms could be greater under No Action if infestations continue to increase.

Cumulative Effects: The impacts to soils from manual and mechanical control methods would be negligible as compared to planned disturbances from fuels treatments, residential and roadway construction activities, and recreation activities.

Low application rates and application methods that target individual plants, along with the upper limit of 100 acres per year for chemical treatment would limit herbicide contact with soils and ensure that soil organisms would be minimally impacted by chemical treatments. The proposed herbicides are non-persistent to moderately persistent and these chemicals would not build up in the soil and would be unlikely to affect water quality, when applied as directed on the label and within the design features specified herein.

Cumulative effects to soils from proposed manual, mechanical, and chemical treatments would be negligible under current and expected future infestation levels.

4.5 Heritage

Affected Environment

The basic social and economic group of Washoe was the family or household unit. Washoe households were somewhat loosely combined to form villages, referred to as *bunches* by Downs (1966:44-46). Each bunch had a headman or chief (*teubeyu)* (Downs 1966:41). Washoe practiced seasonal transhumance, moving from one elevation to another, to harvest plants, fish, and hunt across contrasting and vertically defined ecological zones. Transhumance facilitates seasonal exploitation of resources that occur at different altitudes and in different ecological zones. Indeed, Washoe subsistence highlighted fishing along rivers that entered Lake Tahoe, gathering acorns from the western slope of the Sierra Nevada, and hunting a variety of birds and mammals across their territory (Downs 1966).

Contemporary Washoe continue to inhabit the area and are very interested in preserving their traditional culture and protecting their traditional cultural properties. Washoe have developed a Comprehensive Land Use Plan, which addresses these issues. The Plan includes establishing a tribal and political presence across their traditional lands and revitalizing Washoe cultural heritage.

4.5.1 Direct, Indirect and Cumulative Effects (All Alternatives)

All alternatives will have negligible effects (if any) on heritage resources in the LTBMU. Several eradication methods are proposed in this action. Herbicides will be employed in Proposed Action for species difficult to treat with other methods. The methods proposed are designed to eliminate negative effects on plant species important to Native American basket makers and traditional food gathering activities. Herbicide application methods include direct application by wiping & wicking, dip & clip, or directed spot spray, with limited broadcast spray where TIPS occurrences are a dense monoculture. By reducing the use of broadcast spray applications, the threat to traditionally important plant species is eliminated.

Ground disturbance associated with the proposed undertaking will be negligible.

If weeds become established in the future, and future treatments are required, the Tribe will be consulted to determine suitable treatment methods (DF-15).

The No Action Alternative involves the selective removal of TIPS by manual extraction. No large mechanized equipment will be utilized, although shovels and other hand tools are proposed. Disturbance associated with manual methods will be minimal due to the overall small size of infestations.

The LTBMU has consulted with Tribal governments regarding their TIPS eradication proposal. A scoping letter (dated October 16, 2009) was sent to Tribal representatives that have expressed an interest in Federal land management activities on the LTBMU. Forest personnel subsequently placed courtesy calls to the same offices in early November 2009. The follow-up calls provided an opportunity for Tribal members to voice any concerns that the scoping letter and project proposal may have generated. No objections were received, either written or verbal.

Based on the eradication strategy outlined in the Proposed Action, and concomitant Design Features, and including Alternative 1, the No Action Alternative, this office anticipates no significant effect to heritage resources. Under stipulations outlined in the Sierra Programmatic Agreement (USDA Forest Service 1996), the "No Effect" determination fulfills mandatory Section 106 requirements of the National Historic Preservation Act for this undertaking. No comments were received from the Nevada State Historic Preservation Office (NV SHPO).

4.6 Recreation, Recreation Residences, Special Uses

Overview

4.6.1 Alternative 1 – No Action

Direct and Indirect Effects: There will be no risk of herbicide exposure to workers or the general public under this alternative. TIPS populations will continue to expand over time, potentially affecting recreation experiences or availability of native plants for traditional uses.

Cumulative Effects: There will potentially be increased spread of TIPS off Forest lands, resulting in increased control activities, including use of herbicides, on the adjacent lands. This increased use of herbicides on adjacent lands, including private lands, will result in increased risk of public exposure to herbicides.

4.6.2 Alternative 2 - Proposed Action

Direct and Indirect Effects: There is a low risk of herbicide exposure to the public under this alternative. The methods of application: dip & clip, wicking & wiping, directed spot spraying, and limited broadcast spraying all minimize the risk by the small amounts of herbicide used. Risks are further minimized by 1) applications are proposed to avoid high visitor use times (e.g., weekends and holidays), and 2) in areas where herbicide treatments are being done, signs will be posted to alert the public as to the location and type of treatments being done and the date after

which it is not necessary to avoid contact with the treated weeds (which will be at least 48 hours after application).

Design Features specifically for Recreation, Special Uses and Recreation Residences include DF-22, DF-23, and DF-24. Other Design Features that are also beneficial to this resource include DF-27, placement of signs. For future treatments, controlling TIPS populations while they are still relatively small will minimize the overall use of herbicides and minimize the risk of human exposure.

Cumulative Effects: Control of TIPS on site and elimination of expansion of TIPS populations to adjacent and nearby lands will result in less risk over the long term of exposure to the public on adjacent and nearby lands.

4.7 Health and Safety

Affected Environment

The No Action Alternative does not propose to use herbicides; therefore this section on Human Health and Safety of Herbicide Use is only discussed in terms of the Proposed Action.

Risk assessments were completed for the TIPS project (see project file). These risk assessments examine the potential health effects on all groups of people who might be exposed to any of the four herbicides proposed to be used. Those potentially at risk fall into two groups: workers and members of the public. Workers include applicators, supervisors, and other personnel directly involved in the application of herbicides. The public includes other forest workers, forest visitors, and nearby residents who could be exposed through the drift of herbicide spray droplets, through contact with sprayed vegetation, or by eating, or placing in the mouth basketry materials, food items or other plant materials, such as berries or shoots growing in or near treated areas, by eating game or fish containing herbicide residues, or by drinking water that contains such residues.

Members of the general public who might be affected by project-related activities include recreationists, recreation cabin residents, and residents adjacent to urban lots. These groups or individuals would likely be in the project area on a short-term basis. The periods could vary from several hours to extended amounts of time in areas near treatment sites for the recreation cabin residents and residents adjacent to urban lots.

Environmental Consequences

The risk of adverse health effects from the use of any of the four herbicides proposed for use is determined for the level and duration of exposure and the

inherent toxicity of the herbicide. Possible short-term adverse health effects include nausea, headache, dizziness, eye irritation, and coughing.

A comprehensive analysis of human health risks was conducted to analyze the potential for adverse health effects in workers and members of the public from the proposed use of herbicides. This analysis examines a range of potential exposures to herbicides, from routine operations involving workers, to accidents involving workers and the public. Assumptions regarding rates of use range from average (or typical) rates of use to very high rates of use, representing worst-case scenarios.

The risk assessment has five major sections: an introduction (Section 1); an identification of the hazards associated with each herbicide and its commercial formulations (Section 2); an assessment of potential exposure to the product (Section 3); an assessment of the dose-response relationships (Section 4); and a characterization of the risks associated with plausible levels of exposure (Section 5). The complete risk assessments are in the Project File. The following summary of herbicide effects is taken from those risk assessments.

The analysis of the potential human health effects of the use of chemical herbicides was accomplished using the methodology generally accepted by the scientific community (National Research Council 1983, United States Environmental Protection Agency 1986). In essence, the risk assessment consists of comparing doses, based on site-specific herbicide use levels, that people might receive from applying the herbicides (worker doses) or from being near an application site (public doses) with the United States Environmental Protection Agency's (U. S. EPA) established Reference Doses (RfD), a level of exposure considered protective of lifetime or chronic exposures. The site-specific risk assessment also examines the potential for these treatments to cause synergistic effects, cumulative effects, and effects on sensitive individuals, including women and children.

Different types of possible effects were considered in the assessment, including acute and chronic systemic effects, cancer and mutations, and reproductive effects. These effects were evaluated using the appropriate animal test data. General systemic effects were evaluated that could range from nausea and headaches at low doses to organ damage, reproductive problems, birth defects, or even mortality at extreme doses. This risk assessment also examined acute toxic effects from accidental exposure scenarios. For each type of dose assumed for workers and the public, a hazard quotient (HQ) was computed by dividing the dose by the RfD. In general, if HQ is less than or equal to one, the risk of effects is considered negligible. Because HQ values are based on RfDs, which are thresholds for

cumulative exposure, they subsume acute exposures. This aspect is discussed below in the evaluations of possible effects.

One of the primary uses of a risk assessment is risk management. Decision makers can use the risk assessment to identify those herbicides, application methods, or exposure rates that pose the greatest risks to workers and the public. Specific mitigation measures can then be employed where the decision maker believes the risks to be unacceptably high. Because the risk assessment is based on a number of assumptions, risk values are not absolute. If assumptions change, the risk values change. However, the relative risk among herbicides or methods would remain valid. Of course, if new toxicity data became available that indicated more adverse response(s) than previous data indicated, the risk assessment would need to be revised.

To facilitate decision making, acceptable risk levels must be established. EPA has established a significant cancer risk level of one chance in one million; the State of California, through Proposition 65, has established a standard of one chance in one hundred thousand. The RfD is also an EPA-established measure of acceptable risk for non-carcinogen exposures. This assessment uses the standards of one chance in one million for cancer risk and the RfD for non-carcinogen exposures.

Hazard Analysis

The hazards associated with using each of the herbicides were determined by a thorough review of available toxicological studies, which are referenced in the Project File. The reviews are contained in other documents and are referenced here as needed. A considerable body of information has been compiled in a group of risk assessments completed by Syracuse Environmental Research Associates, Inc. (SERA 2003a, 2003b, 2004a, 2004b, 2005), authored by Dr. Patrick Durkin, PhD, under contract to the Forest Service, the risk assessment contained in the programmatic Region 5 Final EIS Vegetation Management for Reforestation (USDA 1989b), and the risk assessment contained in the Herger-Feinstein Quincy Library Group Forest Recovery Act Final Supplemental EIS (USDA, 2003b). Another source of information on toxicity are the background statements contained in Forest Service Agricultural Handbook No. 633 (USDA 1984). Current peer-reviewed articles from the open scientific literature, as well as recent U. S. EPA documents are also used to update the information contained in these documents. Toxicity information for the surfactants being considered for use are summarized in USDA, 2007.

The toxicological database for each herbicide was reviewed for acute, subchronic, and chronic effects on test animals. Because of the obvious limitations on the

testing of chemicals on humans, judgments about the potential hazards of pesticides to humans is necessarily based in large part on the results of toxicity tests on laboratory animals. Where such information is available, information on actual human poisoning incidents and effects on human populations supplement these test results. For a background discussion of the various toxicological tests and endpoints, refer to USDA (1989b, pages F-7 to F-18).

Impurities and Metabolites

Virtually no chemical synthesis yields a pure product. Technical grade herbicides, as with other technical grade products, undoubtedly contain some impurities. The U. S. EPA defines the term impurity as "…any substance … in a pesticide product other than an active ingredient or inert ingredient, including un-reacted starting materials, side reaction products, contaminants, and degradation products" (40 CFR 158.153(d)). To some extent, concern for impurities in technical grade products is reduced by the fact that the existing toxicity studies on these herbicides were conducted with the technical grade product. Thus, if toxic impurities are present in the technical grade product, they are likely to be encompassed by the available toxicity studies on the technical grade product. An exception to this general rule involves carcinogens, most of which are presumed to act by non-threshold mechanisms. Because of the non-threshold assumption, any amount of a carcinogen in an otherwise non-carcinogenic mixture may pose a carcinogenic risk. As with contaminants, the potential effect of metabolites on a risk assessment is often encompassed by the available *in vivo* toxicity studies under the assumption that the toxicological consequences of metabolism in the species on which toxicity studies are available will be similar to those in the species of concern (humans in this case). Uncertainties in this assumption are encompassed by using an uncertainty factor in deriving the RfD and may sometimes influence the selection of the study used to derive the RfD. Unless otherwise specifically referenced, all data and test results are from the references listed at the herbicide heading.

Inert Ingredients

Issues concerning inert ingredients, additives, and the toxicity of formulations is discussed in USDA 1989b (pages 4-116 to 4-119). The approach used in USDA 1989b, the SERA Risk Assessments, and this site-specific analysis to assess the human health effects of inert ingredients and full formulations has been to: (1) compare acute toxicity data between the formulated products (including inert ingredients) and their active ingredients alone; (2) disclose whether or not the formulated products have undergone chronic toxicity testing; and (3) identify, with

the help of EPA and the chemical companies, ingredients of known toxicological concern in the formulated products and assess the risks of those ingredients.

Researchers have studied the relationships between acute and chronic toxicity and while the biological end-points are different, relationships do exist and acute toxicity data can be used to give an indication of overall toxicity (Zeise, et al. 1984). The court in NCAP v. Lyng, 844 F.2d 598 (9th Cir 1988) decided that this method of analysis provided sufficient information for a decisionmaker to make a reasoned decision. In SRCC v. Robertson, Civ.No. S-91-217 (E.D. Cal., June 12, 1992), and again in CATS v. Dombeck, Civ. S-00-2016 (E.D. Cal., Aug 31, 2001), the district court upheld the adequacy of the methodology used in USDA 1989b for disclosure of inert ingredients and additives.

Comparison of acute toxicity (LD_{50} (lethal dose) values) data between the formulated products (including inert ingredients) and their active ingredients alone shows that the formulated products are generally less toxic than their active ingredients (USDA 1989b, USDA 1984, SERA risk assessments).

While these formulated products have not undergone chronic toxicity testing like their active ingredients, the acute toxicity comparisons, the EPA review, and our examination of toxicity information on the inert ingredients in each product lead us to conclude that the inert ingredients in these formulations do not significantly increase the risk to human health and safety over the risks identified for the active ingredients.

Exposure Assessment

Workers

Pesticide applicators are the individuals most likely to be exposed to a pesticide during application. Two types of worker exposure assessments are considered: general and accidental/incidental. The term general exposure assessment is used to designate those exposures that involve estimates of absorbed dose based on the handling of a specified amount of a chemical during specific types of applications. The accidental/incidental exposure scenarios involve specific types of events that could occur during any type of application. In this exposure assessment for workers, the primary goal is to estimate absorbed dose so that the absorbed dose estimate can be compared with available information on the dose-response relationships for the chemical of concern.

General Exposures - Worker exposure rates are expressed in units of milligrams (mg) of absorbed dose per kilogram (kg) of body weight per pound of chemical handled (mg/kg/lb applied) and are based on methods outlines in SERA (2007a). The number of acres treated per hour, hours worked per day, and herbicide

application rate were estimated and a expressed as a range. The range of acres treated per hour and hours worked per day is used to calculate a range for the number of acres treated per day. For this calculation as well as others involving the multiplication of ranges, the lower end of the resulting range is the product of the lower end of one range and the lower end of the other range. Similarly, the upper end of the resulting range is the product of the upper end of one range and the upper end of the other range. This approach is taken to encompass as broadly as possible the range of potential exposures. The central estimate, taken as the arithmetic average of the range, is also calculated.

Accidental Exposures - The available literature does not include quantitative methods for characterizing exposure or responses associated with splashing a solution of a chemical into the eyes; furthermore, there appear to be no reasonable approaches to modeling this type of exposure scenario quantitatively. Consequently, accidental exposure scenarios of this type are considered qualitatively.

Four exposure scenarios are developed; two for each of two types of dermal exposure; direct contact with a solution of the herbicide and accidental spills of the herbicide onto the surface of the skin.

General Public

Under normal conditions, members of the public should not be exposed to substantial levels of any of these herbicides. Nonetheless, any number of exposure scenarios can be constructed for the public, depending on various assumptions regarding application rates, dispersion, canopy interception, and human activity. Several highly conservative scenarios are developed for this risk assessment. The two types of exposure scenarios developed for the general public includes acute exposure and longer-term, or chronic, exposure. All of the acute exposure scenarios are primarily accidental. They assume that an individual is exposed to the compound either during or shortly after its application. Specific scenarios are developed for direct spray, dermal contact with contaminated vegetation, as well as the consumption of contaminated fruit, vegetation, water, and fish. Most of these scenarios should be regarded as extreme, some to the point of limited plausibility.

Dose-Response Assessment

In evaluating the doses received under each scenario, the doses are evaluated against RfDs, as previously discussed. If all the exposures are less than the RfDs (HQ less than or equal to 1) the assumption is that the herbicide presents very little risk of use to either the public or workers. If any exposure exceeds the RfD, a closer examination of the various studies and exposure scenarios must be made to

determine whether a toxic response is expected from the exposure. The risk assessments (Project Record L17-22) describe the RfDs and their basis. For those scenarios that involve doses exceeding RfDs, it provides an analysis of various studies and further refines the risk thresholds. Table xxx displays the acute and chronic RfDs used in the risk assessment.

Table 4.1. Reference Doses (RfD) of Herbicides

Herbicide	Reference Dose (mg/kg/day)	
	Acute	Chronic
Chlorsulfuron	0.25	0.02
Aminopyralid	1.0	0.5
Glyphosate	2.0	2.0
Triclopyr	1.0	0.05

Risk Characterization

A quantitative summary of the risk characterization for workers and the public associated with exposure to these herbicides is presented in the Project Record. The quantitative risk characterization is expressed as the hazard quotient, which is the ratio of the estimated exposure doses to the RfD.

The only reservation attached to this assessment is that associated with any risk assessment: Absolute safety cannot be proven and the absence of risk can never be demonstrated. No chemical has been studied for all possible effects and the use of data from laboratory animals to estimate hazard or the lack of hazard to humans is a process that contains uncertainty. Prudence dictates that normal and reasonable care should be taken in the handling of these herbicides.

Following is a summary of the risk characterization to the proposed herbicides.

Workers

Chlorsulfuron, Aminopyralid, Glyphosate

Given the very low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios approach a level of concern.

Triclopyr TEA

Typical and lower estimates of exposure for all groups of workers are below a level of concern. At the upper application range, exposure levels slightly exceed the level of concern, with hazard quotients of two. The health consequences of these exposure levels are uncertain but would be expected to be minimal. It is also

important to keep in mind that the chronic RfD is based on daily, lifetime exposures, which are unlikely for a worker.

The verbal interpretation of these hazard quotients is that under typical conditions of application and at the typical application rate on this project, there is no indication that workers will be subject to hazardous levels of Triclopyr. Nonetheless, at the upper range of exposures, backpack application methods exceed the level of concern. Thus, for workers who may apply Triclopyr repeatedly over a period of several weeks or longer, it is important to ensure that work practices involve reasonably protective procedures to avoid the upper extremes of potential exposure.

Accidental exposures of workers to formulations containing Triclopyr TEA do not lead to hazard quotients that exceed a level of concern based on the acute RfD of 1 mg/kg/day. However, this acute RfD is not applied to women of child bearing age and the chronic RfD of 0.05 mg/kg/day is used. Thus, for female workers, the level of concern would be 0.05 rather than unity. Even with this more conservative criterion, none of the hazard quotients for accidental scenarios for Triclopyr TEA formulations exceed a level of concern at the central estimate of exposure. At the upper limits of potential exposure, the hazard quotient for Triclopyr TEA exceeds 0.05 for both spill scenarios. Thus, for workers who may apply Triclopyr repeatedly over a period of several weeks or longer, these scenarios point up the need for good industrial hygiene practices while utilizing these products, to avoid the upper extremes of potential exposure.

General Public

Chlorsulfuron

None of the acute scenarios exceeds a level of concern. The longer-term consumption of contaminated vegetation after application of the highest dose yields a hazard quotient that is greater than unity (HQ= 4) at the highest dose. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. This scenario may be extremely conservative in that it does not consider the limited projected use of this herbicide on this project or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

Aminopyralid

For the acute/accidental scenarios, the exposure resulting from the consumption of contaminated water from a spill is the scenario with the highest hazard quotient (HQ = 1.3) at the upper level. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. It is important to realize that the

exposure scenarios involving contaminated water are arbitrary scenarios: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of Aminopyralid, this hazard quotient would be a factor of 10 less. A further conservative aspect to the water contamination scenario is that it represents standing water, with no dilution or decomposition of the herbicide. This is unlikely in a forested situation where flowing streams are more likely to be contaminated in a spill, rather than a standing pond of water. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are substantially below one. Nonetheless, this and other acute scenarios help to identify the types of scenarios that are of greatest concern and may warrant the greatest steps to mitigate. For Aminopyralid, such scenarios involve oral (contaminated water) rather than dermal (spills or accidental spray) exposure. With Aminopyralid, as with all pesticides, prudent measures should be taken to limit exposure to members of the general public after any type of spill event. None of the other acute/accidental or longer-term exposure scenarios approach a level of concern.

Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard quotients are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to Aminopyralid.

Glyphosate

For chronic scenarios, the consumption of contaminated vegetation has a hazard quotient that equals unity (HQ = 1.0) at the upper level. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. As previously described, this scenario may be extremely conservative in that it does not consider the limited projected use of this herbicide on this project or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term. However, this scenario points out the importance of directing the herbicide onto the targeted vegetation and avoiding non-target deposition through overspray.

None of the other longer-term exposure scenarios approach a level of concern. Although there are several uncertainties in the longer-term exposure assessments

for the general public, the upper limits for hazard quotients are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to Glyphosate.

For the acute/accidental scenarios, the exposure resulting from the consumption of contaminated vegetation is the scenario with the highest hazard quotient (HQ = 2) at the upper level. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. These upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. None of the other acute/accidental scenarios approach a level of concern.

Triclopyr TEA

One acute/accidental scenario (the consumption of contaminated vegetation) exceeds a level of concern at the typical and upper levels of exposure (HQ = 4 to 30). These findings suggest that in the unlikely event that someone had a vegetable garden growing in proximity to a treatment area that Triclopyr was applied, especially at the typical or maximum application rates, adult females who consume the vegetables from such gardens could be at risk. At the typical level of exposure, the consumption of contaminated vegetation could lead to acute exposures where the nature and severity of effects are uncertain. Based on the dose-severity relationship for Triclopyr, at these levels of acute exposure (1.5 mg/kg at the upper level of exposure), it is unlikely that there would be any adverse health effects associated with a one-time exposure. The plausibility of the existence of this scenario is limited by several important factors. First, the areas proposed for treatment with Triclopyr are well removed from private residences, and hence, vegetable gardens. Secondly, unless the Triclopyr contamination were to occur immediately before picking, it is plausible that the accidental contamination would kill the plants or diminish their capacity to yield consumable vegetation. Thirdly, this scenario is extremely conservative in that it does not consider the effects of washing contaminated vegetation in reducing doses. Finally, signs at likely access points informing the public that an area has been sprayed and the presence of dye on vegetation would reduce the potential that freshly sprayed material would be consumed.

In the other acute/accidental scenarios involving Triclopyr, based on the high exposure assumptions, four of the acute/accidental scenarios reach or slightly

exceed a level of concern (i.e., child sprayed, woman sprayed on lower legs, exposure to sprayed vegetation, and consumption of contaminated fruit). Based on the dose-severity relationship for Triclopyr, at these levels of acute exposure (≤1.8 mg/kg), it is unlikely that there would be any adverse health effects associated with a one-time exposure.

Two longer term scenarios exceed a level of concern - the consumption of unwashed fruit and the consumption of unwashed vegetation. While the consumption of fruit slightly exceeds a hazard quotient of 1 at only the upper level of exposure, the consumption of vegetation exceeds a level of concern at both the typical and upper exposure level. At the highest application rate, the estimated dose at the upper level of exposure could be about 1.0 mg/kg/day. This value is in the range that, with longer term exposure, could result in effects on kidneys or offspring. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. This is a standard scenario used in all Forest Service risk assessments and is extremely conservative – i.e., it assumes that vegetation that has been directly sprayed is harvested and consumed for a prolonged period of time. In addition, this scenario does not consider the effects of washing contaminated vegetation or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

Cumulative Effects

The proposed use of herbicides could result in cumulative doses of herbicides to workers or the public. Cumulative doses to the same herbicide result from (1) additive doses resulting from various routes of exposure from this project and (2) additive doses if an individual is exposed to other herbicide treatments. Additional sources of exposure include use of herbicides on adjacent private lands, use of herbicides on adjacent National Forest System lands, or home use by a worker or member of the general public. Reported past use of Glyphosate, Aminopyralid, Chlorsulfuron, and Triclopyr (2004-2008) in El Dorado, Alpine, and Placer Counties totals over 35,000 lbs in 2008. Data on herbicide use in Carson, Washoe, and Douglas Counties in Nevada are not reported. This project is estimated to contribute an additional 25 lbs or less per year.

It is conceivable that workers or members of the public could be exposed to herbicides as a result of treatments on surrounding private forestlands or

treatments on National Forest System Lands. Where individuals could be exposed by more than one route, the risk of such cases can be quantitatively characterized by adding the hazard quotients for each exposure scenario. For example, using Glyphosate as an example, the typical levels of exposure for a woman being directly sprayed on the lower legs, staying in contact with contaminated vegetation, eating contaminated fruit, and consuming contaminated fish leads to a combined hazard quotient of 0.023. Similarly, for all of the chronic Glyphosate exposure scenarios, the addition of all possible pathways lead to hazard quotients that are substantially less than one. Similar scenarios can be developed with the other herbicides. This risk assessment specifically considers the effect of repeated exposure in that the chronic RfD is used as an index of acceptable exposure. Consequently, repeated exposure to levels below the toxic threshold should not be associated with cumulative toxic effects.

Since these herbicides persist in the environment for a relatively short time (generally less than one year), do not bio-accumulate, and are rapidly eliminated from the body, additive doses from re-treatments in subsequent years are not anticipated. According to recent work completed by the California Department of Pesticide Regulation, some plant material contained Triclopyr residues up to 1.5 years after treatment, and Glyphosate up to 66 weeks after treatment; however, these levels were less than 1 part per million (Segawa et al. 2001). Since repeat treatments in this project are at one or more years into the future, it is likely that any residue from an application would be substantially degraded between applications. It is possible that residues from the initial herbicide application could still be detectable during subsequent re-treatments, but these plants would represent a low risk to humans as they would show obvious signs of herbicide effects as so would be undesirable for collection.

In order to consider the cumulative effects of other (non forestland) uses, U.S. EPA has developed the theoretical maximum residue contribution (TMRC). The TMRC is an estimate of maximum daily exposure to chemical residues that a member of the general public could be exposed to from all published and pending uses of a pesticide on a food crop. Adding the TMRC to this project's dose estimate can be used as an estimate of the cumulative effects of this project with theoretical background exposure levels of these herbicides. The result of doing this doesn't increase the HQ values appreciably.

Impurities and Metabolites

Cumulative effects can be caused by the interaction of different chemicals with a common metabolite or a common toxic action. The U.S. EPA has conducted

extensive analyses of dietary exposure to 3,5,6-trichloro-2-pyridinol (TCP) from the use of Triclopyr as well as the aggregate risks from exposure to TCP from the use of both Triclopyr and chlorpyrifos (TCP is a metabolite of both Triclopyr and chlorpyrifos). While these dietary exposures appear to be substantially below a level of concern, the risk assessment by EPA does not specifically address concerns for contamination of water with TCP as a soil metabolite of Triclopyr and chlorpyrifos. Exposures to TCP based on modeling of water contamination from the application of both Triclopyr and chlorpyrifos indicate that the peak exposure to TCP in water is below the concentration associated with the chronic risk value for TCP. Thus, there is no basis for asserting that the use of Triclopyr with or without the use of chlorpyrifos will result in hazardous exposure of humans to TCP.

Adjuvants

Colorfast® Purple Colorant (SERA, 1997b)

The active ingredients in Colorfast Purple are acetic acid, dipropylene glycol, and Basic Violet 3. The exact amounts of the ingredients in this product are considered proprietary. Acetic acid, a major component of vinegar, is on the EPA's list 4A of inerts. Dipropylene glycol is on EPA's list 3 of inerts. None of the ingredients in this product are known to be on EPA List 1 or 2. Basic Violet 3 dye is the colorant in Colorfast Purple. Most of the information about its toxicological effects are attributed to the chloride salt, commonly referred to as Gentian Violet. Gentian Violet is used as an antifungal agent, a treatment for oral infections, and as laboratory reagent and stain (SERA, 1997b). Based on the MSDS no toxic chemicals are present that are subject to the reporting requirement of the Emergency Planning and Community Right-to-Know Act (EPCRA, also referred to as SARA Title III) and 40 CFR 372 (Toxic Chemical Release Reporting: Community Right-to-Know). In a Study by Littlefield et al (in SERA, 1997b) marked carcinogenic activity was observed in mice, and is the basis for a qualitative cancer risk assessment in SERA (1997b). Based on SERA, 1997b, risk characterization leads to typical cancer risks for workers of 4.7×10^{-7} or 1 in 2.1 million. For the public, the consumption of sprayed berries yielded an estimated single exposure risk of 1 in 37 million to 1 in 294 million. For public exposures, it is expected that the dye would reduce exposures both to itself and to the other chemicals it might be mixed with (herbicide and other adjuvants) as the public would be alerted to the presence of treated vegetation.

Hi-Light® Blue (USDA, 2007)

Hi-Light® Blue dye is not required to be registered as a pesticide; therefore it has no signal word associated with it. It is mildly irritating to the skin and eyes. It

would likely be considered a Category III or IV material and have a Caution signal word if it carried one.

Hi-Light® Blue is a water-soluble dye that contains no listed hazardous substances. It is considered to be virtually non-toxic to humans. The dye used in Hi-Light® Blue is commonly used in toilet bowl cleaners and as a colorant for lakes and ponds (SERA 1997b).

MSO surfactants (USDA, 2007)

The methylated seed oils are formed from common seed oils, such as canola, soybean, or cotton. They act to increase penetration of the herbicide. These are comparable in performance to crop oil concentrates. The U.S. Food and Drug Administration (FDA) considers methyl and ethyl esters of fatty acids produced from edible fats and oils to be food grade additives (CFR 172.225). Because of the lack of exact ingredient statements on these surfactants, it is not always clear whether the oils that are used in them meet the U.S. FDA standard.

An analysis of the ingredients in these adjuvants did not identify any of specific toxic concern with the exception of the ingredients discussed in this risk assessment. None were on U.S. EPA Inerts Lists 1 or 2. This is either based on the identified ingredients, or if these ingredients are not sufficiently identified, by information given by the manufacturers. The assessment of hazards for these adjuvants is limited by the proprietary nature of the formulations. Unless the U.S. EPA classifies a compound in the formulation as hazardous, the manufacturer is not required to disclose its identity. At the current time, the disclosure of whether a material is hazardous is based primarily on acute toxicity (USDA 2007).

There is little toxicity testing done on these adjuvants. Most of the adjuvants have had some acute toxicity testing, as well as skin and eye irritation studies. The available acute toxicity testing results for the MSO based surfactants identified in USDA 2007 for mammalian species indicates oral LD_{50} > 5g/kg and dermal LD_{50} > 2 g/kg.

The primary summary statement that can be made is that the more common risk factors for the use of these adjuvants are through skin or eye exposure. These adjuvants all have various levels of irritancy associated with skin or eye exposure. This indicates the need for good industrial hygiene practices while utilizing these products, especially when handling the concentrate, such as during mixing. The use of chemical resistant gloves and goggles, especially while mixing, should be observed.

Synergistic Effects

Synergistic effects (multiplicative) are those effects resulting from exposure to a combination of two or more chemicals that are greater than the sum of the effects of each chemical alone (additive).

Instances of chemical combinations that cause synergistic effects are relatively rare at environmental exposure levels. Reviews of the scientific literature on toxicological effects and toxicological interactions of agricultural chemicals indicate that exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects (US EPA 2000c; ATSDR 2004; Kociba and Mullison 1985). The literature review by ATSDR (2004) cited several studies that found no synergistic effects for mixtures of four, eight, and nine chemicals at low (sub-toxic) doses. In assessing health risk associated with drinking water, Crouch et al. (1983) reach a similar conclusion when they stated:

> "...in most cases we are concerned with small doses of one pollutant added to a sea of many pollutants. For those small doses a multiplicative effect is not expected."

EPA (1986) concludes:

> "There seems to be a consensus that for public health concerns regarding causative (toxic) agents, the additive model is more appropriate than any multiplicative model."

Synergism generally has not been observed in toxicological tests involving combinations of commercial pesticides. The herbicide and additives proposed for this project have not shown synergistic effects in humans who have used them extensively in forestry and other agricultural applications. However, synergistic toxic effects of herbicide combinations, combinations of the herbicides with other pesticides such as insecticides or fertilizers, or combinations with naturally occurring chemicals in the environment are not normally studied. Based on the limited data available on pesticide combinations involving these herbicides, it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis.

It is not anticipated that synergistic effects would be seen with the herbicides and the adjuvants that might be added to them. Based on a review of several recent studies, there is no demonstrated synergistic relationship between herbicides and surfactants (Abdelghani et al 1997; Henry et al 1994; Lewis 1992; Oakes and Pollak 1999, 2000 as referenced in USDA 2007).

However, even if synergistic or additive effects were to occur as a result of the proposed treatment, these effects are dose responsive (Dost 1991). This means

that exposures to the herbicide plus any other chemical must be significant for these types of effects to be of a biological consequence.

Based on the very low exposure rates estimated for this alternative, synergistic or additive effects, if any, are expected to be insignificant.

Although the combination of surfactant and herbicide might indicate an increased rate of absorption through the skin, a review of recent studies indicates this is not often true (Ashton et al 1986; Boman et al 1989; Chowan and Pritchard 1978; Dalvi and Zatz 1981; Eagle et al 1992; Sarpotdar and Zatz 1986; Walters et al 1993, 1998; Whitworth and Carter 1969 as referenced in USDA 2007). For a surfactant to increase the absorption of another compound, the surfactant must affect the upper layer of the skin. Without some physical effect to the skin, there will be no change in absorption as compared to the other compound alone. The studies indicate that in general non-ionic surfactants have less of an effect on the skin, and hence absorption, then anionic or cationic surfactants. Compound specific studies indicate that the alkylphenol ethoxylates generally have little or no effect on absorption of other compounds. In several studies, the addition of a surfactant actually decreased the absorption through the skin. It would appear that there is little support for the contention that the addition of surfactants to herbicide mixtures would increase the absorption through the skin.

Two of the four herbicides considered in this risk assessment can be combined with other herbicides to increase the range of effective control. Triclopyr and Aminopyralid are proposed as a mixture under the Proposed Action. Therefore, it is important to consider whether any of the herbicides have shown synergistic effects when combined with other compounds. Studies of these four herbicides in combination with other compounds are not common, as toxicology studies generally involve the active ingredient. So to the extent that any studies exist, they are important to consider for their insight into potential impacts of combinations.

The guidance resulting from the reviews and analyses of available information by both US EPA (2000) and ATSDR (2004) is that, in the absence of known toxicity information on the mixture, mixtures of herbicides that have similar modes of toxic action can be assumed to have additive effects. Further, effects from mixtures are not likely to occur where the dose from each chemical in the mixture is at least one order of magnitude below its respective RfD (i.e. HQ < 0.1), and the sum of individual HQs does not approach an additive HQ = 1. If only one component is present at a HQ>0.1, and if the HQ for that component exceeds unity, this situation is not considered a mixtures problem but should focus on the one chemical that exceeds an HQ of unity.

Reviewing the worksheets in this risk assessment that display the risk characterizations for Chlorsulfuron, Triclopyr, Glyphosate, and Aminopyralid, it is apparent that mixtures containing Triclopyr will represent some degree of risk represented by Triclopyr itself (several scenarios with HQ values > 1). Based on the low hazard quotients for Aminopyralid, none of the acute scenarios involving workers should represent a risk of additive effects when a Triclopyr and Aminopyralid mixture is considered.

Herbicide-Specific Interaction Data

The manufacturers indicate that Aminopyralid formulations may be mixed with non-ionic surfactants to improve efficacy and may be formulated with other herbicides.

The manufacturers recommend that Chlorsulfuron formulations be mixed with a non-ionic surfactant. There is no published literature or information in the US EPA files that would permit an assessment of toxicological effects or risk assessment of Chlorsulfuron mixed with a surfactant (SERA, 2004a).

There is very little information available on the interaction of Glyphosate with other compounds. The available data do not suggest a synergistic interaction between Glyphosate and the POEA surfactant found in some formulations (e.g., Roundup) from plausible routes of exposure (SERA 1996a).

There is very little information available on the interaction of Triclopyr with other compounds. The available data do not suggest a synergistic interaction between the Triclopyr active ingredient and the other components in the commercial Triclopyr formulations of Garlon 3A (SERA 1996b).

Sensitive Individuals

The uncertainty factors used in the development of the RfD takes into account much of the variation in human response. The uncertainty factor of 10 for sensitive subgroups is sufficient to ensure that most people will experience no toxic effects. "Sensitive" individuals are those that might respond to a lower dose than average, which includes women and children. The National Academy of Sciences report entitled Pesticides in the Diets of Infants and Children (NAS 1993) found that quantitative differences in toxicity between children and adults are usually less than a factor of approximately 10-fold. An uncertainty factor of 10 may not cover individuals that may be sensitive to herbicides because human susceptibility to toxic substances can vary by two to three orders of magnitude. Factors affecting individual susceptibility include diet, age, heredity, preexisting diseases, and life style. Individual susceptibility to the herbicides proposed in this project cannot be

specifically predicted. Unusually sensitive individuals may experience effects even when the HQ is equal or less than 1.

There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of Aminopyralid. Due to the lack of data in humans, the critical effect of Aminopyralid in humans, if any, cannot be identified. It is not clear that Aminopyralid has any remarkable systemic toxic effects. The most common effects in experimental mammals involve effects on the gastrointestinal tract which may be viewed as portal of entry effects. These effects are variable among different species of mammals and appear to be associated with levels of exposure that are substantially higher than any likely human exposures. Thus, it would seem highly speculative to suggest that individuals with gastrointestinal diseases might be more susceptible than other individuals to Aminopyralid.

There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of Chlorsulfuron. Due to the lack of data in humans, the likely critical effect of Chlorsulfuron in humans cannot be identified clearly. In animals, the most sensitive effect of Chlorsulfuron appears to be weight loss. There is also some evidence that Chlorsulfuron may produce alterations in hematological parameters. However, it is unclear if individuals with pre-existing diseases of the hematological system or metabolic disorders would be particularly sensitive to Chlorsulfuron exposure. Individuals with any severe disease condition could be considered more sensitive to many toxic agents.

The 1996 Food Quality Protection Act requires that U.S. EPA evaluate an additional 10X safety factor, based on data uncertainty or risks to certain age/sex groupings. U.S. EPA has evaluated Chlorsulfuron against this standard and has recommended a 3X additional safety factor be used for the protection of infants and children. This additional 3X safety factor is factored into the acute and chronic RfDs of this risk assessment as it applies to Chlorsulfuron.

No reports were encountered in the Glyphosate literature leading to the identification of sensitive subgroups. There is no indication that Glyphosate causes sensitization or allergic responses, which does not eliminate the possibility that some individuals might be sensitive to Glyphosate as well as many other chemicals (SERA 2003a).

Because Triclopyr may impair glomerular filtration, individuals with pre-existing kidney diseases are likely to be at increased risk (SERA 1996b). Because the chronic RfD for Triclopyr is based on reproductive effects, women of child-bearing

age are an obvious group at increased risk (SERA 2003b). This group is given explicit consideration and is central to the risk characterization.

Environmental Consequences

Alternative 1 - No Action

Direct, Indirect, and Cumulative Effects: Manual, mechanical, or thermal control methods would pose little safety risk to workers or the public as long as safety practices and Project Design Criteria were enforced. As no chemical control would be implemented, this alternative would not directly contribute to any adverse cumulative impact to human health from herbicides.

Alternative 2 - Proposed Action

Direct, Indirect, and Cumulative Effects: Manual, mechanical, or thermal control methods would pose little safety risk to workers or the public as long as safety practices and Project Design Criteria were enforced.

4.8 Native Vegetation

Affected Environment

According to the Terrestrial Ecological Unit Inventory (TEUI) layer for the Forest, there are 15 plant communities currently containing TIPS. The highest percentage occurs on white-fir dominated sites (53%). Drier Jeffrey pine sites contain the next highest percentage (19.5%). Moist situations, such as moist meadows and wetland-ponds contain about 13.3%, and the higher elevation red-fir sites contain about 8.8%. The remaining 5% are found in the huckleberry oak/manzanita, lodgepole pine, high elevation whitebark pine vegetation types, and on some rocky sites.

Alpine vegetation types are the only communities on the Forest that are believed to be entirely TIPS free at this time. However, some climate models indicate that future climate at higher elevations on the LTBMU may be warm enough and dry enough to allow TIPS infestations in what is currently occupied by alpine vegetation. At this time, there is uncertainty in climate change models which precludes an estimate of changes to vegetation communities in the future.

However, plant communities are abstract categorizations of continuous phenomena, that is, they exist in the eye of the beholder. Current communities are unlikely to exist in their current form in the future. Predictive climate models are being used to ascertain potential future climate in the Lake Tahoe Basin, and subsequently, potential future plant communities. Relatively high average monthly minimum November-December temperatures were very important for predicting

the distribution of cheatgrass, an invasive annual grass that creates a fire-prone monoculture. An on-going study between UC Davis and the US Forest Service has produced an invasion risk model for cheatgrass for the LTBMU using climate change models. Given climate warming, results predict an increase in average climatic suitability for cheatgrass invasion throughout the basin (Veloz 2008).

In many cases, TIPS populations are established where previous disturbance has occurred, disrupting the existing native plant community; however, TIPS, such as cheat grass, have also moved into undisturbed native plant communities as well.

Riparian areas are currently at risk of degradation due to TIPS. Several of the more aggressive tenacious TIPS, such as Canada thistle and St. Johnswort/Klamathweed often occur in riparian areas. These areas are also subject to disturbances, natural and human caused (flooding, road crossings, dispersed recreation use, etc.), creating favorable sites for TIPS establishment. They are highly important areas for native plant and wildlife diversity.

The greatest threat to the drier sagebrush/bitterbrush scrub communities on the east side of the LTBMU may result from ecological interactions with non-native annual grasses, i.e. cheat grass and medusahead. These species respond favorably to disturbance, including fire, and once established they increase the susceptibility of these communities to repeated frequent fires. Over time, this can potentially lead to changes in the fire regime that can negatively affect and potentially exclude native plant species, resulting in complete vegetation type conversion. In addition, these species can compete directly with native plant species, affecting biodiversity and wildlife habitat quality.

There are no known Threatened, Endangered, or Proposed plant species on the LTBMU. There is one Candidate species, Tahoe yellow cress. Twenty-four Region 5 sensitive plant species are known or suspected, including one candidate species, on the LTBMU. Their habitats range from high elevation alpine cushion plant communities to perennially wet meadows and fens. Table 4h lists those sensitive species and their habitats.

Table 4h. LTBMU Sensitive Plant Species and their Habitats.

Scientific Name	Common Name	LTBMU	FED List	CA/NV State List	CNPS	TRPA	Status	Habitat
Arabis rigidissima var demota	Galena Creek rock cress	S	SC		1B.2		S	Species is found in open, rocky areas along forest edges of conifer and/or aspen stands. Usually found on northerly aspects above 7,500 feet (ft).
Arabis tiehmii	Tiehm's rock cress	S			1B.3		S	Species is known from open rocky soils in the Mt. Rose Wilderness.
Botrychium ascendens	Upswept moonwort	S	SC		2.3		S	*Botrychium* species share similar preferences in habitat, *i.e.* wet or moist soils such as marshes, meadows, and along the edges of lakes and streams at elevations between 4,700 and 9,000 ft. They generally occur with mosses, grasses, sedges, rushes, and other riparian vegetation.
Botrychium crenulatum	Scalloped moonwort	S	SC		2.2		S	See above
Botrychium lineare	Slender moonwort	S			1B.3		S	See above
Botrychium lunaria	Common moonwort	S	SC		2.3		S	See above
Botrychium minganense	Mingan moonwort	S			2.2		S	See above
Botrychium montanum	Western goblin	S			2.1		S	See above
Bruchia bolanderi	Bolander's candle moss	S			2.2		S	Montane meadows and stream banks are favored habitat. This moss tends to grow on bare, slightly eroding soil where there is little competition from other vegetation.
Dendrocollybia racemosa	Branched collybia	S					S	This species is a mycoparasite growing on old decayed or blackened mushrooms or occasionally in coniferous duff, usually within old growth stands.
Draba asterophora var asterophora	Tahoe draba	S	SC		1B.3	SI	S, SI	Species is found in rock crevices and open granite talus slopes at high elevations between 8,000 to 10,200 ft on north-east facing slopes.

Scientific Name	Common Name	LTBMU	FED List	CA/NV State List	CNPS	TRPA	Status	Habitat
Draba asterophora var macrocarpa	Cup Lake draba	S			1B.3	SI	S, SI	This species is found on steep, gravelly or rocky slopes at elevations of 8,400 to 9,235 ft.
Epilobium howellii	Subalpine fireweed	S			1B.3		S	Plants are found in wet meadows and mossy seeps at 6,500 to 9,000 ft in subalpine coniferous forest.
Erigeron miser	Starved daisy	S			1B.3		S	Plants are found in high elevation granitic rock outcrops above 6,000 ft.
Eriogonum umbellatum var. torreyanum	Torrey's or Donner Pass buckwheat	S	SC		1B.2		S	This species grows in dry gravelly or stony sites, often on harsh exposures such as ridge tops or steep slopes.
Helodium blandowii	Blandow's bog moss	S			2.3		S	Habitat for this moss is in bogs and fens, wet meadows, and along streams under willows.
Hulsea brevifolia	Short-leaved hulsea	S	SC		1B.2		S	This species is found primarily in red fir forests, but has also been found in mixed conifer forests. The elevational range of the plant is between 4,920 and 8,860 ft.
Lewisia kelloggii ssp.hutchisonii	Kellogg's lewisia	S			3.3		S	Habitat for this plant occurs on ridge tops or flat open spaces with widely spaced trees and sandy granitic to erosive volcanic soil from about 5,000 to 7,000 ft.
Lewisia kelloggii ssp kelloggii	Kellogg's lewisia	S					S	See above
Lewisia longipetala	Long-petaled lewisia	S			1B.3	SI	S, SI	This species occurs on the northerly exposures on slopes and ridge tops at elevations between 8,000 and 12,500 ft where snow banks persist throughout the summer. The plants are often found near the margins of the snow banks in wet soils.
Meesia triquetra	Three-ranked hump-moss	S	SC		2.2		S	This moss prefers bogs and fen habitats, but is also found in very wet meadows.
Meesia uliginosa	Broad-nerved hump-moss	S			2.2		S	This moss prefers bogs and fen habitats, but is also found in very wet meadows.

Scientific Name	Common Name	LTBMU	FED List	CA/NV State List	CNPS	TRPA	Status	Habitat
Peltigera hydrothyria	Veined water lichen	S					S	This species is found in cold, unpolluted streams in mixed conifer forests.
Rorippa subumbellata	Tahoe yellow cress	S	CE	E / CE	1B.1	SI	C, S, SI	This species is endemic to the shorezone around Lake Tahoe in California and Nevada. Typically found in back beach areas between elevations of 6,223 and 6,230 ft.

S = USFS LTBMU Sensitive Species, Regional Forester's Sensitive Species List, Region 5
LSI = USFS LTBMU Species of Interest
SI = TRPA Special Interest Species, Regional Plan for the LTBMU: Goals and Policies (1986) and Code of Ordinances (1987)

CA State List
R = rare T = threatened E = endangered

NV State List
CE = Nevada critically endangered
Fed List:
CE = Candidate for Endangered
SC = Species of concern

CNPS List
1A = presumed extinct in CA, 1B = Rare or Endangered in CA and elsewhere
2 = Rare or Endangered in CA but more common elsewhere
3 = Plants need more information - Review list
4 = Plants of limited distribution - Watch List

CNPS Threat Code extensions
.1 - Seriously endangered in CA (over 80% of occurrences threatened / high degree and immediacy of threat)
.2 - Fairly endangered in CA (20-80% occurrences threatened)
.3 - Not very endangered in CA (<20% of occurrences threatened or no current threats known)

4.8.1. Alternative 1 – No Action

Direct and Indirect Effects: There would be no risk of herbicide damage to native plants on the Forest under this alternative.

The anticipated continued increase in TIPS populations on the Forest in the absence of chemical control efforts would result in degradation of native ecosystems. This degradation of native plant communities could result from direct competition for moisture, light, and/or nutrients between TIPS and native plant species, as well as from changes in ecosystem processes such as fire and flooding.

Approximately 6.5 infested acres would continue to harbor TIPS and TIPS seed banks, reducing native plant diversity and habitat quality. This acreage would likely increase over time across the Forest, and the severity of the existing infestations would worsen, further affecting native plant communities. Over the long term, the lack of control efforts on the Forest could also contribute to a loss or degradation of native plant communities off the Forest, as uncontrolled TIPS populations spread onto adjacent lands. This could lead to greater overall

herbicide use and risk to non-target species in the Tahoe Basin, as control efforts on adjacent lands are accelerated to deal with TIPS spreading off the Forest.

Cumulative Effects: Many other activities have historically impacted, and in some cases continue to impact upland and riparian native plant communities to varying degrees on the Forest, including roads, mining activities, grazing, fuel treatments, water developments, recreation developments, and special use activities. Effects range from direct removal of or damage to native plants, effects on plant health and the overall productivity of native communities, to effects on ecosystem processes integral to the long-term health of native plant communities.

As new activities are undertaken, measures are implemented to minimize the risk of new TIPS infestations or further spread of existing populations through Noxious Weed Risk Assessments as mandated by the Forest Plan as amended (USDA Forest Service 2004). However, existing populations continue to affect native plant communities. Alternative 1 would contribute the most to the cumulative effects of past, present, and reasonably foreseeable actions on native plant communities. TIPS would have the ability to continue to grow and expand populations to the greatest degree under this alternative. With the exception of the very limited use of borax, a fungicide, used to treat cut tree stumps in forested areas to minimize spread of *Annosus* root disease, there is no pesticide use currently on the Forest, and no risk of herbicide contamination to native plant communities. In the surrounding region, herbicide use is significantly more common on non-Forest lands.

This alternative would not contribute to the cumulative level of risk to native plant communities from herbicides in the region.

4.8.2. Alternative 2 - Proposed Action

Direct and Indirect Effects: The risk of herbicide applications to non-target plants is minimal, due to the methods of application and Design Features. There is a slight risk of damage to native plants from accidental herbicide spills under this alternative. In the event of a spill, effects would range from decreased productivity or injury to plant death. This risk is minimized through the use of Project Design Features when applying herbicides.

This alternative provides the best long term protection overall for native vegetation communities, due to the greater effectiveness of TIPS eradication methods under this alternative. This is true in particular for riparian plant communities, as the deeper-rooted riparian corridor TIPS are more resistant to manual treatments. Under this alternative, TIPS will be eradicated from approximately 107 gross acres,

resulting in improved quality of native vegetation communities in these areas. An additional 202 gross acres should experience some habitat improvement, with at least partial eradication, and containment of further spread. Manual treatments will be prioritized and are not expected to eradicate some of the primary TIPS of concern from the Forest due to their widespread distribution, e.g. cheat grass, woolly mullein. Where eradication is not feasible, threats upland native plant communities will continue. These threats include a change in plant communities with reduced native plant biodiversity.

The Proposed Action would contribute approximately 10 pounds of herbicide Forest-wide annually over the life of the project. This is about two hundred thousandths of what is currently being used in the three California counties adjacent to the lake. Although the pounds of pesticide use for just the Basin is not reported on the California Department of Pesticide Regulation web site, total pesticide use in Alpine, El Dorado and Placer Counties combined in 2007 was 489,922 pounds (CDPR 2007). Pesticide use information was not available for Nevada counties.

Cumulative Effects: Many other activities have historically impacted, and in some cases continue to impact upland and riparian native plant communities to varying degrees on the Forest, including roads, mining activities, grazing, fuel treatments, water developments, recreation developments, and special use activities. Effects range from direct removal of or damage to native plants, effects on plant health and the overall productivity of native communities, to effects on ecosystem processes integral to the long-term health of native plant communities.

As new activities are undertaken, measures are implemented to minimize the risk of new TIPS infestations or further spread of existing populations through Noxious Weed Risk Assessments as mandated by the Forest Plan

With the exception of the very limited use of borax, a fungicide, used to treat cut tree stumps in forested areas to minimize spread of *Annosus* root disease, there is no pesticide use currently on the Forest. In the surrounding region, herbicide use is more common on non-Forest lands.

Forest Service Sensitive and Special Interest Plant Species

For purposes of this analysis, threatened, endangered, candidate, sensitive, and species of interest plants within a distance of 100 feet (ft) of TIPS populations proposed for treatment are analyzed. This distance is more than enough to describe the effects of the proposed control treatments, and in estimating the effects of unchecked TIPS spread (No Action Alternative).

Rare plant species located more than 100 ft from proposed treatments are well outside the potential area of effects from accidental spills or normal application of herbicides using methods and Design Features proposed for this project. However, rare plant populations within 100 ft of TIPS populations are close enough that they may be affected by continued spread of existing TIPS populations in the absence of treatments.

There are two sensitive species that occur within 100 ft of known TIPS locations proposed for treatment. Herbicide use is proposed only for one of these populations, the three-ranked hump-moss population along Angora Creek within the Angora burn area. Table 4i lists the species and the known populations of TIPS that occur nearby.

Table 4i. Sensitive plant populations occurring within 100 feet of known TIPS populations, including proposed treatment.

Common name	Scientific Name	List*	Number of Occur-rences	Known TIPS	Treatment
Tahoe yellow cress	*Rorippa subumbellata*	S, C, TRPA	9	Bull thistle	Manual
Three-ranked hump-moss	*Meesia triquetra*	S	1	St. Johnswort/Klamathweed (Actually may be the native species of *Hypericum*)	Manual/Chemical

*S=FS Sensitive, SOI=FS Species of Interest, C= Candidate, TRPA=Tahoe Regional Planning Agency species

Tahoe yellow cress (*Rorippa subumbella*): This low-growing, perennial herbaceous plant in the mustard family is endemic to the Tahoe Basin, found only on beach habitat around the perimeter of Lake Tahoe. It is considered threatened in California, endangered in Nevada, and is a candidate species for listing with the USFWS. It occurs generally as a megapopulation on private, county, state, and Federal lands, with three out of a total of 10 core populations on the LTBMU. Its reproductive strategies have not been completely investigated, although it does produce viable seeds in addition to occurring clonally. Annual surveys of the species go back to 1978.

Three-ranked hump-moss (*Meesia triquetra*): This perennial, circumboreal moss prefers fen habitats but is also found in very wet meadows. The LTBMU has 40 occurrences of this moss, the occurrence at Grass Lake RNA being the largest in California. As of 2005 (Dillingham), there were 74 fens occupied by three-ranked hump-moss on national forests in California.

Environmental Consequences

Effects Common to All Alternatives: The effects of TIPS on native vegetation discussed earlier in this document also pertain to rare plant species. These effects include direct competition for moisture, sunlight, or nutrients, alteration of habitat, and potential effects on fire regimes or allelopathic effects.

Alternative 1 - No Action:

Direct and Indirect Effects: Under this alternative only manual treatment will be used, and there will be no use of herbicides and therefore no risks from herbicide use to non-target rare plant species on NFS lands. Infestations of difficult-to-control species under this alternative would likely expand, potentially leading to competition with populations of rare plants, if future TIPS are within close proximity to TEPCS plant species. Treatment of the bull thistle may affect individuals of Tahoe yellow cress from tramping. Pulling of the TIPS where roots are intertwined with Tahoe yellow cress may affect individual Tahoe yellow cress plants.

The No Alternative represents the greatest threat of all the alternatives to rare plant species and their habitat, as in the long-run, it will likely lead to competition between TIPS and rare plants.

Cumulative Effects: A multitude of activities that potentially cause impacts to rare plants, historically as well as currently, would continue to occur on Forest land and in other locations where these species occur. These activities include roads, development, pack stock and wildlife use, theft of rare species, fuel treatments, wildfire, recreation developments, and special uses. Impacts may include damage to individual rare plants, alteration of habitat, and effects to ecosystem processes that may affect rare species. Possible, but unknown effects may also come from a changing climate.

Under the No Action Alternative, existing TIPS infestations that are difficult to control will continue to spread, gaining increasing dominance over the long term, contributing to the potential cumulative effects of other activities on rare plant populations.

Alternative 2 - Proposed Action

Direct and Indirect Effects: No Threatened, Endangered, Proposed, Candidate, or Sensitive (TEPCS) species occur in the midst of any occurrences of TIPS that will be treated with herbicide. One population of three-ranked hump-moss occurs within 100 ft of a possible occurrence of St.Johnswort/Klamathweed proposed for chemical treatment. However, it is suspected that these plants may actually be the

native *Hypericum formosum* var. *scouleri* rather than the TIPS. Habitat for this native *Hypericum* includes springs and moist places, which is the habitat at this site. Dr. Robert Preston, author of the Hypericaceae in The Jepson Manual, 2nd edition opined, from photos and descriptions sent to him, that it was the aforementioned native species. Confirmation of species will be done at flowering during the 2010 field season. If it is the TIPS, herbicide methods will be dip & clip or wick & wipe, so that non-target plant species will not be affected.

Because of the limited number and size of TIPS populations proposed overall for herbicide treatment, the physical separation between rare plant populations and TIPS populations targeted for herbicide treatment, the highly targeted application methods, and the relatively short degradation time of the herbicides, no adverse effects to rare plants from herbicides are expected from this TIPS control effort for known TIPS occurrences.

Under this alternative, due to the implementation of the most effective overall treatment methods, the rare plant populations and their habitat will be less threatened by TIPS invasion.

Tahoe yellow cress: Treatment of the bull thistle that is within 100 feet of 9 occurrences of this species may affect individuals of Tahoe yellow cress from tramping. Pulling of the TIPS where roots are intertwined with Tahoe yellow cress may affect individual Tahoe yellow cress plants. Because known sites of bull thistle will be treated manually, mechanically, or thermally, no effects from herbicide application will occur.

This alternative would allow for greater protection of rare plant populations from TIPS invasions than the No Action Alternative, although individual Tahoe yellow cress plants may be affected from pulling bull thistle. Future TIPS occurrences or expansions or new TIPS, especially those that are difficult-to-treat, can be removed before becoming large infestations. If they are near TEPCS plants, they can be controlled in time before seriously threatening the habitat of the rare plants. Once infestations have been allowed to produce seed or vegetatively reproductive parts, they will take more time and effort to eradicate.

Cumulative Effects: A multitude of activities that potentially cause impacts to rare plants, historically as well as currently, would continue to occur on Forest land and in other locations where these species occur. These activities include roads, development, pack stock and wildlife use, theft of rare species, fuel treatments, wildfire, recreation developments, and special uses. Impacts may include damage to individual rare plants, alteration of habitat, and effects to

ecosystem processes that may affect rare species. Possible, but unknown effects may also come from a changing climate.

Under the Proposed Action, existing TIPS infestations that are difficult to control will be controlled or eradicated. The Proposed Action would decrease the overall cumulative effects to rare plants over the time period of this NEPA document, as it would do the most of any of the alternatives towards limiting the negative effects, such as competition with TIPS, on rare plant populations and habitat.

Determinations

The Terrestrial TIPS Treatment Project **may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for Tahoe yellow cress (*Rorippa subumbellata*)**, or any other plant species listed as threatened, endangered, proposed for listing, or listed as candidate species under the ESA.

The Terrestrial TIPS Treatment Project, **may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for all LTBMU Forest Service sensitive species.**

These species are known from the project area.

- *Meesia triquetra* (three-ranked hump-moss)
- *Meesia uliginosa* (broad-nerved hump-moss)
- *Rorippa subumbellata* (Tahoe yellow cress)

Design Features have been incorporated to the Terrestrial Non-native Invasive Plant Species Treatment Project that will eliminate adverse effects to these species. However, these species may be affected during project implementation if undetected individuals or populations are present but were not detected within the project area.

- *Arabis rigidissima* var. *demota* (Galena Creek rock cress)
- *Botrychium crenulatum* (Scalloped moonwort)
- *Botrychium lineare* (Slender moonwort)
- *Botrychium lunaria* (Common moonwort)
- *Botrychium minganense* (Mingan moonwort)
- *Botrychium montanum* (Western goblin)
- *Bruchia bolanderi (*Bolander's candle moss)
- *Dendrocollybia racemosa* (branched collybia)
- *Epilobium howellii* (Subalpine fireweed)
- *Erigeron miser* (Starved daisy)
- *Eriogonum umbellatum* var. *torreyanum* (Donner Pass buckwheat)
- *Helodium blandowii*, (Blandow's bog-moss)
- *Hulsea brevifolia* (short-leaved hulsea)
- *Lewisia kelloggii* ssp *kelloggii* (Kellogg's lewisia)
- *Lewisia kelloggii* ssp. *hutchisonii* (Hutchinson's lewisia)
- *Peltigera hydrothyria* (Veined water lichen)

These species may be affected during project implementation if undetected individuals or populations are present. However, treatment of expanding infestations or new infestations of TIPS, known generally as EDRR, will be reviewed first with the Forest Botanist prior to treatments. This will ensure no to minimum risk to TES plant species in areas that have not yet been surveyed due to no currently known TIPS at those sites.

4.9 Terrestrial Invasive Plant Species

Overview

Information on TIPS, including natural history, status, control strategies, and reports on amounts and types of herbicides used in each state and county, is available from county agricultural commissioners, the State Departments of Pesticide Regulation, in the references cited in this document, as well as on the World Wide Web at several sites:

http://www.cal-ipc.org/

http://www.cdpr.ca.gov/docs/pur/pur99rep/99_pur.htm

http://agri.state.nv.us/weed.pdf

http://www.ipm.ucdavis.edu/default.html

http://www.blm.gov/ca/st/en/fo/folsom.html

http://www.invasive.org/gist/index.html

A summary of specific information on the TIPS addressed in this analysis is provided below. Thirty-four TIPS from within or near the Tahoe Basin, and new TIPS that are not yet known within the Basin but are likely to be discovered in the future, are proposed for treatment. These species could be eradicated and/or controlled within the boundaries of the LTBMU.

Hand-pulling and grubbing efforts on the Forest over the past eight years have proven ineffective in reducing or eradicating some populations of TIPS. Surrounding landowners, including counties, state parks, county and state roadways, and private individuals on private lands, have been using chemicals for at least the past five years. Providing effective treatment for hard-to-control TIPS would provide a consolidated front within the Basin against these invaders.

Affected Environment

- According to Kauneckis et al. (2000), there are 132,772 acres of NFS lands within the Tahoe Basin (77% of Basin). There are 8.9 infested acres (0.00007% of the total Forest) of TIPS on the LTBMU.

- The 10 TIPS sites with the highest acres account for over 50% of the total TIPS acres on the Forest. This includes the site with the highest net acreage: site #154 oxeye daisy at Slaughterhouse Meadow at 3.125 acres, a rhizomatous species.
- There are 6.5 infested acres (0.00008% of the total Forest) that are *proposed* for potential chemical treatment on the LTBMU. This is 75% of the infested acres. Manual treatment will be utilized in lieu of chemical treatment where effective. (DF-36).
- There are 3.1 infested acres (0.004% of the total forest) of TIPS within Stream Environment Zones (SEZs) on the LTBMU that are *proposed* for potential chemical treatment[9].
- There are 2.4 infested acres that are proposed for manual, mechanical, or thermal treatment. Currently, there are no known sites for manual treatment that are larger than 0.1 acre.
- There are 493 known sites of TIPS on the LTBMU, 198 (40% of the known sites) of which are *proposed* for potential chemical treatment.
- 192 sites of the 198 sites proposed for chemical treatment are 0.1 acres or less in size (96%). Only ten sites are greater than 0.1 acre, including only one site that is greater than one acre (3.12 infested acres of oxeye daisy at Prey Meadows).
- Of the 34 TIPS, 31 are proposed for potential chemical treatment on known sites. Manual treatment is proposed for field bindweed, common/woolly mullein, and current sites of bull thistle.
- 1.4 acres of TIPS are within 50 ft of perennial rivers, streams, lakes and other water bodies. Only 0.9 acre of this are proposed for chemical treatment. The average infestation within this 50 ft range is 0.06 acre of TIPS per site.
- No 5th field watershed has more than 1.0 percent proposed for treatment, and most have well under 0.1 percent.

[9] SEZs are based on riparian vegetation GIS layer unless noted otherwise.

Russian knapweed

Russian knapweed is a long-lived perennial herb that can spread vegetatively or by seed. Roots can grow 6 to 8 feet deep during the first growing season, and 16 to 23 feet deep in the second growing season. The primary method of reproduction is vegetative from the creeping root system. In addition to these traits, it exhibits allelopathic effects, suppressing other plant species (North Dakota Department of Agriculture, unknown date). Although reported in the Tahoe Basin, currently there is no known occurrence on the LTBMU. Hand pulling of this species reportedly has limited effectiveness and repeated pulling may not eradicate the infestation (Beck 2001; CDFA online; Carpenter and Murray 1998).

Tree of Heaven

Tree of Heaven is a fast growing tree, currently documented in the Lake Tahoe Basin, but not on the LTBMU. Much like salt cedar, this non-native tree is deep rooted and aggressive, crowding out native plant species and degrading wildlife habitat, particularly in riparian areas. The known infestation in the Basin consists of a few individuals. These trees are prolific resprouters if cut stems are left untreated (Bossard 2000).

Cheatgrass

Cheatgrass is a weedy annual grass that is widespread across the Great Basin, and is invading the LTBMU. It is unlikely that control of all populations is possible. Higher priority populations, such as those that are smaller and manageable, will be targeted for control. The primary focus for this species is to prevent further spread where possible through management practices. Management will likely require a combination of chemical control, cultural control, seeding perennial grasses, and proper land management.

Plant surveys for the Upper Truckee River Sunset Stables Restoration Project (2008) found an additional 32 populations and significant expansions of the 15 existing populations since the 2004 survey (Entrix 2009). The occurrences will be treated under the project actions, including a mitigation plan that specifies revegetation.

Cheatgrass is most common on the lower slopes of the mountains, but can occur as high as 9,000 feet. Cheat grass is becoming a common and widespread weed on the Forest and has a high impact rating from the California Invasive Plant Council (CalIPC, online). Seed of this brome is spread by attaching to fur, clothing, or equipment, by wind, or by livestock or wildlife. Cheat grass may displace native vegetation, alter microhabitat characteristics, and compete for nutrients and light.

The presence of these weeds may change the frequency, extent, and timing of wildfires (Bossard et al., 2000). Young and Clements (2009) found that cheat grass was competitive with native vegetation primarily during the seedling stage.

Hoary cress – two species

Heart-podded hoary cress and globe-podded hoary cress are perennial herbs that reproduce by seed and thick, creeping rhizomes, and are highly competitive with other species once established (CDFA et.al. 1999). Some control can be attained through repeated manual treatments throughout the growing season but eradication is difficult if not impossible without herbicides, due to the creeping rhizomes (North Dakota Department of Agriculture, date unknown). This weed tends to establish large monospecific mats that crowd out native vegetation. There is one known population each on the Forest. Both are located in a meadow near the FS fire station at Spooner Summit. All known populations on the Forest are currently less than a half acre in size.

Musk thistle

Musk thistle is a biennial or sometimes a winter, or summer annual, that can grow up to six feet tall and that prefers moist, bottomland soil, but can be found on drier uplands. The taproot is long, thick and fleshy, occasionally branched, and is capable of penetrating the soil to depths of a foot and a half or more. The plant reproduces by seed, each flower head capable of producing 1,500 or more seeds.

The largest known location of musk thistle in California, 600 acres, is found on Boca Hill, Tahoe National Forest, just north of the LTBMU near Boca Reservoir (Moonshineink. 2009). On the LTBMU, three persistent occurrences occupy less than half an acre, at Lam Watah, near Meyers in the Heavenly SEZ, and a site near Mt. Watson north of Kings Beach.

Purple starthistle

Purple starthistle is a close relative of yellow starthistle and an aggressive annual to short-lived perennial that is a major problem in the San Francisco Bay Area. Many of the visitors to the LTBMU are from the Bay Area. Flowers are surrounded by long, stout, pointed spines, which persist even on dead plants and create barriers to movement of animals and humans. Reproduction is by seed. Currently, there are no known occurrences within the Basin, although it is found close by.

Diffuse knapweed

Diffuse knapweed is a diffusely branched annual, biennial, or short-lived perennial that can resemble spotted knapweed with the black-tipped bracts, and is known to

hybridize with it. It reproduces and spreads by seed. However, reports suggest it may resprout from the root crown as well.

A single plant can produce up to 18,000 seeds. The seeds germinate spring or fall or anytime during the growing season following disturbance (such as manual control), if adequate soil moisture is present. The plants break off at the soil surface, and become tumble weeds that disperse their seeds. Like other knapweeds, is it readily established in disturbed soil, and can produce allelopathic chemicals, excluding native plant species in disturbed areas. Management must be continuous, otherwise, reinfestation inevitable (CDFA et.al. 1999). There is one location of diffuse knapweed reported in the project files, located on FS land near Kings Beach.

Yellow starthistle

Yellow starthistle has not been found on NFS lands, but small occurrences have been known within the Tahoe Basin. However, all previous infestations have been eradicated. Extensive infestations of this TIPS exist in California, with its range expanding into the mountains. El Dorado County has a "Save the Sierras" program with a 'knock back zone' at the 3,500 foot level (El Dorado 2008). Yellow starthistle, an annual, or sometimes a biennial, is highly competitive, and can develop dense, impenetrable stands. Taproots grow vigorously early in the season to depths of 3 feet or more, giving plants access to deep soil moisture. One plant can produce 100,000 seeds, and nearly all seeds are able to germinate within one week of dispersal.

Spotted knapweed

Spotted knapweed is a biennial or short-lived perennial with a stout taproot. Like other knapweeds, is it readily established in disturbed soil, and can produce allelopathic chemicals, excluding native plant species (CDFA et.al. 1999). It is currently reported from one site at the Nevada Beach Campground, and one plant was removed in 2009 from the parking lot of the LTBMU Supervisor's Office. CDFA (Online) reports that hand pulling spotted knapweed has limited effectiveness, since vegetative reproduction from short lateral roots can occur for several years.

Squarrose knapweed

Squarrose knapweed is a long-lived perennial with a stout taproot. It is a highly competitive plant that can displace native species. It has a habit of breaking off at the base and tumbling across the landscape, dispersing seeds along the way. Like other knapweeds, is it readily established in disturbed soil, and can produce allelopathic chemicals, excluding native plant species (utahweed.org. 2009). It has

not been reported in the Tahoe Basin. CDFA (Online) reports that hand pulling spotted knapweed has limited effectiveness, since vegetative reproduction from short lateral roots can occur for several years.

Rush skeletonweed

Rush skeletonweed has recently been found within the Tahoe Basin near Echo Summit, located on the edge of the road and directly next to the Forest. It was treated by both the LTBMU and El Dorado County. This herbaceous, relatively long-lived perennial can flourish in very dry to very wet environments. It has the ability to form dense monocultures, displacing native species. Diligent hand-pulling or grubbing can provide effective control of very small infestations. As with oxeye daisy, this plant is difficult to control, even with herbicides.

Canada thistle

Fourteen locations of Canada thistle are currently known on the LTBMU, covering less than one half infested acres. Although the overall acreage of this species has increased over time, some sites found along the shoreline of Lake Tahoe appear to have been eradicated due to high lake levels in 2008. Although the large infestation found in 2005 along the Lam Watah Trail actually decreased in infested area by about half, the gross area continues to rise (Reed2008). This indicates that some of the stems have been suppressed by treatment, but the underground rhizomes are healthy and spreading out to encompass a larger area.

Canada thistle is a perennial with a rhizomatous root system. Although a single plant can produce thousands of seeds, and the seeds can remain viable for 20 years, Canada thistle primarily spreads by horizontal creeping roots. It is difficult to treat through manual methods because the plant regenerates unless all root fragments are removed.

Bull thistle

Bull thistle is the most common TIPS on the LTBMU, and currently is known from 279 dispersed locations on the Forest. It was the most common TIPS treated in the Angora Fire area. It can colonize relatively undisturbed grasslands and meadows, as well as disturbed areas.

Bull thistle is a coarse biennial, reproducing only by seed, and dying following seed set (Bossard 2000), making manual eradication feasible for smaller populations. The 2008 known occurrences are proposed for manual treatment, if effective. Site expansions or new sites are proposed for all treatment types.

Poison hemlock

This species was introduced from Europe as an ornamental, and has since spread to become naturalized in nearly every state in the US. It is toxic to wildlife, livestock, and humans and was commonly used to kill political prisoners in ancient Greece. All parts of the plant are considered poisonous.

This plant usually behaves like a biennial reproducing only by seed, which is dispersed by water, mud, wind, animal fur, human clothing, boots, and machinery. It has no means of vegetative reproduction. Although hand pulling is effective, care must be taken to wash the hands before eating any food! This species has been found recently on the LTBMU.

Field Bindweed

Field bindweed, *Convolvulus arvensis,* is a native of Eurasia and was first documented in California in 1884 when it was collected in San Diego. By the first quarter of the twentieth century, field bindweed was proclaimed the worst weed in California. Because of its flowers and climbing nature, some seeds were probably planted as ornamentals (http://www.ipm.ucdavis.edu/PDF/PESTNOTES/pnfieldbindweed.pdf). Only 2 sites are currently known on the LTBMU, both in the South Shore area, and one within the Angora Fire area, with total acreage about 1/1000th of an acre.

Scotch broom

There are currently three known population on the Forest, at Fallen Leaf Lake Campground, at an old mill foundation off Cathedral Road, and in an Urban Lot off Kingsbury Grade, occupying less than half an acre.

Scotch broom is a large perennial shrub with extensive roots that spreads aggressively by seed, and is an effective stem sprouter, even when cuts are made close to the ground. To minimize resprouting, larger plants should be cut when under drought stress. It is considered a fire hazard, and poor forage for native wildlife. The seeds can remain viable for years, making eradication difficult. Manual removal is typically effective only when plants are young, and can be removed in entirety (Bossard 2000; LeBlanc 2001).

Teasel

Teasel is native to Europe and was intentionally brought to North America in the 1700s because of its role in wool fleecing. The firm, elastic, spiny flower head was attached to a cylinder and turned against cloth to raise the nap of woolen cloth. Teasel readily escapes from gardens to meadows, displaces native Sierran plants, is not a food source for wildlife, and dense stands of the prickly plant limit trail

access for hikers. Teasel has been found close to the LTBMU near the Angora burn area.

Stinkwort

Stinkwort is a poisonous, strongly aromatic annual native to the Mediterranean region. It reproduces large amounts of seed that are dispersed by wind, water, machinery, vehicles, and animals. The wind can carry seeds great distances. It can be difficult to control with herbicides due to its oily leaves, which reduce penetration by most chemicals. Isolated plants can be controlled by hand (wear gloves!) Stinkwort has recently been found near the Tahoe Basin.

Quackgrass

This rhizomatous perennial grass is a common weed of agricultural lands, turf grass, nurseries, and landscaped areas. It can be found abundantly in mountains meadows in California, thriving on different soil types, in gravel and peat, and also under saline and alkaline conditions. Chemical applications often need to be repeated. Although known on the LTBMU, no locations are in the database.

St. Johnswort/Klamathweed

St. Johnswort was introduced from Europe in the 1700s, and by the 1900s it was invading rangelands in California. By 1940, more than one million hectares of California were infested by St. Johnswort, but biological control agents have eliminated most populations below 4900 ft elevation.

On the LTBMU, this species is spreading along the stream corridors in Ward and Blackwood Canyons on the west shore, occurring at 49 sites on the Forest (Reed 2009). It is a perennial, with stout taproots and many branched, lateral roots up to five feet deep. Rhizomes develop just below the soil surface from the crown and can extend outwards to about two feet. New shoots grow from the crown and rhizomes in early spring. It reproduces from both seed and rhizomes. Fragmented rhizomes can develop new plants (CDFA 2009).

Dyer's woad

This aggressive TIPS is a member of the mustard family native to southeastern Russia. It was first discovered in the US in Siskiyou County, believed to have come over in contaminated alfalfa seed. It invades both disturbed and undisturbed areas, but is most common in dry, rocky areas. Modoc County is especially infested with this plant. A small infestation was found in 2009 along Highway 267 on the south side of Brockway Summit.

Perennial pepperweed/Tall whitetop

Eighteen locations of perennial pepperweed/tall whitetop are currently known on the LTBMU, including a large occurrence at the Meyers Landfill. Many of the sites occur near the chairlifts at the Heavenly Ski Resort, and were likely brought in on equipment used in construction of the lifts. Most populations are currently small, covering a total of less than two acres. There are stands, some very large and dense along the Truckee River in Nevada, that are being treated by other agencies.

Perennial pepperweed forms dense colonies by adventitious shoots from roots and deep-seated rhizomes and spreads vigorously. It also produces abundant highly germinable seeds that can survive in the soil for at least 1 year. Fluctuating temperature regimes produce optimum germination. It can grow at altitudes of 4,000 to 8,000 feet. Perennial pepperweed is an aggressive invader of moist to wet ecosystems, even invading ecologically healthy areas, and is currently rapidly invading the Lake Tahoe Basin from the east, where it is a serious weed. Perennial pepperweed spreads aggressively by both seeds and root sprouts. Mechanical removal has been shown to be ineffective because plants form clonal stands and continue to sprout from extremely deep roots, and from root fragments (Ryan 1998, Renz 2000, Young 1995; USDI BLM 1994). It is difficult to control manually, and the LTBMU has been unsuccessful in eradicating even small populations.

Oxeye daisy

Oxeye daisy is leading in invasiveness on the LTBMU. It has shown significant increases in acreage, primarily due to one site, Slaughterhouse Canyon. It is taking over this meadow at a rapid rate and has expanded in gross area from five gross acres in 2003-2007 to 76 gross acres in 2009 (Reed 2009).

Oxeye daisy impacts forage for wildlife in infested meadows, and wildlife avoids grazing and walking in infested areas because it irritates their noses, mouths, and legs. This perennial herb produces 2,000 to 4,000 seeds per plant and up to 26,000 seeds per plant, and can germinate within 10 days. Seeds can remain viable for several years.

A total of 31 locations of oxeye daisy were known on the LTBMU in 2008. Native to Europe, it was introduced in the U.S. as an ornamental in the 1800s. It has a lovely flower similar to Shasta daisy, to which it is related. It is also closely related to another TIPS, common tansy (*Tanecetum vulgare*). It is widely planted and easily escapes cultivation; the creeping rhizomes enable it to outcompete and displace native vegetation (Jacobs 2009).

Dalmatian toadflax

Dalmatian toadflax is an escaped ornamental perennial, introduced in North America in the mid-1800s, and reproducing aggressively both by seeds and by vegetative propagation. The extensive deep root system and waxy leaves make it very difficult to control (CDFA et.al. 1999). Fourteen populations, consisting of a few individuals each are known on the LTBMU. Thirteen of these populations are on Urban Lots. Repeated annual pulling of small infestations of this species can reportedly be successful (Carpenter and Murray 1998).

Yellow toadflax

Yellow toadflax is native to Europe, and was introduced in North America as an ornamental. Aboveground parts of yellow toadflax plants are winter-killed, but protected buds at the soil surface and buds on creeping roots produce actively growing shoots the following spring.

While most new infestations are probably started by seeds, spread of established infestations is mostly vegetative from shoots sprouting from the large network of creeping roots. Severely damaged plants, such as those killed by wildfire, can quickly regenerate from the stout, soil-protected roots. This enables yellow toadflax to become a dominant member of post-fire plant communities.

Among other places on the Forest, Yellow toadflax is found at the Valhalla and 64 Acres (near Tahoe City). It is a significant problem around the Tahoe City area and along the Truckee River. Clipping and hand-pulling have not proven to be effective methods as the plants quickly resprout and set seed at short heights. It has also been found in the Angora burned area, where post-fire inspections show an expansion of this species (Reed 2008).

Purple loosestrife

Purple loosestrife is a beautiful but aggressive invader, brought to North America by settlers for their flower gardens. It grows an impressive four- to seven feet tall and prolifically invades wetlands and other moist areas.

Pulling purple loosestrife by hand is easiest when plants are young (up to two years) or when in sand. Older plants have larger roots that can be eased out with a garden fork. Remove as much of the root system as possible, because broken roots may sprout new plants. Bio-control works best in areas of severe infestation. This species is known along Highway 50 west of the Tahoe Basin.

Scotch thistle

Scotch thistle, an annual, biennial, or short-lived perennial, was introduced into the U.S. in the late 1800s as an ornamental. Although it occurs widely in California, major infestations are in northeastern California. In the Tahoe Basin it is known from only a few occasional sites, with one site on the LTBMU near Taylor Creek and Highway 89. Only a few plants were found there in 2008.

Scotch thistle has the ability to invade most habitats, and can germinate year-round, often growing to 8 feet or more in height. A single plant is imposing, but an entire colony can ruin a site. Scotch thistle is a prolific seed producer – 20,000 to 40,000 seeds per plant - and seeds can remain viable for 7 years, up to at least 20 years.

Reed canarygrass

This plant is a robust, sod-forming perennial grass that produces new stems from creeping rhizomes. There is a debate whether or not it is native to North America. Athena Demetry at Sequoia-Kings Canyon National Parks reports that it is spreading in the Sierra Nevada, suggesting that perhaps these infestations are non-native (Cal-IPC 2010). The aggressive nature may be the result of agronomic breeding for vigorous growth and drought tolerance. It was seeded throughout the Blackwood Creek corridor in an erosion control seed-mix and has formed large clumps along the stream banks (Reed2008). Inventory and monitoring of this species is recommended, with control/containment of any large occurrences and removal of small ones.

Sulfur cinquefoil

This perennial herb in the rose family has a single, woody taproot that can grow one to two feet in height. Key features include pointed hairs that protrude outward at right angles from the stem and leafstalk. The leaves have green coloring rather than silver on the underside.

Of particular concern is the impact on native cinquefoil (*Potentilla*). A single plant can produce thousands of seeds annually that allows for its rapid spread. The infestation of sulfur cinquefoil off Kahle Drive was treated in 2004 by digging up the entire infestation, but when monitored in 2005, the treatment had not reduced the size of the infestation, and in 2007 it was found to have expanded 20 times the size in 2005. Selective herbicides applied at recommended label rates are likely the only method of effective control (Reed 2008).

Himalayan blackberry

This plant is a robust, sprawling, evergreen shrub with hooked prickles, in the rose family. Rooting can occur at the cane tips to form daughter plants. Canes can grow up to about 9 feet tall, and form impenetrable mounds in the forest, often near streams, seeps, and high groundwater tables. In 2009, a plant was found growing next to the Supervisor's Office.

Medusahead

This annual grass forms monocultures in some areas of the west, including just to the north in Lassen and Modoc Counties. There are limited chemical options for this species, similar to the limited options for cheat grass, both monocots. The best strategy is prevention and early detection rapid response. For larger infestations, Glyphosate followed by planting of native species is recommended, in the absence of an herbicide that is selective on annual grasses (rimsulfuron).

Woolly mullein/Common mullein

Mullein is common across the Forest. The known populations on the Forest typically consist of scattered individuals vs. dense stands. It is the most common TIPS growing near the rare plant, Tahoe yellow cress.

Mullein is an annual or biennial plant that can invade not only disturbed sites but also pristine meadows. It reproduces only by seed, and field studies of buried seeds showed low germination rates; however, the seeds can be very long-lived, viable for up to 100 years under the right conditions (Bossard 2000). The most effective method of controlling mullein is to cut plants with a weed hoe. Pulling is also effective. Treatments will be prioritized where resource values are at greatest risk, such as on beaches around Tahoe yellow cress, and where the feasibility of control is highest. Only manual control is being proposed at this time for mullein.

Tamarisk/Salt Cedar

Salt cedar is not found in the Tahoe Basin, but is in adjacent communities in wet and riparian areas. Salt cedar, originally brought to the U.S. as an ornamental and soil stabilizer, has taken over many of Nevada's stream banks and lake margins (Conrad and Paris 2004). Salt cedar uses large amounts of ground water that causes water tables to fall and springs and small streams to dry up (DeLoach 2009). Large populations of salt cedar are found in the Humboldt and Walker areas of Nevada.

Salt cedar exudes excess salt from glands in its leaves, which fall during drought to form a salty crust on the soil surface, producing an allelopathic effect (DeLoach 1997). The transpiration rate of salt cedar is generally higher than that of native

riparian species, depleting water supplies of the areas it inhabits (USDA APHIS 1999; Neill, unknown date). Wiesenborn (1996) discusses four common physical changes caused by salt cedar: increased soil salinity inhibiting native plant germination and growth, increased water consumption and loss, increased wildfire frequency, and increased frequency and intensity of flooding.

Reproduction by seed can begin by the end of the first year of growth and a single large salt cedar can produce a half million seeds per year, primarily from late May to October. Seeds are short-lived (a few weeks) and will germinate on saturated soils or while afloat. Because of the long flowering season salt cedar has an advantage over native riparian species by exploiting suitable germinating conditions over a longer time interval. Salt cedar spreads by windblown seeds and aggressively invades flood prone washes and disturbed areas downwind of a parent plant.

When cut or disturbed, salt cedar sprouts aggressively from the root crown. If the plants have grown beyond small shrub size salt cedar is difficult to eradicate without the use of an herbicide (Bossard 2000; Muzika 2006; Tesky 1992).

Environmental Consequences

4.9.1. Alternative 1 – No Action

Direct and Indirect Effects: Without full TIPS control efforts, some TIPS populations would continue to spread and increase, eventually becoming well-established and potentially impossible to eradicate without extremely intensive and expensive treatments. Seeds from TIPS populations would continue to be transported and infest new sites throughout the area. Seed beds of invasive plants would continue to be fortified with new seed. TIPS would increasingly affect native ecosystems, including floral and faunal diversity and native and sensitive species. Native plant diversity and wildlife habitat quality would be reduced over time due to increasing dominance by invasive species. Few existing TIPS or populations would be eradicated or contained under this alternative. Acreage of existing populations would most likely increase as manual control methods have proven inadequate at containing certain species.

There is a high risk that seeds or propagative parts from Forest TIPS populations would migrate off site, resulting in increased infestations and subsequent manual, mechanical, and thermal treatments over a wider area that may infest adjoining lands. Lack of eradication and control on NFS lands would cause a reduction in effectiveness of others' efforts in the Basin (S. Donaldson, pers. comm.). Increased populations and subsequent spread onto non-NFS lands would result in greater

herbicide use by others over the long term, vs. eradication of TIPS sources on the Forest before they spread further. Herbicide use in the Tahoe Basin could potentially be higher overall as TIPS spread off the Forest, and control efforts were implemented on adjacent lands, resulting in an increased risk of non-target species exposure to herbicides and/or residues.

Under Alternative 1, existing infestations would continue to spread, gaining increasing dominance over the long term. Non-native invasive plants might be preselected to take advantage of a changing climate because they have the potential to respond to shifting niches more rapidly than natives (Crossman et al 2008).

From an on-going study between UC Davis and the US Forest Service, an invasion risk model for cheatgrass for the LTBMU using climate change models predicts an increase in average climatic suitability for cheatgrass invasion throughout the basin, particularly at higher elevations along the west shore when using the GDFL-CM2.1 model[10] (Veloz et al 2008). Without timely control of this species, the scattered satetille occurrences potentially would inoculate a widely dispersed area on the LTBMU. Manual control of TIPS would, over time, only be able to eradicate at most 6 TIPS, with poor control of other species, especially those with rhizomes or root buds.

Cumulative Effects: Vectors (livestock, vehicles, hikers, water, wind, wildlife) and disturbances (roads, fuel treatments, recreation developments, etc.) would continue to be present on NFS land. These factors have contributed in the past and currently to the establishment of TIPS populations on the LTBMU. Project-specific design features, incorporated into all new projects on the LTBMU, are helping to reduce the risk of new infestations and the spread of TIPS associated with new disturbances. Projects on the LTBMU, including livestock use, trail construction, road maintenance, and fuels reduction, have measures included for post project TIPS control, as well as TIPS prevention measures, e.g. equipment cleaning, animal management, revegetation, etc.

Adjacent to the Forest, on lands managed by states, counties, and private lands, TIPS control efforts that include herbicide application are underway for high priority species, particularly perennial pepperweed/tall whitetop, knapweeds, and thistles. Forest weed infestations that cannot be controlled well without herbicides would represent an ongoing source of weeds to off-forest lands.

[10] Geophysical Fluid Dynamics Laboratory model.

4.9.2. Alternative 2 - Proposed Action

Direct and Indirect Effects: This alternative would allow for an aggressive TIPS control program. Reductions in number of occurrences and in size of the occurrences would be expected. New sites, expanded sites and new TIPS can be treated in this alternative, and therefore these new infestations most likely would be controlled or eliminated while small. This would result in eradication of high priority TIPS where herbicide treatment is proposed, and control and/or eradication of TIPS populations where manual treatment is proposed. It is expected that 24 species would be eradicated from the Forest, and up to 127 or more TIPS sites will be eliminated (see Table 2b). The status of invasive plant species on the Forest, and consequently native vegetation and wildlife habitat, will be improved. Effective control using an aggressive treatment plan would, over time, eradicate 24 TIPS and control nine others.

This alternative offers the most effective treatment for many species, especially those that are difficult to control. Riparian habitats in particular would benefit from this alternative, with the eradication of species such as perennial pepperweed and oxeye daisy. Oxeye daisy would be removed from meadows, helping to protect those important environments.

There is a minor risk of damage to native plants on the Forest from accidental herbicide spill under this alternative. Because of the protection of non-target species by the more direct application methods prescribed in Design Features, the relatively short degradation time of the herbicides, and the small amount of herbicide being used, only minor effects to native plants are expected from this alternative.

Cumulative Effects: Vectors (livestock, vehicles, hikers, water, wind, wildlife), and projects doing earth-disturbing work, would continue to be present on NFS lands. These factors have contributed in the past, and continue to contribute currently, to the establishment of TIPS populations on the Forest. Project-specific design features, incorporated into all new projects on the Forest, are helping to reduce the risk of new infestations and the spread of TIPS associated with new disturbances. Projects on the Forest, including recreational stock use, trail construction, road maintenance, and fuels reduction, have measures included for project TIPS control, as well as TIPS prevention measures, e.g. equipment cleaning, animal management, revegetation, etc.

Adjacent to the Forest, on lands managed by states, counties, and private lands, TIPS control efforts that include herbicide applications are underway for high priority species, particularly perennial pepperweed/tall whitetop, knapweeds, and

thistles. This alternative would allow the Forest to synchronize its weed control efforts with the mix of tools used on adjoining lands, thereby improving efforts at eradicating infestations Basin-wide; no weed species would remain only partially controlled, as is the case currently.

Effects from future treatments would prevent spot introductions and newly found infestations or expanding infestations of known and yet to be discovered species from becoming large infestations. Most likely, if new introductions are caught early, the use of chemical treatments would be minimized. However, if hard-to-control species are not stopped while the infestation is small, these infestations will increase in size and density, and produce propagules that will infect newer areas with an ever-increasing presence on the landscape.

5.0 Agencies and Persons Consulted

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

5.1 Interdisciplinary Team Members

Cheryl Beyer, Forest Botanist

Robert Carroll, Pesticide Use Coordinator, Eldorado National Forest

Matt Dickinson, NEPA Coordinator

Denise Downie, Soil Scientist

Jim Harris, Hydrologist

Stan Kot, Wildlife Biologist

John Maher, Heritage

Mary Moore, Urban Lots Specialist

Scott Parsons, Forest Pesticide Coordinator

Cecilia Reed, Ecologist and Noxious Weed Coordinator

Maura Santora, Fisheries Biologist

Others:

Gina Thompson, Recreation Specialist

Richard Vacirca, Fisheries Biologist

5.2 Federal, State, and Local Agencies

Alpine County Board of Supervisors

California Department of Fish and Game

California Department of Food and Agriculture

California Department of Forestry

California Department of State Parks

California Department of Transportation

California Tahoe Conservancy

Carson City Board of Supervisors

City of South Lake Tahoe Parks and Recreation Department

El Dorado County Board of Supervisors

El Dorado County Dept. of Agriculture

Eldorado National Forest

Douglas County Board of Commissioners

Douglas County Parks and Recreation District

Humboldt-Toiyabe National Forest

Lahontan Regional Water Quality Control Board, South Lake Tahoe

Nevada Department of Agriculture

Nevada Department of Conservation and Natural Resources

Nevada Department of Transportation

Nevada Division of Environmental Protection

Nevada Division of Forestry

Nevada Division of State Lands

Nevada Division of Water Resources

Nevada Department of Wildlife

Nevada Heritage

Nevada State Parks

Nevada Tahoe Conservation District

Placer County Board of Supervisors

Placer County Department of Agriculture

Sierra Nevada Conservancy

South Tahoe Public Utility District

Tahoe National Forest

Tahoe Regional Planning Agency

Tahoe Resource Conservation District

University of California Cooperative Extension

University of Nevada Cooperative Extension

U.S. Department of Agriculture, Natural Resource Conservation Service

U.S. Fish and Wildlife Service, Reno

Washoe County Board of Commissioners

Washoe County Public Works Department

5.3 Tribes

Washoe Tribe of Nevada and California

5.4 Coordination

LTBMU staff will coordinate with TRPA per the Memorandum of Understanding between TRPA and Forest Service (2009). No permitting will be required for herbicide treatments.

LTBMU staff will coordinate with LTBWCG per the Memorandum of Understanding between LTBWCG and Forest Service (2009).

LRWQCB will be notified of herbicide treatments as outlined in Design Feature #12.

6.0 References

Akweeds. Online resource. Online summaries for several weed species from University of Alaska; individual authors not listed. [On-line] Available at: http://akweeds.uaa.alaska.edu/ (Accessed 12/28/2009).

Audubon "Import Bird Areas." Available at: http://www.audubon.org/bird/IBA/

AmphibiaWeb: Information on amphibian biology and conservation. [On-line] 2009. Berkeley, California: AmphibiaWeb. Available at: http://amphibiaweb.org/. (Accessed: Oct 29, 2009).

Antunes-Kenyo, S.E., and G. Kennedy. 2004. A Review of the Toxicity and Environmental Fate of Triclopyr. Massachusetts Department of Agricultural Resources.

ATSDR (Agency for Toxic Substances and disease Registry). 2004. Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures. US Department of Health Services, Public Health Service, ATSCR, Division of Toxicology. May 2004. 108 pages. On-line (accessed 10/26/2006) at http://www.atsdr.cdc.gov/interactionprofiles/ipga.html.

Bakke, D. 2007. Analysis of issues surrounding the use of spray adjuvants with herbicides. http://www.fs.fed.us/r5/spf/fhp/pesticide/surfactants_Jan_07_update.pdf

Bakke, D. 2003. Human and ecological risk assessment of nonylphenol polyethoxylate-based (NPE) surfactants in Forest Service herbicide applications. http://www.fs.fed.us/r5/spf/fhp/pesticide/index.shtml

Bakke, D. 2000. Site-specific Risk Assessment, Salmon River Knapweed Control Project. Unpublished Manuscript. USDA Forest Service, Pacific Southwest Region.

Beck, K.G. 2001. Russian knapweed. Fact sheet. Colorado State University Cooperative Extension, Natural Resources. Online resource. http://www.ext.colostate.edu/PUBS/NATRES/03111.html

Belnap, J. and S.L. Philips. 2001. Soil biota in an ungrazed grassland: response to annual grass (*Bromus tectorum*) invasion. Ecological Applications 11 (5): 1261-1275.

Berg, Neil. 2004. Assessment of Herbicide Best Management Practices: Status of Our Knowledge of BMP Effectiveness. Pacific Southwest Research Station. USDA FS, Albany, CA. http://www.fs.fed.us/r6/invasiveplant-eis/Region-6-Inv-Plant-Toolbox/#link05

Beschta, R.L. 1997. Riparian shade and stream temperature: An alternative perspective. Rangelands 19: 25-28.

Beyer, C. 2009. Biological Evaluation for Threatened, Endangered, and Sensitive Plants and Fungi, Terrestrial Invasive Plant Species Treatment Project, Lake Tahoe Basin.

Biocontrol Network. Updated December 12, 2005. Burnout II, Weed and grass killer. Online resource. http://www.biconet.com/lawn/burnout.html .

Bossard, Carla C., John M. Randall, and Marc C. Hoshovsky, eds. 2000. Invasive Plants of California's Wildlands. University of California Press, Berkeley and Los Angeles, CA. University of California Press, Ltd., London, England. 360 pp.

Bozek, M.A., and W.A. Hubert. 1992. Segregation of resident trout in streams as predicted by three habitat dimensions. Canadian Journal of Zoology, Vol 70: 886-890.

Bradford, D.F. 1983. Winterkill, oxygen relations, and energy metabolism of a submerged dormant amphibian. *Rana muscosa*. Ecology 64: 1171-1183.

Brady, N.C., and R.R. Weil. 1999. The nature and properties of soils. 12th Edition. 881 pp. Upper Saddle River, NJ: Prentice Hall.

CalFlora Occurrence Database (CNDDB). Ongoing. Electronic database. University of California Davis Project. University of California, Davis, CA.

California Department of Fish and Game. 2009. RAREFIND database. Electronic database managed by the Natural Diversity Data Base, Natural Heritage Division, California Department of Fish and Game. Sacramento, CA.

California Department of Food and Agriculture (CDFA). "Common St.Johnswort. " [Online] Available at: http://www.cdfa.ca.gov/phpps/ipc/weedinfo .

California Department of Food and Agriculture (CDFA). "Russian knapweed. " [Online] Available at: http://www.cdfa.ca.gov/phpps/ipc/weedinfo .

California Department of Pesticide Regulation (CDPR). Annual reports for pesticide use by county. [Online] Available at: http://www.cdpr.ca.gov (Accessed12/22/2009)

California Environmental Protection Agency (CalEPA), 1997. Public Health Goal for Glyphosate in Drinking Water. Pesticide and Environmental Toxicology Section; Office of Environmental Health Hazard Assessment. December, 1997. 14 pgs.

California Invasive Plant Council. Online resource. Interactive database. http://www.cal-ipc.org

Carpenter, Alan and Thomas Murray. 1998. Element stewardship abstract for *Acroptilon repens* (L.) DeCandolle *(Centaurea repens* (L.)) Russian knapweed. http://tncweeds.ucdavis.edu/esadocs/documents/acrorep.pdf

Carpenter, Alan and Thomas Murray. 1998. Element stewardship abstract for *Linaria genistifolia* ((L.) P. Miller ssp. *dalmatica* (L.) Maire & Petitmengin and *Linaria vulgaris* P. Miller. Dalmatian toadflax, broad-leaved toadflax and yellow toadflax, butter and eggs, wild snapdragon, common toadflax. http://tncweeds.ucdavis.edu/esadocs/documents/linadal.pdf

CEQ. 1997. Council on Environmental Quality, Executive Office of the President (CEQ). 1997. *Considering Cumulative Effects Under the National Environmental Policy Act.* January 1997.

Chandra, S., M.J. Vander Zanden, A.C. Heyvert, B.C. Allen and C.R. Goldman. 2005. The effects of cultural eutrophication on the energetics of lake benthos. Limnology and Oceanography 50: 1368–1376.

Choudhury, H.; J. Cogliano; R. Hertzberg; D. Mukerjee; G. Rice; L. Teuschler; E. Doyle; and R. Schoeny. 2000. Supplementary guidance for conducting Health Risk Assessment of chemical mixtures. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. 143 pp. + appendices.

Conrad, B. and A. Paris. 2004. Researcher Aids in Solution for Invasive Salt Cedar Plant. [On-line] Available at: http://www.ag.unr.edu/BCNR/News_Full_Story.aspx?StoryID=232 (Accessed 11/29/2009)

Cordone, A.J., T.C. Frantz. 1968. An evaluation of trout planting in Lake Tahoe. California Department of Fish and Game 54:68-69

Cornell University. Ongoing. Pesticide Management Education Program. http://pmep.cce.cornell.edu/ Electronic database. Cornell University. Ithaca, NY.

Crossman, N.D., B.A. Bryan, and D.A. Cooke. 2008. An Invasive Plant and climate Change Threat Index for Weed Risk Management: Integrating habitat Distribution Pattern and dispersal Process. Ecol. Indicat. (2008), doi: 10.1016/j.ecolind.2008.10.011.

Crouch, E.A.C., R. Wilson, and L. Zeise. 1983. The risks of drinking water. Water Resources Research 19 (6): 1359-1375.

DeLoach, C.J. Saltcedar Biological Control: Methodology, Exploration, Laboratory Trials, Proposals for Field Releases, and Expected Environmental Effects [On-line] Available at: http://www.invasivespeciesinfo.gov/docs/news/workshopSep96/deloach-cont.html (Accessed 11/29/2009)

DiTomaso, JM and DW Johnson. 2006. The Use of Fire as a Tool for Controlling Invasive Plants.

Dillingham, C. 2005. Conservation Assessment for *Meesia triquetra* (L.) Aongstr. (three-ranked hump-moss) and *Meesia uliginosa* Hedwig (broad-nerved hump-moss) in California with a focus on the Sierra Nevada Bioregion. USDA FS, internal document. 29pp.

Dost, Frank N. 1991. Declaration in the case of SRCC et al v. Robertson, U.S. District Court for the Southeast District of California, CIV. No. 91-217-DFL-PAN. Oct. 10, 1991. 24 pp.

Downs, James F. 1966. *The Two Worlds of the Washo: An Indian Tribe of California and Nevada*. Holt, Rinehart and Winston, New York.

Downie, D. 2010. Soils Report for the Terrestrial Non-native Invasive Plants Species Treatment Project, Lake Tahoe Basin.

Duncan, C.A., J.J. Jachetta, M.L. Brown, V.F. Carrithers, J.K. Clark, J.M. DiTomaso, R.G. Lym, K.C. McDaniel, M.J. Renz, and P.M. Rice. 2004. Assessing the Economic, Environmental, and Societal Losses from Invasive Plants on Rangeland and Wildlands. Weed Technology 18:1411-1416.

Eaglin, G.S. and W.A. Hubert. 1993. Effect of logging and roads on substrate and trout in streams of the Medicine Bow National Forest, Wyoming. North American Journal of Fisheries Management 13:844-846.

Ehrenfield, J.G., Kourtev, P., and W. Huang. 2001. Changes in soil functions following invasions of exotic understory plants in deciduous forests. Ecological Applications 11(5): 1287-1300.

Ekschmitt, E.K., Kandeler, E., Poll, C., Brune, A., Buscot, F., Friedrich, M., Gleixner, G., Hartmann, A., Kästner, M., Marhan, M., Miltner, A., Scheu, S., and V. Wolters. 2008. Soil-carbon preservation through habitat constraints and biological limitations on decomposer activity. J. Plant Nutr. Soil Sci. 2008, 171, 27–35

El Dorado County Noxious Weed Projects. 2008. [On-line] Available at: http://www.cdfa.ca.gov/phpps/IPC/weedmgtareas/pdf/08/wma08_supplemental_eldorado.pdf (Accessed 12/5/2009)

Entrix, Inc. 2009. Noxious Weed Risk Assessment for the Upper Truckee River Sunset Stables Restoration Project on the Lake Tahoe Basin Management Unit. USFS internal document. 21 pp.

Environment, Health and Safety On-Line. [On-line] Available at: http://www.ehso.com/pesticides.htm Accessed 1/16/2010.

EPA. Pesticide Fact Sheet: Aminopyralid. 2005. United States Office of Prevention,

Pesticides Environmental Protection and Toxic Substances Agency (7501C). August 10, 2005. Available at: http://www.epa.gov/opprd001/factsheets/aminopyralid.htm

EPA. Pesticide Fact Sheet: Chlorsulfuron. 2005. United States Office of Prevention, RED Facts. Available at: http://www.epa.gov/oppsrrd1/reregistration/REDs/factsheets/chlorsulfuron_factsheet.pdf

EPA. Pesticide Fact Sheet: Glyphosate. United States Office of Prevention, RED Facts. Available at: http://www.epa.gov/ogwdw000/pdfs/factsheets/soc/tech/glyphosa.pdf

EPA. Pesticide Fact Sheet: Triclopyr. 1998. United States Office of Prevention, RED Facts. Available at: http://www.epa.gov/oppsrrd1/REDs/factsheets/2710fact.pdf

Erman, D.C. 1986. Long-term changes of fish populations in Sagehen creek, California. Trans. Am. Fish. Soc. 115:682-692.

Evans, R. D., Rimer, R., Sperry,L., and J. Belnap. 2001. Exotic plant invasion alters nitrogen dynamics in an arid grassland. Ecological applications, 11(5), 2001, pp. 1301–1310

ExToxNet Database. [On-line] Electronic database. Available at: http://ace.ace.orst.edu/info/extoxnet/ University of California Berkeley Digital Library Project. University of California, Berkeley, CA.

Fausch, K. D., and R. J. White. 1981. Competition between brook trout (Salvelinus fontinalis) and brown trout (Salmo trutta) for positions in a Michigan stream. Canadian Journal of Fisheries and Aquatic Sciences 38:1220–1227.

Fowler, C.S. and J.E. Bath. 1981. Pyramid Lake Northern Paiute Fishing: The Ethnographic Record. Journal of California and Great Basin Anthropology

Frantz, T.C., and A.J. Cordone. 1970. Food of Lake Trout in Lake Tahoe. California Fish and Game 56:21-35.

Frazier, JW., S.L.Grant 2003. Water Quality Monitoring for Herbicide Residue, Stanislaus National Forest, 1995-2002. Unpublished Report on File at USDA Forest Service, 2545 Greenley Dr. Sonora, CA. June 2003.

Furnish, J. 2005. Sensitive aquatic mollusks of the US Forest Service Pacific Southwest Region. US Forest Service, Pacific Southwest Region, Vallejo, CA.

Ganapathy C. 1997. Environmental Fate of Triclopyr. January 1997.

Gerstung, E.R. 1988. Status, life history, and management of Lahontan

cutthroat trout. American Fisheries Society Symposium 4:93-106.

Gluesenkamp, D. 2009. A cost-effective approach to controlling invasive plants. CNPS Bulletin (39) 4: p.1.

Goodwin, K. and R. Sheley. 2006. Protecting Prioritized Rangelands from Invasive Weed Spread. Montana State U.

Guiliani, Derham. March 1990. Eastern Sierra Nevada Salamander Survey, Part II. Final Report, Contract No. FG 8450 for California Department of Fish and Game.

Harris, J. 2009. Hydrologist Specialist Report, Terrestrial Invasive Plant Species Treatment Project, LTBMU.

Harvey, B.C., and A. J. Stewart. 1991. Fish size and habitat depth relationships in headwater streams. Oecologia (1991) 87:336-342.

Herbicides for weed and brush control in natural areas. [On-line] Available at: http://www.ipaw.org/herbicides.htm Accessed 12/28/2009.

Hershler, Robert. 1989. Springsnails (Gastropoda: Hydrobiidae) of Owens and Amargosa River (Exclusive of Ash Meadows) Drainages, Death Valley System, California-Nevada. Proceedings of the Biological Society of Washington: 102(1). pp 176-248.

Hickman, J.C., ed. 1993. The Jepson manual: higher plants of California. University of California Press, Berkeley and Los Angeles, CA. 1400 pp.

Inventory of Rare and Endangered Plants [online] Available at: http://cnps.site.aplus.net/cgi-bin/inv/inventory.cgi (Accessed 11/13/2009)

Jacobs, J. Ecology and Management of Oxeye Daisy [On-line] Available at: http://www.msuextension.org/ruralliving/Dream/PDF/oxeye.pdf Accessed 11/29/2009.

Johnson, S.L. 2004. Factors influencing stream temperatures in small streams: substrate effects and a shading experiment. Canadian Journal of Fish Aquatic Sciences 61:913-923.

Kadrmas, T. and W. Johnson. 2009. "Managing Scotch Thistle." Cooperative Extension, U Nevada, Reno.

Kamerath, M., S. Chandra and B.C. Allen. 2008. Distribution and impacts of warm water invasive fish in Lake Tahoe, USA. Aquatic Invasions 3(1):35-41.

Kauneckis, D., L. Koziol, M. Imperial. 200. Tahoe Regional Planning Agency: The Evolution of Collaboration. School of Public and Environmental Affairs, Indiana University, Bloomington IN. 97 pp.

Kegley, S.E., Hill, B.R., Orme S., Choi A.H. 2009. PAN Pesticide Database, Pesticide Action Network, North America (San Francisco, CA, 2009), http://www.pesticideinfo.org.

Knapp, R.A. and K.R. Matthews. 2000. Non-native fish introductions and the decline of the mountain yellow-legged frog from within protected areas. Conservation Biology 14: 428-438.

Kyser, G., Roncoroni, J., and R. Wilson. Chemical Application Methods for Herbaceous Weeds. [On-line] Available at: http://ceeldorado.ucdavis.edu/files/65228.pdf Accessed 12/28/2009.

LeBlanc, John W. 2001. Getting a handle on broom – Scotch, French, Spanish, and Portuguese brooms in California. Publication 8049. University of California, Agriculture and Natural Resources. Oakland, CA http://anrcatalog.ucdavis.edu.

LRWQCB. 1995. Water Quality Control Plan for the Lahontan Region. State of California Regional Water Quality Control Board, Lahontan Region.

Lynch, J.A., Rishel G.B., and Corbett, E.S. 1984. Thermal alterations of streams draining clearcut watersheds: quantification and biological implications. Hydrobiologia, 111: 161-169.

Mahler, R.L., Homan, H.W. and G.P. Carpenter. 2002. Pesticides and their movement in soil and water. University of Idaho. Current Information Series 865. Moscow, ID. http://www.uidaho.edu/wq/wqpubs/cis865.html

Managing Invasive Plants. [On-line] Available at: http://www.fws.gov/invasives/staffTrainingModule/methods/biological/practice.html#part1 (Accessed 12/30/2009).

Mangum, F. A. 1991. Aquatic ecosystem inventory; macroinvertebrate analysis. Annual progress report, Inyo National Forest 1989. Fisheries files, Supervisor's Office, Inyo National Forest, Bishop, CA.

McConnell, L., J. LeNoir, S. Datta, J. Seiber. 1998. Wet Deposition of Current Use Pesticides in the Sierra Nevada Mountain Range, California, USA. *Environmental Toxicology and Chemistry*, 17(10) 1908-1916.

Moonshineink. 2009. "Boca Hill Weed Day." [On-line] Accessed at: http://moonshineink.com/archives.php/49/730

Moyle, P. B. 2002. Inland fishes of California, revised and expanded. University of California Press, Berkeley, California, USA.

Muzika, Rose-Marie, and Jil M. Swearingen. 2006. Salt cedar. Salt cedar fact sheet, Native Plant Conservation Initiative Alien Plant Working Group.

Obtained electronically: http://www.nps.gov/plants/alien/fact/tama1.htm. Referenced in 2006; no date on webpage.

National Academy of Sciences (NAS). 1993. Pesticides In the Diets of Infants and Children. National Academy Press. Washington, D.C.

National Research Council (NRC). 1983. Risk assessment in the Federal Government: Managing the Process. National Academy Press. Washington, D. C. No. 20647. 99 pp.

Natural Resource Information System. [Online] Available at: http://fsweb.nris.fs.fed.us/

NEPA for Invasive Plant Control [On-line] Available at: www.fs.fed.us/r6/invasiveplant.../biocontrols-not-meet-Std14_2009.doc Accessed 12/30/2009.

North Dakota Department of Agriculture. Date unknown. Online resource. www.agdepartment.com/noxiousweeds/pdf

Norton, J.B., T.A. Monaco, J.M. Norton, D.A. Johnson, and T. A. Jones. 2004. Soil morphology and organic matter dynamics under cheatgrass and sagebush-steppe plant communities. Journal of Arid Environments 57:445-466.

Perkins, P.J., Boermans, H.J., and Stephenson, G.R. 2000. Toxicity of Glyphosate and Triclopyr Using the Frog Embryo Teratogenesis Assay - *Xenopus*. Environmental Toxicology and Chemistry. 19 (4): 940-9454.

Pope, K.L. 1999. Mountain yellow-legged frog habitat use and movement patterns in a high elevation basin in Kings Canyon National Park. Master's thesis, California Polytechnic State University, San Luis Obispo.

Powers, J.B. 1950. Klamath Weed: Imported beetles promising as part of general control program. [On-line] Available at: http://ucce.ucdavis.edu/files/repositoryfiles/ca205p12-71217.pdf (Accessed 12/5/2009)

Pauchard, A., C. Kueffer, H. Dietz, C.C. Daehler, J. Alexander, P.J. Edwards, J.R. Arevalo, L.A. Cavieres, A. Guisan, S. Haider, G. Jakobs, K. McDougall, C. I Millar, B.J. Naylor, C.G. Parks, L.J. Raw, and T. Seibel. 2009. Isn't no mountain high enough: plant invasions reaching new elevations. Frontiers in Ecology and the Environment. (7) [Online] Available at: http://www.treesearch.fs.fed.us/pubs/31764

Perkins, P.J., H.J. Boermans, and G.R. Stephenson. 2000. Toxicity of Glyphosate and Triclopyr Using the Frog Embryo Teratogenesis Assay - *Xenopus*. Environmental Toxicology and Chemistry. 19 (4): 940-9454.

Pope, K.L. 1999. Mountain yellow-legged frog habitat use and movement patterns

in a high elevation basin in Kings Canyon National Park. Master's thesis, California Polytechnic State University, San Luis Obispo.

Quigley, T.M. 1981. Estimating Contribution of Overstory Vegetation to Stream Surface Shade . Wildlife Society Bulletin 9:22-27.

Radosevich, S. In: *CIPM Online Invasive Plant Management Textbook* Available at: http://www.weedcenter.org/textbook/pdf_toc.html (Accessed 11/21/2009)

Reed, C. 2009. 2009 Annual Invasive Weed Report for the Lake Tahoe Basin Management Unit. USFS internal document. 21 pp.

Reed, C. 2009. 2008 Annual Invasive Weed Report for the Lake Tahoe Basin Management Unit. USFS internal document. 26 pp.

Reed, C. 2008. 2007 Annual Invasive Weed Report for the Lake Tahoe Basin Management Unit. USFS internal document. 11 pp.

Reed, C. 2007. 2006 Annual Invasive Weed Report for the Lake Tahoe Basin Management Unit. USFS internal document. 8 pp.

Relyea, Rick A. 2005. The lethal impacts of Roundup and predatory stress on six species of North American tadpoles. Archives of Environmental Contamination and Toxicology. 48 (3): 351-357.

Relyea RA, and Jones D.K. 2005. The Toxicity of Roundup Original Max ® To 13 Species of Larval Amphibians. Environmental Toxicology and Chemistry. 28 (9): 2004-2008.

Renz, M.J. 2005. Perennial pepperweed, *Lepidium latifolium* L. Alaska Natural Heritage Program, Environment and Natural Resources Institute, University of Alaska Anchorage. http://akweeds.uaa.alaska.edu/pdfs/potential_species/bios/Species_bios_LELA.pdf

"Risk Assessments." Available at: http://www.fs.fed.us/foresthealth/pesticide/risk

Roth, J., T.C. Thayer, J.T. Gallagher, B. Brenneman, P.N. Manley, A.J. Lind and L.A.Campbell. 2007. Multi-species inventory and monitoring: a foundation for comprehensive biological status and trend monitoring in the Lake Tahoe Basin. Final Report for: USDA Forest Service, Lake Tahoe Basin Management Unit.

Rowe, H.I., Brown, C.S., and M. W. Paschke. 2008. The Influence of Soil Inoculum and Nitrogen Availability on Restoration of High-Elevation Steppe Communities Invaded by *Bromus tectorum* Restoration Ecology Vol. 17, No. 5, pp. 686–694

Rueppel, M.L., B.B. Brightwell, J., J. Schaefer, and J.T. Marvel. 1977. Metabolism and degradation of Glyphosate in soil and water. Journal of Agricultural and Food Chemistry 25: 517-528.

Ryan, Maria. 1998. Perennial pepperweed (*Lepidium latifolium*) in southern Nevada. University of Nevada Cooperative Extension. Reno, NV. www.unce.unr.edu/tallwhitetop/

Saucedo, G. J. 2005. Geologic Map of the Lake Tahoe Basin, California and Nevada. Regional Geologic Map Series. California Geological Survey. 1:100,000 Scale, Map No. 4. Sacramento, CA.

Segawa, R., C. Ando, A. Bradley, J. Walters, R. Sava, C. Gana, K. Goh. 2001. Dissipations and Off-site Movement of Forestry Herbicides in Plants of Importance to California Tribes. California Department of Pesticide Regulation. 11 pp.

SERA (Syracuse Environmental Research Associates, Inc.) 2007b. Aminopyralid (Milestone) – Human Health and Ecological Risk Assessment Final Report. June 28, 2007. SERA TR-052-04-04a. Fayetteville, New York. 231 pp.

SERA (Syracuse Environmental Research Associates, Inc.) 2007a. Preparation of Environmental Documentation and Risk Assessments for the USDA/Fore Service. January 21, 2007. SERA MD 2007-01a. 147 pp.

SERA 2006 Human Health and Ecological Risk Assessment for Borax (Sporax). Final Report. SERA TR 04-43-21/06-30-12b. (Syracuse Environmental Research Associates, Inc.). February 24, 2006.

SERA (Syracuse Environmental Research Associates, Inc.) 2004a. Chlorsulfuron - Human Health and Ecological Risk Assessment – Final Report. November 21, 2004. SERA TR 04-43-18-01c. Fayetteville, New York. 180 pp.

SERA (Syracuse Environmental Research Associates, Inc.) 2003b. Triclopyr – Revised Human Health and Ecological Risk Assessments – Final Report. March 15, 2003. SERA TR 02-43-13-03b. Fayettesville, New York. 264 pp.

SERA (Syracuse Environmental Research Associates, Inc.) 2003a. Glyphosate – Human Health and Ecological Risk Assessment Final Report. March 1, 2003. SERA TR 02-43-09-04a. Fayettesville, New York. 281 pp.

SERA (Syracuse Environmental Research Associates, Inc.) 2002. Neurotoxicity, immunotoxicity, and endocrine disruption with specific commentary on Glyphosate, Triclopyr, and Hexazinone: final report. Prepared by P. Durkin, G. Diamond. February 14, 2002. SERA TR 01-43-08=04a. 68pp.

SERA (Syracuse Environmental Research Associates, Inc.) 2001. Documentation for the Use of GLEAMS and Auxiliary Programs in Forest Service Risk Assessments. July 6, 2001. SERA AT 2001-01b. 25pp.

SERA (Syracuse Environmental Research Associates, Inc.) 1998. A reevaluation of Methods for Assessing Occupational Exposure in Pesticide Applicators. SERA TR 98-21-08-01d2. May 18, 1998. 45 pp.

SERA (Syracuse Environmental Research Associates, Inc.) 1997b. Use and assessment of marker dyes used with herbicides. December 21, 1997. SERA TR 96-21-07-03b. 47 pp.

SERA 1997a. Effects of Surfactants on the Toxicity of Glyphosate, with specific Reference to RODEO. SERA TR 97-206-1b. Syracuse Environmental Research Assoc., Inc. Fayetteville, New York. February 6, 1997.

SERA (Syracuse Environmental Research Associates, Inc.) 1996b. Selected Commercial Formulations of Triclopyr – Garlon 3Z and Garlon 4- Risk Assessment. Final Report. March 31, 1996. SERA TR 95-22-02-02a. 163 pp.

SERA (Syracuse Environmental Research Associates, Inc.) 1996a. Selected Commercial Formulations of Glyphosate – Accord, Rodeo, and Roundup. Risk Assessment. Final Report. March 20, 1996. SERA TR 96-22-02-01b. 159 pp.

Servizi, J.A., R.W. Godon, and D.W. Martens. 1987. Acute toxicity of Garlon 4 and Roundup herbicides to salmon, *Daphnia*, and trout. Bull. Environ. Contam. Toxicol. 39:15-22

Sheley, Roger L. and Janet K. Petroll, eds. 1999. Biology and management of noxious rangeland weeds. Oregon State University Press, Corvallis OR. 438 pp.

Skinner, M.W. and B.M. Pavlik, eds. 1994. Inventory of rare and endangered vascular plants of California. California Native Plant Society Special Publication No. 1 (Fifth Edition). California Native Plant Society, Sacramento, CA. 338 pp.

Smith, H.A., Johnson, W.S., Shonkwiler, J.S., and S. R. Swanson. 1999. The implications of variable or constant expansion rates in invasive weed infestations. Weed Science 47: 62-66.

South Fork Salmon River (SFSR) SubBasin Noxious and Invasive Weed Management Program. [On-line] Available at: http://www.fs.fed.us/r4/payette/publications/sf_weed_mgt/sf_weed_chap2.pdf (Accessed 12/30/2009).

Stephans, W.J. 2008. Agricultural Crop and Livestock Report El Dorado and Alpine Counties. [On-line] Available at: http://www.co.el-dorado.ca.us/ag/cropreport/2008CropReport.pdf (Accessed 12/5/2009)

Swift L.W. and Messer, J.B. 1971. Forest cutting raise temperatures of small streams in the Southern Appalachians. J. Soil Water Conservation 26:111-116.

Tesky, Julie L. 1992. *Tamarix ramosissima*. In: Fischer, William C., compiler. The Fire Effects Information System [Database]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Trumbo, J. 2005. California Dept. Fish & Game, Rancho Cordova, CA. An Assessment of the Hazard of a Mixture of the Herbicide Rodeo® and the Non-Ionic Surfactant R-11® to Aquatic Invertebrates and Larval Amphibians. Environmental Toxicology and Chemistry. 91 (1): 38-46.

Tu, Mandy. 2004. Waipuna Hot Foam System. The Nature Conservancy. Global Invasive Species Initiative. http://www.invasive.org/gist/tools/hotfoam.html

Tu, Mandy, Callie Hurd, and John M. Randall. 2001. Weed control methods handbook: tools and techniques for use in natural areas. Wildland Invasive Species Program. The Nature Conservancy. http://www.invasive.org/gist/handbook.html

USDA Forest Service. 2009. Climate Change Resource Center. PNW-GTR 789. [On-line] Available at: http://www.fs.fed.us/ccrc/ (Accessed 12/21/2009)

…… 2007. Regional Forester's Letter (dated Feb 5, 2007): This letter provided clarification to Forest Supervisors on the appropriate use of the R5 Soil Management Handbook Supplement (R5 FSH Supplement 2509.18-95-1).

----------. 2007. Analysis of Issues surrounding the use of spray adjuvants with herbicides. Unpublished report, written by David Bakke, pacific Southwest Regional Pesticide-Use Specialist. Revised January, 2007. 61 pp.

…… 2005. Preventing and managing invasive plants Environmental Impact Statement. Forest Service Region 6, Portland Oregon. Available at: http://www.fs.fed.us/r6/invasiveplant-eis/

----------. 2005b. Summary of herbicide effects to wildlife (Draft). Appendix B. Summary of herbicide effects. Preventing and managing invasive plants Environmental Impact Statement. Forest Service Region 6, Portland Oregon. Available at http://www.fs.fed.us/r6/invasiveplant-eis/

----------. 2005c. Fire Vegetation Management Project. Environmental Impact Statement. February 2005.

----------. 2004a. Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement – Record of Decision, U.S.D.A. Forest Service, Pacific Southwest Region, R5-MB-046, Vallejo, CA. 55 pages plus various appendices.

----------. 2004b. National Strategy and Implementation Plan for Invasive Species Management. FS-805. Washington D.C. 17 pp.

----------. 2003 Herger-Feinstein Quincy Library Group Final Supplemental Environmental Impact Statement. July 2003. 406 pp.

----------. 2001a. Pacific Southwest Region: Noxious Weed Strategy and Plan; http://fsweb.r5.fs.fed.us/unit/nrm/range.htm

----------. 2001b. A review and assessment of the results of water monitoring for herbicide residues for the years 1991 to 1999, USFS Region 5. Unpublished report. 27 pp.

----------. 2000. Water Quality Management for National Forest System Lands in California – Best Management Practices. Pacific Southwest Region, Vallejo, California.

----------. 1994. Neotropical Migratory Bird Reference Book. Volume 1. USDA- Forest Service, San Francisco, CA.

----------. 1999. Environmental Assessment, Noxious Weed Control Program, Humboldt-Toiyabe National Forest, Austin, Bridgeport, Carson and Tonopah Ranger Districts and Spring Mountains National Recreation Area. USDA-Forest Service, Sparks, NV. 39 pp.

----------. 1999. Stemming the Invasive Tide: Forest Service Strategy for Noxious and Nonnative Invasive Plant Management. Washington D.C. 31 pp.

----------. 1998. Regional Forester's Sensitive Species List. Region 5.

----------. 1996. Programmatic Agreement Among the U.S.D.A. Forest Service, Pacific Southwest Region, California State Historic Preservation Officer, and Advisory Council on Historic Preservation Regarding the Identification, Evaluation, and Treatment of Historic Properties Managed by the National Forests of the Sierra Nevada, California. Manuscript on file, Inyo National Forest Supervisors Office, Heritage Resources Program, Bishop, CA.

----------. 1995. Forest Service Handbook 2509.18 Soil Management Handbook. R5 Supplement No. 2509.18-95-1. U.S.D.A. Forest Service, Pacific Southwest Region, San Francisco, CA.

----------. 1994. Neotropical Migratory Bird Reference Book. Volume 1. USDA- Forest Service, San Francisco, CA

----------. 1989. Final Environmental Impact Statement – Vegetation Management for Reforestation. Pacific Southwest Region. Vallejo, CA.

----------. 1988. Land and Resource Management Plan for the Lake Tahoe Basin Management Unit.

----------. 1984. Pesticide Background Statements: Volume 1. Herbicides. Agriculture handbook 633. Washington, D.C.

USDA NRCS 2007. Soil survey of the Lake Tahoe Basin Area, California and Nevada. [online] Accessible at http://soils.usda.gov/survey/printed_surveys/

USDI BLM. Invasive Species. [On-line] Available at: http://www.blm.gov/wo/st/en/res/Education_in_BLM/Learning_Landscapes/For_Kids/homework_helpers/invasive_species.html (Accessed 12/18/2009)

U.S. EPA. (Environmental Protection Agency) 2006. 2006 Edition of the Drinking Water Standards and Health Advisories. EPA 822-R-06-013. Summer 2006. Office of Water. 18pp. Accessed on-line at http://www.epa.gov/waterscience/drinking/standards/dwstandards.pdf On 10/25/2006.

U.S. EPA. (Environmental Protection Agency) 2005. Aminopyralid, Pesticide Tolerance. August 10, 2005. Federal Register 70 (153): 46419-46428.

U.S. EPA. (Environmental Protection Agency) 2002a. Triclopyr; Pesticide Tolerance. September 18, 2002. Federal Register 67 (181):58712-58725.

U.S. EPA. (Environmental Protection Agency) 2002e. Chlorsulfuron; Pesticide Tolerance. August 14, 2002. Federal Register 67 (157):52866-52873.

U.S. EPA. (Environmental Protection Agency) 2002f. Notice of Filing a Pesticide Petition to Establish a Tolerance for a Certain Pesticide Chemical in or on Food. March 8, 2002. Federal Register 67 (46):10722-10727.

U.S. EPA. (Environmental Protection Agency) 2000a. Notice of Filing of Pesticide (Glyphosate) Petition. July 25, 2000. Federal Register. 65(143):45769-45773.

U.S. EPA. (Environmental Protection Agency) 2000b. Gyphosate; Pesticide Tolerance. September 27, 2000. Federal Register. 65(188):57957-57966.

U.S. EPA. (Environmental Protection Agency) 1999. Notice of Filing of Pesticide (clopyralid) Petitions. February 9, 1999. Federal Register. 64(26):6351-6357.

U.S. EPA. (Environmental Protection Agency) 1998. Reregistration Eligibility Decision (RED) – Triclopyr. U.S. EPA 738-R-98-011. October 1998. 285pp.

U.S. EPA. (Environmental Protection Agency) 1993. Reregistration Eligibility Decision (RED) – Glyphosate. U.S. EPA 738-R-93-014. September 1993. 291 pp.

U.S. EPA. (Environmental Protection Agency) 1986. Guidelines for the health risk assessment of chemical mixtures. Federal Register. 51((1850:3414-3425) September 24, 1986.

USFWS. 2009. [On-line] LTBMU TEPC list. Available at: http://www.fws.gov/sacramento/es/spp_lists/NFFormPage.htm, accessed 1/1/2010.

USFWS (US Fish and Wildlife Service. 1995. Lahontan cutthroat trout (*Oncorhuynchus clarkihenshawi*) recovery plan. Portland, OR.

Utahweed.org. "Squarrose Knapweed" [On-line] Available at: http://www.utahweed.org/weed_squarrose.htm (Accessed 11/29/2009)

Vander Zanden, J., S. Chandra, B.C. Allen, J.E. Reuter, and C.R. Goldman. 2003. Historical Food Web Structure and Restoration of Native Aquatic Communities in the Lake Tahoe (California-Nevada) Basin. Ecosystems 6: 274-288.

Veloz, S., B. Anacker, and H. Safford. 2008. Tahoe Science Research Update: Predictive modeling of cheatgrass invasion risk for the Lake Tahoe Basin. [Online] Available at: http://www.fs.fed.us/psw/partnerships/tahoescience/modeling_cheatgrass.shtml

Vivanco, J.M., Bais, H.P., Stermitz, F.R., Thelen, G.C., and R. M. Callaway. 2004. Biogeographical variation in community response to root allelochemistry: novel weapons and exotic invasion. Ecology Letters, (2004) 7: 285–292

Vredenburg, V.T., G.M. Fellers, and C. Davidson. 2005. Mountain Yellow-legged Frog. (species account). Pp. 563-566 In Amphibian Declines, Lannoo, M. (Ed.). University of California Press, Berkeley, California, USA.

Washington State Department of Transportation. 2006. Chlorsulfuron Roadside Vegetation Management Herbicide Fact Sheet. Developed by Oregon State University and Intertox, Inc. February 2006.

Whitson, T.D., L.C. Burrill, S.A. Dewey, D. W. Cudney, B.E. Nelson, R.D. Lee, R. Parker, 1996. Weeds of the West. Western United States Land Grant Universities and the Western Society of Weed Science, Newark, CA. Univ. of WY, Jackson, WY. 630 pp.

Wiesenborn, William D. 1996. Salt cedar impacts on salinity, water, fire frequency, and flooding. Salt cedar Management Workshop. USFWS National Wildlife Refuge System. June 12, 1996. http://refuges.fws.gov/NWRSFiles/HabitatMgmt/PestMgmt.../Paper2.htm

Williams, Gary, R. Kroes, I. Munro. 2000. Safety evaluation and risk assessment of the herbicide Roundup and its active ingredient, Glyphosate, for humans. *Regulatory Toxicology and Pharmacology31, pages 117-165.*

Wolkovich, E. M., Bolger, D. T., and K.L. Cottingham. 2009. Invasive grass litter facilitates native shrubs through abiotic effects. Journal of Vegetation Science 20: 1121–1132.

Young, I.A., Blanchart, E., Chenu, C., Dangerfield, M., Fragoso, C., Grimaldi, M., Ingram, J., and L.J. Monrozier. 2008. The interaction of soil biota and soil structure under global change. Global Change Biology (1998) 4, 703–712.

Young, James A. and Charlie D. Clements. 2009. Cheatgrass, Fire and Forage on the Range. U Nevada Press, Reno. 348pp.

Young, James A., Debra E. Palmquist, Robert S. Blank and Charles E. Turner. 1995. Ecology and control of perennial pepperweed (*Lepidium latifolium* L.). California Exotic Pest Plant Council Symposium. 1995. http://www.caleppc.org/symposia/95symposium/young2.html

Zeise, Lauren, R. Wilson, and E. Crouch. 1984. Use of acute toxicity to estimate carcinogenic risk. Risk Analysis 4 (3):187-199.

Zweifel, R. G. 1955. Ecology, distribution, and systematics of frogs of the *Rana boylii* group. Univ. of California Publ. Zool. 54:207-292.
Akweeds. Online resource. Online summaries for several weed species from University of Alaska; individual authors not listed. [On-line] Available at: http://akweeds.uaa.alaska.edu/ Accessed 12/28/2009

Appendix A. Method for Adding New TIPS[11]

Plant Species Being Considered	Yes = 1, No = 0
Factor*	
Mode of Reproduction	
Reproduces vegetatively	
Produces large number of seeds per plant	
Seeds are long-lived	
Plants are long-lived	
Spread	
Likely to disperse great distances	
Spread is highly associated with human activities	
Sold in nurseries	
Likely to hybridize	
Grows across a variety of ecosystems	
Has allelopathic properties	
Invades intact plant communities	
Invades riparian areas, streams and meadows	
High rate of spread	
Control	
Difficult to control	
Geographic distribution and priority	
Listed as noxious in adjacent states	
Present in adjacent states	
Populations located within 50 miles of Basin	
Already present in target area	

[11] This sheet was developed by the Lake Tahoe Basin Weed Coordinating Group, and is still in draft form. It is presented here as the best method for quantifying this qualitative process.

Existing populations are small in size and distribution	
Impacts[12]	
Injurious to humans, livestock, or wildlife	
Damages stream environment zones or water quality	
Impacts abiotic ecosystem process (e.g. fire, erosion, salinity)	
Reduces water availability	
Greatly reduces habitat for native species (e.g. wildlife, fisheries, plants)	
TOTAL SCORE	

* *A high score would result in a high priority rating.*

[12] Scoring for 'Impacts' would be obtained from scientific literature and the Cal-IPC website for wildlands.

Appendix B. Monitoring Strategy

An essential element of invasive plant management is observing changes in their populations over time, monitoring. This helps to determine the effectiveness of the treatments. Through the Forest Service Natural Resource Manager Natural Resource Inventory System (NRM NRIS) Invasives program (http://fsweb.nris.fs.fed.us/), the nationally accepted protocol that provides a consistent system for managing invasives information within the Forest Service, TIPS would be treated and monitored every year until eradicated.

Thereafter, as funding and personnel are available, the sites would be monitored for an additional 3 years. This follow-up monitoring is important because of the viability of seeds in the soil, known as the seedbank. Seeds can remain viable for many years, leaving past sites vulnerable to reinfestation and subsequent spread until rediscovery at some future date, if not monitored.

NRM NRIS Invasives monitoring is not a mitigation measure or a requirement intended to reduce environmental consequences; they are elements of an adaptive management scheme designed to allow us to respond to changing conditions and new information.

Implementation Monitoring

Implementation monitoring asks the question: Has the project been implemented as designed? The project manager will select random sites to visit to accomplish this monitoring and a record would be kept in a daily diary.

Appendix C. Regional BMP Handbook*

BMP#	Description	Applicable Design Feature (section3.2)
5-7	Pesticide Use Planning Process Incorporation of BMPs # 5-8 through 5-13 into project design and management.	All
5-8	Pesticide Application According to Label Directions and Applicable Legal Requirements Constraints identified on the label and other legal requirements of application must be incorporated into the project plans and contracts.	7, 25, 26, 28, 32
5-9	Pesticide Application Monitoring and Evaluation The need for a monitoring plan will be identified during the pesticide use planning process as part of the project environmental evaluation and documentation.	27
5-10	Pesticide Spill Contingency Planning Pesticide spill contingency plan consists of predetermined actions to be implemented in the event of a pesticide spill.	29, 30, 31
5-11	Cleaning and Disposal of Pesticide Containers and Equipment The cleaning and disposal of pesticide containers must be done in accordance with Federal, State, and local laws, regulations and directives.	7, 30
5-12	Streamside Wet Area Protection During Pesticide Spraying (spraying is not proposed in SEZs for this project) To minimize the risk of pesticide inadvertently entering waters or altering the riparian area, SMZ or wetland.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
5-13	Controlling Pesticide Drift During Spray Application Spraying according to prescription which accounts for all site specific factors and pesticide application methods.	1, 2, 3, 4, 34, 35,

*Design Features presented in section 3.2 provide specificity to BMPs.

Reference: Water Quality Management for Forest System Lands in California, Best Management Practices

Appendix D. Glossary

Acronyms

ACSO: Aquatic Conservation Strategy Objective

AE: Acid equivalent

AI: Active ingredient

AEL: Adverse-effect level

BA/BE: Biological Assessment/ Biological Evaluation

BMP: Best Management Practice

BMPEP: Best Management Practices Evaluation Program

BCF: Bioconcentration factor

CAR: Critical Aquatic Refuge

CATs: Californians for Alternatives to Toxics

CDFG: California Department of Fish and Game

CWE: Cumulative Watershed Effects

CWHR: California Wildlife Habitats Relationships System

DFC: Desired future condition

DHS: (California) Department of Health Services

DPR: (California) Department of Pesticide Regulation

DPS: Distinct population segments

DWEL: Drinking water equivalent level

EA: Environmental assessment

EC50: Effect concentration where 50% shows an effect

EDRR: Early Detection Rapid Response

EPA: Environmental Protection Agency

ESA: Endangered Species Act

FSS: Forest Service Sensitive

GIS: Geographic information system

g: gram

gpa: gallons per acre

HQ: Hazard quotient

IWM: Integrated Weed Management

kcal/g: Kilocalories per gram

L: Liter

LC50: Lethal concentration for 50% of population

LCT: Lahontan cutthroat trout

LD50: Lethal dose for 50% of population

LOAEL: Lowest observed adverse effects level

LOEC: Lowest observable effect concentration

LOEL: Lowest observed effects level

LOP: Limited Operating Period

LTBMU: Lake Tahoe Basin Management Unit

MCL: Maximum contaminant level

meq/l: milliequivalents per liter

mg/kg: milligrams per kilogram

Mg/L: Milligrams per liter

MIS: Management Indicator Species

MRL: Minimal risk level

NEPA: National Environmental Policy Act

NF: National forest

NFS: National Forest System

NFMA: National Forest Management Act

TIPS: Terrestrial Invasive Plant Species

NOAEL: No observed adverse effects level

NOEC: No observed effects concentration

NOEL: No observed effects level

NPE: Nonylphenol polyethoxylate

NPS: National Park Service

NTMB: Neotropical migratory bird

NTU: Nephelometric turbidity Units

PH: Acidity

PAC: Protected Activity Center

PFC: Proper functioning condition

POEA: polyoxyethylamine surfactant

ppb: Parts per billion

PPE: Personal Protective Equipment

ppm: Parts per million

RfD: Reference dose

RCA: Riparian Conservation Area

RCO: Riparian conservation objective

ROD: Record of Decision

RWB: Regional Water Board

SEZ: Stream environment zone

SERA: Syracuse Environmental Research Associates

SNFPA: Sierra-Nevada Forest Plan Amendment

SNYLF: Sierra Nevada yellow-legged frog

SOHA: Spotted Owl Habitat Area

TBRIT: Tahoe Basin Recovery Implementation Team

TES: Threatened and endangered species

TOC: Threshold of concern

TRPA: Tahoe Regional Planning Agency

UF: Uncertainty factor

ug: microgram

USDA: United States Department of Agriculture

USFS: United States Forest Service

USFWS: United States Fish and Wildlife Service

Definitions

Absorption: The process by which the agent is able to pass through the body membranes and enter the bloodstream. The main routes by which toxic agents are absorbed are the gastrointestinal tract, lungs, and skin.

Acid equivalent (a.e.): The acid equivalent of a salt or ester form of the active ingredient of an herbicide is that portion of the molecule that represents the parent acid form of the molecule.

Active ingredient (a.i.): The main ingredient produces the desired effect.

Acute exposure: A single exposure or multiple exposures occurring within a short time (24 hours or less).

Additive effect: A situation in which the combined effects of two chemicals is equal to the sum of the effect of each chemical given alone. The effect most commonly observed when two chemicals are given together is an additive effect.

Adjuvant(s): Formulation factors used to enhance the pharmacological or toxic agent effect of the active ingredient.

Adsorption: The tendency of one herbicide to adhere to another material.

Adverse-Effect Level (AEL): Signs of toxicity that must be detected by invasive methods, external monitoring devices, or prolonged systematic observations. Symptoms that are not accompanied by grossly observable signs of toxicity. In contrast to Frank-effect level.

Affected Environment: The physical, biological, social, and economic environment where human activity is proposed.

Alien species: A species (including its seeds, eggs, spores, or other biological material capable of propagating that species) that is not native to a particular ecosystem. Executive Order 13112

Allelopathic effects: Literally reciprocal pathology. In plant pathology, the term is used to describe the release of substances from one plant that may have an adverse effect on another plant.

Alternative: In project planning, a given combination of resource uses and mix of management practices that achieve a desired management direction, goal, or emphasis.

Aquatic ecosystems: The stream channel, lake, or estuary bed, water, biotic communities, and habitat features that occur therein.

Basin: the Tahoe Basin.

Best Management Practices (BMPs): A practice, or combination of practices, that is determined by the state to be the most effective, practicable (including technological, economic, and institutional considerations) means of preventing, or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.

Bioconcentration factor (BCF): The concentration of a compound in an aquatic organism divided by the concentration in the ambient water of the organism.

Biodiversity: The distribution and abundance of different plant and animal communities and species, habitats, seral stages, and special habitat components in an ecosystem.

Biologically sensitive: A term used to identify a group of individuals who, because of their developmental stage or some other biological condition, are more susceptible than the general population to an herbicide or biological agent in the environment.

Broadcast spray: Broadcast applications consist of applying a spray solution uniformly over the entire treated area. The kinds of herbicides used are usually selective, such as Aminopyralid. When (1) herbicides are applied according to label directions and (2) the equipment is operated properly, broadcast applications are very effective for weed control and are safe on non-target plants.

Broadleaf weed: A non-woody dicotyledonous plant with wide bladed leaves designated as a pest species in gardens, farms, or forests.

California Spotted Owl Protected Activity Center: A 300-acre, protected area in which California Spotted owls find suitable nesting sites and several suitable roosts, and in which they carry out at least half of their nighttime foraging during the breeding season

California Wildlife Habitat Relationships System (CWHR): The California Wildlife Habitat Relationships System includes habitat relationships models for over 600 wildlife species in the State of California. The system was designed as a planning tool to predict wildlife species communities, habitat suitability, and differences in habitat values between two situations for geographic locations and habitats in California. The system provides species habitat suitability ratings for feeding, cover, and foraging in varying habitat types and seral stages. These suitability ratings are converted to numeric values, and the three values are averaged to calculate overall habitat values for each habitat type and seral stage, for particular species. The California Wildlife Habitat Relationships System can be

used to predict differences in habitat values between two habitat conditions, and can indicate which species may be negatively or positively affected, based on differences in habitat values between the two habitat conditions.

Carrier: In commercial formulations of insecticides or control agents, a substance added to the formulation to make it easier to handle or apply.

Chemical treatments: in this NEPA decision, chemical refers to 'herbicide.'

Chronic exposure: Long-term exposure studies often used to determine the carcinogenic potential of chemicals. These studies are usually performed in rats, mice, or dogs and extend over the average lifetime of the species (for a rat, exposure is 2 years).

Contact herbicides: cause the parts of the plant in contact with the herbicide to die back, leaving the roots alive and able to re-grow.

Contain: keep an infestation of TIPS within a pre-determined perimeter; similar to control.

Contaminants: For herbicides, impurities present in a commercial grade herbicide. For biological agents, other agents that may be present in a commercial product.

Control: Process of limiting a TIPS infestation to a desirable level; containment.

Controls: In toxicology or epidemiology studies, a population that is not exposed to the potentially toxic agent under study.

Control spectrum: Which TIPS the herbicide will and will not control.

Cooperative Agreement: A written agreement between the Forest Service and a county, State, or Federal agency.

Cumulative effects: Changes as a result of more than one action that may enhance or degrade a specific site.

Cumulative exposures: Exposures that may last for several days to several months or exposures resulting from program activities that are repeated more than once during a year or for several consecutive years

Cumulative watershed effects: environmental changes that are affected by more than one land-use activity and that are influenced by processes involving the generation or transport of water.

Dermal: Pertaining to the skin.

Dermatitis: Inflammation of the skin, due to either direct contact with an irritating substance, or an allergic reaction.

Dicot: Flowering plants whose seed contains two embryonic leaves. Examples include dandelion, potatoes, sulfur cinquefoil, perennial pepperweed/tall whitetop.

Dip & Clip: method of applying herbicide where clippers are dipped in concentrated herbicide, and then used to clip the TIPS stems and/or other plant parts.

Directed Spray: is accomplished by wand with regulated nozzle in such a fashion that spray is directed within 1 to 2 feet of the target vegetation. This spraying is done at an angle to reduce overspray. Plants that are three feet tall are left standing. Taller plants are will need to be cut or bent to insure that spray is within three feet of the ground.

Dose-response assessment: A description of the relationship between the dose of a herbicide and the incidence of occurrence or intensity of an effect. In general, this relationship is plotted by statistical methods. Separate plots are made for experimental data obtained on different species or strains within a species.

Draft Environmental Assessment: The statement of environmental effects required for major Federal actions under Section 102 of the National Environmental Policy Act (NEPA), and released to the public and other agencies for comment and review.

Drift: That portion of a sprayed herbicide that is moved by wind off a target site.

Early Detection Rapid Response: phrase for 'treating new infestations, expanding infestations, and new TIPS species"

EC100: An effect concentration that causes complete inhibition or reduction. As used in this document, this values refers to a complete inhibition of growth.

EC50: An effect concentration that causes 50% inhibition or reduction. As used in this document, this value refers to a 50% inhibition of growth.

Endangered Species: Any species listed in the Federal Register as being in danger of extinction throughout all or a significant portion of its range.

Environmental Assessment: The statement of environmental effects required for major Federal actions under Section 102 of the National Environmental Policy Act (NEPA).

Eradication: Elimination of all plants and plant parts.

Exotic: Introduced from a foreign country or a different region. An exotic plant is one not native to the place where it is growing, such as Japanese honeysuckle, which has naturalized in the northeastern United States, or eucalyptus trees, which have naturalized on the west coast.

Expanded TIPS infested acres: Known (2008) TIPS infested acres doubled to account for the potential expansion of TIPS through the NEPA process – projected to be completed in 2010. The expanded acres for TIPS on the LTBMU in 2008 = 21.56 acres.

Exposure assessment: The process of estimating the extent to which a population will come into contact with a herbicide or biological agent.

Forest Plan: The Land and Resource Management Plan for the Lake Tahoe Basin Management Unit.

Formulation: A commercial preparation of an herbicide including any inerts or contaminants.

Frank effects: Obvious signs of toxicity.

Frank-effect Level (FEL): The dose or concentration of a herbicide or biological agent that causes gross and immediately observable signs of toxicity.

Geographic Range: The collection of all the habitat areas of a species.

Gross Acres: Entire land surface over which the TIPS are dispersed**.** The acres are defined by drawing a line around the general perimeter of the infestation, not the canopy cover of the plants. The gross acres may contain significant parcels of land that are not occupied by TIPS.

Habitat: A habitat is the actual location in the environment where an organism lives and consists of all the physical and biological resources available to a species.

Half time or half-life: For compounds that are eliminated by first-order kinetics, the time required for the concentration of the herbicide to decrease by one-half.

Hazard identification: The process of identifying the array of potential effects that an agent may induce in an exposed human population.

Hazard Quotient (HQ): The ratio of the estimated level of exposure to the RfD or some other index of acceptable exposure.

Herbaceous: A plant, annual, biennial, or perennial, that does not develop persistent woody tissue above the ground, but whose aerial portion naturally dies back to the ground at the end of a growing season.

Herbicide: A chemical used to control, suppress, or kill plants.

Infested Acres: Same as Net Acres; actual area occupied by TIPS. See also 'Gross acres.'

Inerts: Adjuvants or additives in commercial formulations of Glyphosate that are not readily active with the other components of the mixture.

Integrated pest management (IPM): A process that determines an economic or environmental threshold for managing pest populations and prescribes the management technique to reach desired conditions. IPM includes four broad categories of techniques: biological, cultural, mechanical, and chemical. (National Strategy and Implementation Plan for Invasive Species Management FS-805 2004)

Integrated Weed Management (IWM): An IWM program is an interdisciplinary management approach for selecting methods for preventing, containing, and controlling noxious weeds in coordination with other resource management activities to achieve optimum management goals and objectives. Methods include: education, preventive measures, herbicide, cultural, physical or mechanical methods, biological control agents, and general land management practices, such as manipulation of livestock or wildlife grazing strategies that accomplish vegetation management objectives. (FSM 2080.5)

Introduced: A species is defined as introduced (also known as non-indigenous, alien or exotic) in a certain geographical area, if that area is outside the species' native distributional range, and the species has arrived there by human activity.

Invasive Species: A species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health according to The Forest Service Framework for Invasive Species (USDA Forest Service, 2003)

Invertebrate: An animal that does not have a spine (backbone).

Irritant effect: A reversible effect, compared with a corrosive effect.

Larva (pl. larvae): An insect in the earliest stage after hatching.

Lethal Concentration50 (LC50): A calculated concentration of a herbicide in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

Lethal Dose50 (LD50): The dose of a herbicide calculated to cause death in 50% of a defined experimental animal population over a specified observation period. The observation period is typically 14 days.

Limited Treatment (a type of weed treatment)**:** Perimeter treatment only to contain infestation.

Lowest-Observed-Adverse-Effect Level (LOAEL): The lowest dose of a herbicide in a study, or group of studies, that produces statistically or biologically significant increases in frequency or severity of adverse effects between the exposed population and its appropriate control.

Lowest-Observed-Effect Level (LOEL): The lowest dose of a herbicide where no adverse treatment-related effects were observed.

Management Indicator Species (MIS): Animals or plants identified in Forest Land and Resource Management Plans (LRMPs, or Forest Plans) developed under the 1982 Planning Rule, that are selected because their population changes are thought to indicate the effect of Forest Service management activities (USDA Forest Service, Pacific Southwest Region, Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement, 2001: 69).

Margin of safety (MOS): The ratio between an effect or no effect level in an animal and the estimated human dose.

Mechanism of action: How the herbicide kills weeds.

Microorganisms: A generic term for all organisms consisting only of a single cell, such as bacteria, viruses, and fungi.

Minimal Risk Level (MRL): A route-specific (oral or inhalation) and duration-specific estimate of an exposure level that is not likely to be associated with adverse effects in the general population, including sensitive subgroups.

Mitochondria: Subcellular organelles involved in the conversion of food to stored energy.

Monitoring: The collection of information over time, generally on a sample basis to measure change in an indicator or variable, for purposes of determining the effects of resource management treatments.

Monocots: Flowering plants whose seed contains only one embryonic leaf. Examples include grasses, sedges, rushes, lilies, onions.

Most sensitive effect: The adverse effect observed at the lowest dose level, given the available data. This is an important concept in risk assessment because, by definition, if the most sensitive effect is prevented, no other effects will develop. Thus, RfDs and other similar values are normally based on doses at which the most sensitive effect is not likely to develop.

MOU: Memorandum of Understanding.

National Environmental Policy Act (NEPA): The United States' basic national charter for protection of the environment. It establishes policy, sets goals, and provides means for carrying out the policy. The Act directs agencies to inform the public of projects, and that agencies consider public comment.

National Forest Management Act (NFMA): The National Forest Management Act of 1976 amended the Resources Planning Act to direct the Secretary of Agriculture to develop direction and guidance for management of lands and resources of National Forest System lands.

Native plant species: A plant species which occurs naturally in a particular region, state, ecosystem and habitat without direct or indirect human actions. FSM, 2070 Vegetation Ecology

Net acres: Actual area occupied by TIPS; also known as 'infested' acres.

Niche: A niche refers to the way in which an organism fits into an ecological community or ecosystem. Through the process of natural selection, a niche is the evolutionary result of a species' morphological (morphology refers to the organism's physical structure), physiological, and behavioral adaptations to its surroundings.

TIPS: Acronym for non-native invasive plant species. This category may include species that are alien, and/or exotic, noxious, nuisance, undesirable, or weeds. In this project, it does not include plants that are native to the LTBMU.

Non-native plants: A plant grown outside of its natural range.

Non-selective, broad spectrum herbicides will generally affect all plants that they come in contact with.

Non-target: Any plant or animal that a treatment inadvertently or unavoidably harms.

No-Observed-Adverse-Effect Level (NOAEL): The dose of a herbicide at which no statistically or biologically significant increases in frequency or severity of adverse effects were observed between the exposed population and its appropriate control. Effects may be produced at this dose, but they are not considered to be adverse.

No-Observed-Effect Level (NOEL): The dose of a herbicide at which no treatment-related effects were observed.

Noxious weed: Those plant species designated as noxious weeds by the Secretary of Agriculture or by the responsible State official. Noxious weeds

generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease, and being non-native or new to or not common to the United States or parts thereof. (FSM 2080.5)

Nuisance plant: A plant which causes offense, annoyance, trouble or injury.

Pathway: In metabolism, a sequence of metabolic reactions.

Perennial plant: A plant species having a lifespan of more than 2 years.

Perennial stream: A stream that flows throughout the year.

Permeability: The property or condition of being permeable. In this risk assessment, dermal permeability refers to the degree to which a herbicide or herbicide in contact with the skin is able to penetrate the skin.

Pesticide: A chemical used to control, repel, or destroy pests of any sort. Pesticides can be herbicides to kill plants, rodenticides to kill rodents, etc.

pH: The negative log of the hydrogen ion concentration. A high pH (>7) is alkaline or basic and a low pH (<7) is acidic.

Phenology: the study of periodic plant and animal life cycle events and how these are influenced by seasonal and interannual variations in climate.

Plant materials: Seeds, spores, parts of plants or whole plants. FSM, 2070 Vegetation Ecology

Protected Activity Center (PAC): This refers to areas of delineation around habitat for a specific animal. Protected activity centers are designed to minimize land disturbance within the delineated area.

Reference dose (RfD) -- Oral dose (mg/kg/day) not likely to be associated with adverse effects over a lifetime exposure, in the general population, including sensitive subgroups. **RfD:** A daily dose that is not anticipated to cause any adverse effects in a human population over a lifetime of exposure. The U.S. EPA derives these values.

Rehabilitation: Reparation of ecosystem processes, productivity and services based on functioning pre-existing or existing ecosystems, but allowing for adaptation of sites to specific current or future uses. FSM, 2070 Vegetation Ecology

Reproductive effects: Adverse effects on the reproductive system that may result from exposure to a herbicide or biological agent. The toxicity of the agents may be directed spray to the reproductive organs or the related endocrine system. The manifestations of these effects may be noted as alterations in sexual behavior,

fertility, pregnancy outcomes, or modifications in other functions dependent on the integrity of this system.

Residual: Length of time the herbicide will provide effective weed control.

Restoration: Assisting the recovery of an ecosystem that has been degraded, damaged or destroyed including the re-establishment of the pre-existing biotic integrity in terms of species composition and community structure. FSM, 2070 Vegetation Ecology

Revegetation: Re-establishment of plants on a site. FSM, 2070 Vegetation Ecology

Riparian Conservation Area (RCA): The delineations of RCAs for this EA as described below, are from the Sierra Nevada Forest Plan Amendment FEIS Record of Decision (USDA Forest Service Pacific Southwest Region 2004 p.42), and for this EA 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.

Risk: Risk is an assessment of the potential for adverse effects that result from some activity. Practically anything can be toxic if the dose or level of exposure is high enough. Toxicity alone does not indicate risk. This concept was first elaborated by Paracelsus (1492-1541), who said “What is there that is not poison?” In other words, the dose makes the poison.

Route of exposure: The way in which a herbicide or biological agent enters the body. Most typical routes include oral (eating or drinking), dermal (contact of the agent with the skin), and inhalation.

Ruderal: A ruderal plant grows where the natural vegetational cover has been disturbed by humans.

Seasonally flowing stream: Any non-permanent flowing drainage feature having a definable channel and evidence of annual scour and deposition, including ephemeral and intermittent streams with a definable channel and evidence of annual scour or deposition.

Sedimentation: The process of sediment deposition, usually resulting from erosion.

Seed bank: Seeds that remain in the ground even after TIPS are treated by herbicides or physical methods. They can remain viable for many years.

Selective herbicides will affect only some plants.

Sensitive subgroup: Subpopulations that are much more sensitive than the general public to certain agents in the environment.

Sensitive: Sensitive species for herbicide testing are those plant species used in testing that are more sensitive to the herbicides. These are not Forest Service Sensitive (FS sensitive) species.

Soil Quality Standards (SQS): Threshold values that indicate when changes in soil properties and soil conditions would result in significant change or impairment of productivity potential, hydrologic function, or buffering capacity of the soil. Detrimental soil disturbance is the resulting condition when threshold values are exceeded.

Soil Seed Bank: Unsprouted seeds in the soil.

Solarize: To injure or kill TIPS by long exposure to the heat of the sun usually with the aid of clear or black plastic.

Specialized pollination system: Association between a flowering plant species and a specific pollinator that is required to achieve cross-pollination and seed production.

Species-to-species extrapolation: A method involving the use of exposure data on one species (usually an experimental mammal) to estimate the effects of exposure in another species (usually humans).

Spot spray: For most herbicide applications in natural areas, spot spraying is preferred. This permits application of the chemical just to target species. Foliar application should be made with a low-pressure (20-50 psi) backpack sprayer equipped with a wand applicator. A sprayer nozzle which creates a flat or cone-shaped pattern is preferable. The herbicide should be allowed to dry for at least two hours to ensure adequate absorption. (Do not spray when rainfall is threatened.) Addition of a nonionic surfactant to the mixture helps ensure complete leaf coverage and increases the rate of absorption. The herbicide should thoroughly cover the foliage but not to the point of run-off. Personnel applying herbicide must be properly trained and knowledgeable about the native vegetation.

Sub-chronic exposure: An exposure duration that can last for different periods of time, but 90 days is the most common test duration. The subchronic study is usually performed in two species (rat and dog) by the route of intended use or exposure.

Surfactant: Short for 'SURFace ACTive AgeNT' – a surfactant is a molecule/compound that reduces the surface tension of water, thereby permitting it to penetrate a material more easily or to spread over the surface. For aquatic labeled herbicides, if the label states that surfactants are needed, then one (or more) should be added. Make sure to use only an aquatic registered surfactant for aquatic herbicides.

Synergistic effect: A situation is which the combined effects of two herbicides is much greater than the sum of the effect of each agent given alone.

Systemic herbicides are capable of killing the entire plant, vs. contact herbicides which kill only that part of the plant that comes in contact with the herbicide.

Systemic toxicity: Effects that require absorption and distribution of a toxic agent to a site distant from its entry point at which point effects are produced. Systemic effects are the obverse of local effects.

Terrestrial: Anything that lives on land as opposed to living in an aquatic environment.

Threatened and Endangered Species (TES): A plant or animal species identified, defined, and recorded in the Federal Register, as being in danger of extinction throughout all or a significant portion of its range, in accordance with the Endangered Species Act of 1976.

Threshold: The maximum dose or concentration level of a herbicide or biological agent that will not cause an effect in the organism.

Toxicity: The inherent ability of an agent to affect living organisms adversely.

Toxicity index: The benchmark dose used to determine a potential adverse effect when it is exceeded. Usually a NOAEL, but when data are lacking other values may be used.

Uncertainty factor (UF): A factor used in operationally deriving the RfD and similar values from experimental data. UFs are intended to account or (1) the variation in sensitivity among members of the human population; (2) the uncertainty in extrapolating animal data to the case of humans; (3) the uncertainty in extrapolating from data obtained in a study that is less than lifetime

exposure; and (4) the uncertainty in using LOAEL data rather than NOAEL data. Usually each of these factors is set equal to 10. See Table 2-5 for additional details.

Undesirable Plants: Plant species that are classified as undesirable, noxious, harmful, exotic, injurious, or poisonous pursuant to State or Federal laws. Species listed as threatened or endangered by the Secretary of the Interior according to the Endangered Species Act of 1973 are not classified as undesirable plants.

Upland vegetation: A plant species that is nearly always found in upland areas. Upland areas are any areas that do not qualify as a wetland because the associated hydrologic regime is not sufficiently wet to elicit development of vegetation, soils, or hydrologic characteristics associated with wetlands (U.S. Army Corps of Engineers, 1989).

Vehicle: A substance (usually a liquid) used as a medium for suspending or dissolving the active ingredient. Commonly used vehicles include water, acetone, and corn oil.

Vertebrate: An animal that has a spinal column (backbone).

Volatile: Referring to compounds or substances that have a tendency to vaporize. A material that will evaporate quickly

Watershed: A region or land area drained by a single stream, river, or drainage network.

Weed. A plant that is considered by the user of the term to be a nuisance, and normally applied to unwanted plants in human-made settings such as gardens, lawns or agricultural areas, but also in parks, woods and other natural areas. More specifically, the term is often used to describe native or nonnative plants that grow and reproduce aggressively. Generally, a weed is a plant in an undesired place (http://en.wikipedia.org/wiki/Weed).

Wicking and Wiping: method of applying herbicide. A wick applicator consists of an herbicide reservoir attached to a wiper made of absorbent material such as cotton rope, carpet, or sponge, similar to a self-filling paint roller. It is used to apply highly concentrated herbicide solution (10% to 100% of product) by wiping it directly onto plant surfaces.