United States
Department of
Agriculture

Forest
Service

R5-MB-306

August 2017

Updated
December
2017

Final Environmental Impact Statement

Power Fire Reforestation Project

Amador Ranger District, Eldorado National Forest
Amador County, California

POWER FIRE REFORESTATION PROJECT

Environmental Impact Statement
Amador County, California

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Abstract: This Environmental Impact Statement (EIS) describes a proposal by the Eldorado National Forest, Amador Ranger District, which includes the following: plant trees, perform mechanical and chemical treatments to ensure survival and growth of planted and naturally regenerated forests, reduce fuels, enhance oak regeneration and growth, and reduce the occurrence and spread of invasive plants in portions of the Power Fire area. The EIS discloses the direct, indirect, and cumulative environmental effects that would result from the proposed action, an alternative to the proposed action, and a no action alternative.

SUMMARY

The Eldorado National Forest proposes to plant trees, perform mechanical and herbicide treatments to ensure survival and growth of planted and naturally regenerated forests, reduce fuels, enhance oak regeneration and growth, and reduce the occurrence and spread of invasive plants in portions of the Power Fire area. The area affected by the proposal includes portions of the 2004 Power Fire on National Forest land. The proposed action would accelerate the reestablishment of a fire-resilient, forested landscape, restore wildlife habitats and provide conditions to support native plant and animal species associated with these ecosystems. The proposed action provides the necessary tools to control or eliminate invasive plant species and to reduce the potential for spread of invasive plants to other areas in the forest.

Areas within the Power Fire that were salvage logged and pre-fire plantations have mostly been replanted and had brush and grass removed by hand at least once. Surveys show that some of these plantations have failed because the brush and grasses consumed the limited water and nutrients and the seedlings died. Tree survival and growth in the remainder of the plantations are at continued risk of mortality due to high levels of competing vegetation. Some logged areas have not been replanted due to rapid post-fire return of highly competitive vegetation.

The proposed action was designed to primarily reforest previously salvage logged areas where the density of snags would not create safety risks for workers. The proposal avoids treatments in designated Wilderness, presently suitable spotted owl habitat, areas with low post fire tree mortality, and areas of moderate to high mortality that were not salvage logged and are too steep for mechanical site preparation.

The goal of this project is to move the project area toward the desired future conditions as defined in the Sierra Nevada Forest Plan Amendment (SNFPA) ROD.

The Notice of Intent (NOI) was published in the Federal Register on April 30, 2014. The NOI asked for public comment on the proposal by June 6, 2014. Seven scoping comments were submitted. Comment letters and a summary of comments are found in the project record located at the Amador Ranger District office and in the electronic files. In addition, as part of the public involvement process, the agency held an open house for the public to learn about the proposed action and provide comments on May 15, 2014. The Amador Calaveras Consensus Group (ACCG), a local citizens group involved in the Collaborative Forest Landscape Restoration Program, provided feedback to the Forest Service during three meetings (July 9, August 5, and September 10, 2014) and one field trip (July 23, 2014). Using the comments from the public, other agencies, and local governmental officials (see *Issues* section), the interdisciplinary team developed a list of issues to address. Significant issues are summarized below:

Issue 1: Intensive site preparation and reforestation efforts limit both the diversity and the duration of complex early seral forests. Ecological integrity and biodiversity are best maintained by protecting shrub habitat and allowing natural succession to proceed unimpeded.

Issue 2: Broadcasting herbicide over large areas will immediately reduce cover of native vegetation, permanently reduce the percent of native vegetation in treated plantations, and increase cover of alien grasses and forbs.

Issue 3: There is no evidence that the proposed action will result in forests that are more resistant to fire or more resilient to fire effects and climate change.

Issue 4: The herbicide risk assessments utilized by the Forest Service (FS), the Syracuse Environmental Research Associates, Inc. (SERA) reports, and the 1989 Regional Vegetation Management EIS do not provide sufficient information regarding potential effects of the chemicals and mixtures proposed for use in the Power Fire area to allow the Forest Service to make an informed decision.

These issues led the agency to develop alternatives to the proposed action, including the following:

- *Alternative 2 – No Action Alternative:* The Forest Service is required to analyze a no action alternative. Under Alternative 2, the No Action alternative, current management plans would continue to guide management of the project area. Actions approved under other NEPA decision documents would continue to be implemented. No reforestation and other activities as described herein would be implemented to accomplish the purpose and need. The No Action alternative addresses Issues 1 and 4. Aside from other approved projects, which includes previous planting and hand release on approximately 2,500 acres, the trajectory of early seral forest development would continue unimpeded by management actions.
- *Alternative 3 – Radial Spray:* Alternative 3 was designed to address Issues 2, 3, and partially address Issue 4. With the exception of grass and bearclover, this alternative employs a radial spray approach to herbicide application for release in order to enhance native plants when compared to the Proposed Action. Under this alternative, the amount of herbicide spray would be reduced as compared to the proposed action. Except where noted, vegetation is treated only within a designated radius of each planted tree to reduce competition while allowing existing native vegetation to grow in-between planted trees thereby maintaining a seed bank and habitat diversity. In addition, this alternative varies the planting density to emulate the spatial heterogeneity of forest conditions that would have been created by topography's influence on fire frequency and intensity. This alternative differs from the Proposed Action primarily in planting arrangements, planting density (trees per acre), and type and methods of release.

Major conclusions related to environmental impacts include:

- Completion of this project would increase the long term resiliency of this landscape to wildfire by reducing shrub cover and accelerating the growth of trees, restore forest cover to areas impacted by the Power Fire, improve oak habitat, and reduce occurrences of invasive plants. Compared with the No Action Alternative, the project is more likely to provide resilient forest conditions and develop conifer forest into the future.
- Significant impacts on forest resources or human health are not expected to result from implementation of this project. Risks of adverse effects will be avoided and/or minimized through implementation of Design Criteria Common to All Action Alternatives (see Chapter 2).

Based upon the effects of the alternatives, the responsible official will decide whether to implement the proposed action, the alternative action, or take no action to reforest areas impacted by the Power Fire in the project area.

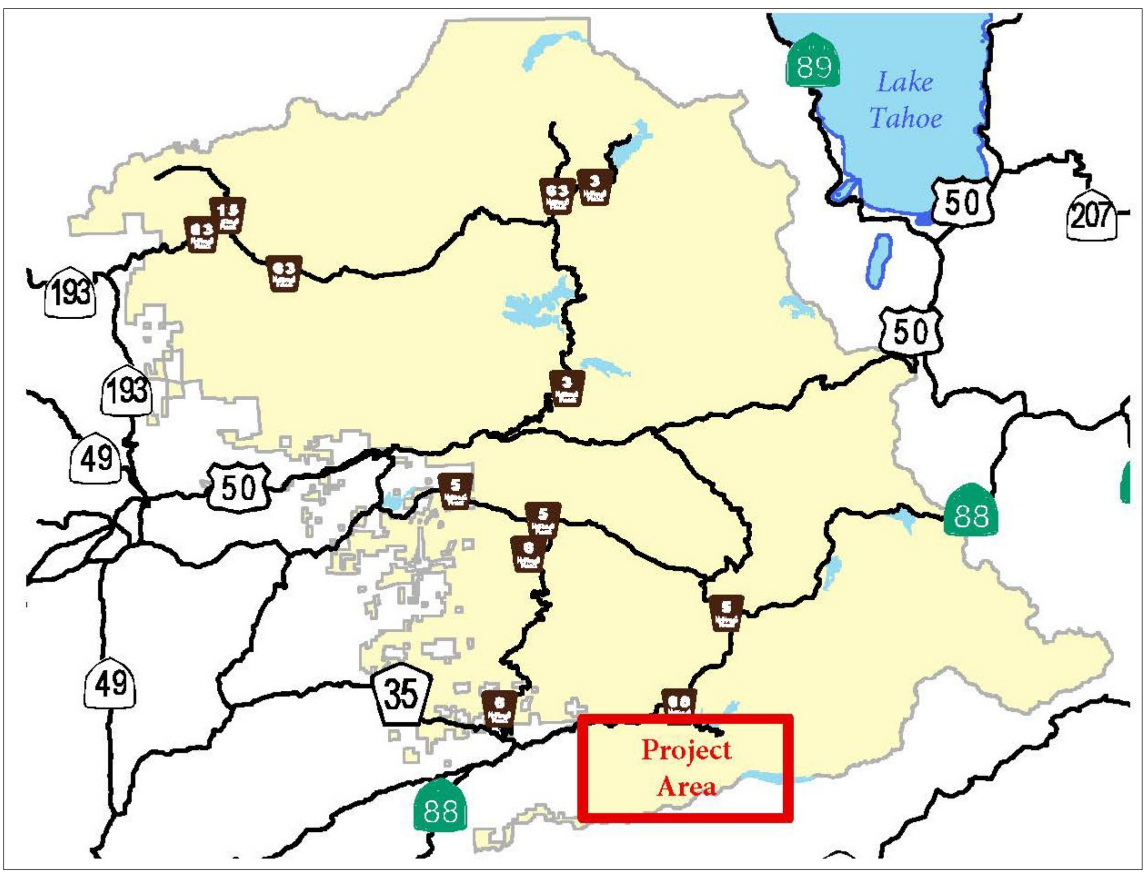

Figure 1.1 Project Vicinity Map

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List of Acronyms

a.e.	acid equivalent
ai	acid ingredient
BA	Biological Assessment
BE	Biological Evaluation
BE/BA	Biological Assessment and Evaluation
BEE	butoxyethyl ester
BMP	Best Management Practice
BO	Biological Opinion
CDF	California Department of Forestry
CDFG	California Department of Fish and Game
CEQ	The Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH	critical habitat
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CSO	California spotted owl
CVRWQCB	Central Valley Regional Water Quality Control Board
CWE	cumulative watershed effects
CWHR	California Wildlife Habitat Relations
dbh	diameter breast height
EEZ	Equipment Exclusion Zone
EIS	Environmental Impact Statement
EPCRA	Emergency Planning and Community Right-to-Know Act
ERA	Equivalent Roaded Acreage
FEIS	Final Environmental Impact Statement
FOFEM	First Order Fire Effects Model
FS	Forest Service
FSM	Forest Service Manual
FSWEPP	Forest Service Water Erosion Prediction Project
FWS	Fish and Wildlife Service
FYLF	foothill yellow-legged frog
GIS	Geographical Information System
GLEAMS	Groundwater Loading Effects of Agricultural Management Systems
HQ	Hazard quotient
HRCA	Home Range Core Area
HSG	Hydrologic Soil Group
HUC	Hydrologic Unit Code
IARC	International Agency for Research on Cancer
LOP	limited operating period
LRMP	Land Resource Management Plan
LWD	large woody debris
MAPSS	Mapped Atmospheric Plant Soils System
MHC	Montane hardwood conifer
MHW	Montane hardwood

MIS	Management Indicator species
MOU	Memorandum of Understanding
MSDS	Material Safety Data Sheets
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFMA	National Forest Management Act
NOAA	National Atmospheric and Oceanic Administration
NOAEL	No Observed Adverse Effect Level
NOEC	No Observable Effect Concentration
NOI	Notice of Intent
NP	nonylphenol
NPE	nonylphenol polyethoxylate
NPS	National Park Service
NPV	net present value
NRCS	National Resources Conservation Service
OHV	off-highway vehicle
PAC	Protected Activity Center
PCE	primary constituent element
PFRP	Power Fire Reforestation Project
PIF	Partners in Flight
ppm	parts per million
RCA	Riparian Conservation Area
RfD	Reference Doses
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SERA	Syracuse Environmental Research Associates, Inc.
SNFPA	Sierra Nevada Forest Plan Amendment
SNYLF	Sierra Nevada yellow-legged frog
SOM	soil organic matter
TCP	3,5,6-trichloro-2-pyridinol
TES	Threatened, Endangered, Proposed and Candidate Species
THP	timber harvest plan
TMDL	total maximum daily load
TMRC	theoretical maximum residue contribution
TOC	threshold of concern
TPA	trees per acre
US EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USDA FS	United States Department of Agriculture Forest Service
USDI	U.S. Department of the Interior, Washington, DC
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WEPP	Water Erosion Prediction Project
WPT	western pond turtle
WQLS	Water Quality Limited Segments
WUI	Wild Urban Interface

Glossary

aquatic	Growing or living in or frequenting water; taking place in or on water.
aquatic refugia	A watershed that has remained unaltered by climatic change affecting surrounding regions and therefore forms a haven for relict fauna and flora. Some provide habitat for localized populations of rare and/or at-risk populations of native fish and/or amphibians.
aspect	The direction a slope faces. For example, a hillside facing east has an eastern aspect.
basal area	The total cross-sectional area of all stems, including the bark, in a given area, measured at breast height (4.5 feet above the ground). Usually given in units of square feet per acre.
Best Management Practices (BMPs)	Water Quality Best Management Practices, a codified series of about 100 practices for protecting water quality when conducting forest management activities. BMPs are referenced in R5 FSH 2509.22, Soil and Water Conservation Handbook; Chapter 10, Water Quality Management Handbook.
biodiversity	The number and abundance of species found within a common environment. This includes the variety of genes, species, ecosystems, and the ecological processes that connect everything in a common environment.
biomass	Trees less than 10 inches dbh not used as saw logs. This material is usually chipped and/or removed from the project area and hauled to a mill to be used for cogeneration of energy or as fiber for wood products.
buffer	Used in the context of GIS; a buffer is a zone of a specified distance around a feature in a coverage.
California Wildlife Habitat Relations (CWHR)	A system of classifying vegetation in relation to its function as wildlife habitat. Tree-dominated habitat is classified according to tree size and canopy closure.
canopy	The part of any stand of trees represented by the tree crowns. It usually refers to the uppermost layer of foliage, but it can be used to describe lower layers in a multi-storied forest
canopy cover	The degree to which the canopy (forest layers above

	one's head) blocks sunlight or obscures the sky. Same as crown closure.
coarse woody debris	Coarse woody debris is 1,000-hour dead fuel, with a minimum diameter (or an equivalent cross section) of three inches at the widest point and includes sound and rotting logs, standing snags, stumps, and large branches (located above the soil).
Condition Class	See Fire Regime Condition Class
Council on Environmental Quality (CEQ)	The Council on Environmental Quality established by Title II of NEPA (40 CFR 1508.6).
critical habitat (CH)	Areas designated for the survival and recovery of Federally listed threatened or endangered species.
cumulative impact	the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such actions (40 CFR 1508.7).
desired future conditions	Land or resource conditions that are expected to result based on goals and objectives.
diameter breast height (dbh)	The diameter of a tree trunk 4.5 feet above the ground.
disjunct population	A population of plants or animals which are separated by a large distance from the typical distribution of the species.
early succession	The biotic (or life) community that develops immediately following the removal or destruction of vegetation in an area. For example, grasses may be the first plants to grow in an area that was burned.
ecology	The interrelationships of living things to one another and to their environment, or the study of these interrelationships.
ecosystem	An arrangement of living and non-living things and the forces that move them. Living things include plants and animals. Non-living parts of ecosystems may be rocks and minerals. Weather and wildfire are two of the forces that act within ecosystems.
Endangered Species	Those plant or animal species that are in danger of

	extinction throughout all or a significant portion of their range. Endangered species are identified by the Secretary of the Interior in accordance with the Endangered Species Act of 1973.
endemic	An organism that evolved in and is restricted to a particular locality. Sawtooth lewissia is endemic to the American River watershed region, as an example.
ephemeral streams	Streams that flow only as the direct result of rainfall or snowmelt. They have no permanent flow since their streambeds are not connected to groundwater below.
Equivalent Roaded Acreage (ERA)	A standardized unit of measure for land disturbance. A road prism is considered the reference to which other types of land disturbing activities are measured. A road is given an ERA coefficient of 1.0 (1 acre of road is equal to 1.0 ERA). Other disturbances such as logging, site preparation, and wildfires are equated to a road surface by ERA coefficients that reflect their relative level of contribution to changes in runoff and sediment regimes in the watershed.
erosion	Soil disturbance
erosion hazard	Low, moderate, high, very high
fire intensity	Fire intensity describes the physical combustion process of energy release from organic matter (Keeley 2009).
fire line	A corridor, which has been cleared of organic material to expose mineral soil. Fire lines may be constructed by hand or by mechanical equipment (e.g., dozers).
flora	The plant life of an area.
Forest System road or trail	A road or trail wholly or partly within or adjacent to and serving the National Forest system that the Forest Service determines is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources (36 CFR 212).
fuel loading	The weight per unit area of fuel, often expressed in tons per acre.
fuel reduction treatment	The treatment of fuels that left untreated would

	otherwise interfere with effective fire management or control. For example, prescribed fire can reduce the amount of fuels that accumulate on the forest floor.
fuel	The amount of biomass that could potentially burn.
fuels management	The planned manipulation and/or reduction of living and dead forest fuels for forest management and other land use objectives.
Geographic Information System (GIS)	A computer system capable of storing, manipulating, analyzing, and displaying geographic information.
GIS	Geographical Information System
GLEAMS	Groundwater Loading Effects of Agricultural Management Systems
GLEAMS model	calculates the amount of chemical lost in runoff water and sediment and percolated below the root zone
Ground cover	Natural organic and inorganic material that covers the watershed ground surface in sufficient quantity to allow a satisfactory rate of water infiltration to replenish ground water and limit erosion to natural rates. Groundcover usually consists of perennial vegetation, forest floor litter and duff, rock, downed wood, or similar erosion resistant material. Sufficient groundcover is usually 50% or greater, and cover of many forested ground surface areas is 80% or higher.
habitat	The area where a plant or animal lives and grows under natural conditions.
hazard tree	A standing tree that presents a hazard to people due to conditions such as deterioration of or damage to the root system, trunk, stem, or limbs or the direction or lean of the tree. Synonymous with danger tree for purposes of this project.
herbaceous	A vascular plant having little or no woody tissue. This commonly refers to grass and grass-like plants.
herbicide release	Refers to the use of herbicides to help establish planted conifer species by reducing competition.
Home Range Core Area (HRCA)	An area designed to encompass the best available spotted owl habitat, and is in the closest proximity to owl protected activity centers where the most concentrated owl foraging activity is likely to occur.
hydrophobic soils	Soils that repel water, causing water to collect on the

	soil surface rather than infiltrate into the ground. Wild fires generally cause soils to be hydrophobic temporarily, which increases water repellency, surface runoff and erosion in post-burn sites.
Interdisciplinary Team	A diverse group of professional resource specialists who analyze the effects of alternatives on natural and other resources. Through interaction, participants bring different points of view and a broader range of expertise.
intermittent stream	A stream that flows during the wet season due to precipitation runoff and has streamflow extending partially through the dry season due to at least some groundwater contribution.
invasive plant species	Refer to Noxious Weeds for the purposes of this project.
irretrievable	A term that applies to the loss of production, harvest, or use of natural resources. For example, some or all of the timber production from an area is lost irretrievably while an area is serving as a winter sports site. The production lost is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume timber production.
irreversible	A term that describes the loss of future options. Applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity that are renewable only over long periods of time.
lahar	Volcanic mud flow soils, often referred to as “lava caps”
landing	A forested opening, cleared of vegetation, leveled and graded, and used to stockpile sawlogs for eventual loading of load log trucks for haul to a sawmill.
landscape	A large land area composed of interacting ecosystems that are repeated due to factors such as geology, soils, climate, and human impacts.
large woody debris (LWD)	Large woody debris is typically greater than 12 inches in diameter at the midpoint and at least 10 feet in length and refers to large logs on the forest floor or in stream areas. LWD provides wildlife habitat and soil building processes on land, and can provide aquatic habitat complexity and stream stability. LWD is important habitat for a variety of wildlife species.

lentic	still water, ponds and lakes
limited operating period (LOP)	A specified period of time during which certain land management activities are prohibited.
lotic	moving water, streams and rivers
LRMP	Land Resource Management Plan
maintenance	The upkeep of the entire forest transportation facility including surface and shoulders, parking and side areas, structures, and such traffic-control devices as are necessary for its safe and efficient utilization (36 CFR 212).
management action	Any activity undertaken as part of the administration of the National Forest.
MAPSS	Mapped Atmospheric Plant Soils System
MIS	Management Indicator species
mitigation	Avoiding an impact by not taking a certain action or parts of an action. Minimizing impacts by limiting the degree or magnitude of the action. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
Montane hardwood forest	Vegetation communities dominated by California black oak, canyon live oak, Pacific madrone or tanoak, for the purposes of this project.
Mycorrhizal fungi	A type of fungi which forms a symbiotic relationship with vascular plants for the purpose of exchanging nutrients and moisture by growing amongst the roots of the plants.
National Environmental Policy Act (NEPA)	Codifies the national policy of encouraging harmony between humans and the environment by promoting efforts to prevent or eliminate damage to the environment. It declares the Federal government to be responsible for: (a) coordinating programs and plans regarding environmental protection; (b) using an interdisciplinary approach to decision-making; (c) developing methods to ensure that non-quantifiable amenity values are included economic analyses; and (d) including in every recommendation, report on proposals for legislation, or other major Federal actions significantly affecting the quality of the environment a detailed environmental impact statement (EIS).

National Forest System	As defined in the Forest Rangeland Renewable Resources Planning Act, the "National Forest System" includes all National Forest lands reserved or withdrawn from the public domain of the United States, all National Forest lands acquired through purchase, exchange, donation, or other means, the National Grasslands, and land utilization projects administered under Title III of the Bankhead-Jones Farm Tennant Act (50 Stat. 525, 7 U.S.C. 1010-1012), and other lands, waters, or interests therein which are administered by the Forest Service or are designated for administration through the Forest Service as a part of the system (36 CFR 212).
natural resource	A feature of the natural environment that is of value in serving human needs.
natural succession	The natural replacement, in time, of one plant community with another. Conditions of the prior plant community (or successional stage) create conditions that are favorable for the establishment of the next stage.
noxious weed	Any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment.
old forest	Areas that contain large, old trees relative to the species-specific, environmentally-constrained growth capacity of the site.
patch	An area of vegetation, similar in structure and composition.
perennial stream	A stream that typically has running water on a year-round basis due to precipitation runoff in the wet season and continual contribution of groundwater to support streamflow throughout the dry season except in smaller streams during droughts.
plantation	A group of trees that have been planted together.
preferred alternative	The alternative(s) which the Agency believes would best fulfill the purpose and need for the proposal, consistent with the Agency's statutory mission and responsibilities, giving consideration to environmental, social, economic, and other factors and disclosed in an EIS.

prescribed fire or burn	A type of fuel treatment whereby fire is intentionally set in wildland fuels under prescribed conditions and circumstances.
Proposed Action	A proposal made by the Forest Service to authorize, recommend, or implement an action to meet a specific purpose and need.
Protected Activity Center (PAC)	Designated areas that are afforded protection to specific species by restricting certain management activities. For example, California spotted owl PACs protect owl habitat and breeding areas by restricting timber harvest.
Radial Ground Application	Target vegetation is treated with herbicides only within a designated radius of each planted tree to reduce competition.
Reasonably foreseeable future action	Those Federal or non-Federal activities not yet undertaken, for which there are existing decisions, funding, or identified proposals. Identified proposals for Forest Service actions are described in 220.4(a)(1) (36 CFR 220.3).
Record of Decision (ROD)	A concise public record of the responsible official's decision to implement an action when an environmental impact statement has been prepared.
reforestation	The natural or intentional restocking of existing forests and woodlands that have been depleted.
regeneration	Tree seedlings and saplings that have the potential to develop into mature forest trees.
release	See definition for "herbicide release."
resilience	The ability of an ecosystem to maintain diversity, integrity, and ecological processes following a disturbance.
Responsible Official	The Agency employee who has the authority to make and implement a decision on a proposed action (36 CFR 220.3).
riparian area	The area along a watercourse, around a lake or pond, or in other wetlands.
Riparian Conservation Areas (RCAs)	Identified areas within a certain distance from streams, special aquatic features, or riparian vegetation. RCA width and protection measures are determined through project-level analysis.

road	A motor vehicle route over 50 inches wide, unless identified and managed as a trail (36 CFR 212).
salvage logging	Dead conifer trees will be cut down and transported to a mill for processing. Logging systems may include ground-based equipment such as harvesters and rubber-tired skidders, or helicopter logging or skyline systems on steeper slopes and where necessary to meet resource objectives.
scope	The range of actions, alternatives, and impacts to be considered in an environmental impact statement (40 CFR 1508.25).
scoping	An early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).
sensitive species	Plant or animal species which are susceptible to habitat changes or impacts from management activities. The official designation is made by the USDA Forest Service at the regional level and is not part of the designation of threatened or endangered species made by the US. Fish and Wildlife Service.
seral stage	The stage of succession of a plant or animal community that is transitional. If left alone, the seral stage will give way to another plant or animal community that represents a further stage of succession.
severe burning	Soil disturbance
silviculture	The art and science that promotes the growth of single trees and the forest as a biological unit.
slash	Tree tops and branches left on the ground after logging or accumulating as a result of natural processes.
snag	A standing dead tree. Snags are important as habitat for a variety of wildlife species and their prey.
Soil burn severity	The effect of a fire on ground-surface characteristics, described in terms of char depth, organic matter loss, altered color and structure of soil, and reduced infiltration. Soil burn severity is measured in high, moderate, and low classes based upon the degree of effects.

Soil compaction	An increase in soil density resulting from repeated tracking by mechanized equipment. Compaction reduces infiltration of water and can cause subsequent erosion, and can adversely affect forest vegetation in compacted areas.
Soil displacement	A lateral relocation of topsoil and often subsoil by movement of mechanized equipment or from sawlog yarding practices. Displacement can result in soil berms or ditches that divert water and lead to erosion.
soil functions	Support for plant growth, soil hydrologic function, filtering-buffering function
special aquatic features	Lakes, ponds, vernal pools, meadows, bogs, fens, springs, and other wetlands.
species	A class of individuals having common attributes and designated by a common name; a category of biological classification ranking immediately below the genus or subgenus; comprising related organisms or populations potentially capable of interbreeding.
stand	A group of trees that occupies a specific area and is similar in species, age, and condition.
Fr-11Standards and Guidelines	The primary instructions for land managers. Standards address mandatory actions, while guidelines are recommended actions necessary to a land management decision.
Targeted area ground application	Herbicide application that is directed at target species. For this project, target species include, but are not limited to, bearclover, grass, whitethorn, manzanita, and deer brush.
understory	The trees and woody shrubs growing beneath branches and foliage formed collectively by the upper portions of adjacent trees.
water quality objectives	Water quality objectives, as listed in the Basin Plan of the California Central Valley Regional Water Quality Control Board, are the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water.
watershed	An area of land above a given point on a stream that contributes water to the streamflow at that point.
WEPP	Water Erosion Prediction Project

wetlands	Areas that are inundated by surface or ground water with a frequency sufficient to support (and that under normal circumstances do or would support) a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.
wildland	An area in which development is essentially nonexistent, except for roads, railroads, power lines, and similar transportation facilities.

CHAPTER 1. PURPOSE OF AND NEED FOR ACTION

Document Structure

The Forest Service has prepared this Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This Environmental Impact Statement discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four chapters:

- *Chapter 1. Purpose and Need for Action:* The chapter includes information on the history of the project proposal, the purpose of 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.
- *Chapter 2. Alternatives, including the Proposed Action:* This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- *Chapter 3. Affected Environment and Environmental Consequences*: This chapter describes the environmental effects of implementing the proposed action and other alternatives.
- *Chapter 4. Consultation and Coordination:* This chapter provides a list of preparers and agencies consulted during the development of the environmental impact statement.
- *Appendices:* The appendices provide more detailed information to support the analyses presented in the environmental impact statement.
- *Index:* The index provides page numbers by document topic.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Amador Ranger District office.

Background

In October 2004, the Power Fire burned approximately 17,005 acres on the Eldorado National Forest (ENF) and private timberlands approximately 17 air miles east of Pioneer, California, in Amador County. Of the 17,005 acres burned, approximately 13,600 was on ENF land. The fire burned with varying intensity, with approximately 6,000 acres burning at high intensity, killing 75% to 100% of the trees and burning the duff and litter that protects the soil. In the high and moderate intensity areas, the fire resulted in high rates of soil erosion, sedimentation to streams, and loss of old forest habitat for sensitive species.

Subsequent to the fire, the Eldorado National Forest prepared the Power Fire Restoration Final Environmental Impact Statement (FEIS) and Record of Decision (ROD), signed August 1, 2005, to address long-term fuel loading, dead tree removal, road repair and public safety. The Power Fire Restoration Project was implemented during the summer and fall of 2005.On August 11, 2005 a lawsuit was filed against the Power Fire Restoration Project. On August 18, 2005 a temporary restraining order was granted until the hearing for a preliminary injunction. The District court denied the preliminary injunction and vacated the temporary restraining order on August 25, 2005. An appeal of the District Court's decision was filed with the Ninth Circuit Court on September 13, 2005. The Ninth Circuit Court issued an emergency injunction on January 11, 2006. The Ninth Circuit Court reversed the District Court decision and issued a preliminary injunction halting falling of trees on March 24, 2006. On August 30, 2006 the District Court issued a preliminary injunction prohibiting logging operations; consequently only approximately 2,500 of the 6,000 high intensity burn acres on NFS lands were salvaged logged.

Figure 1.2 Photo of Power Fire untreated area 10 years post fire (2014). Due to a court injunction the planned logging was not conducted which has resulted in this current condition of high density snags, and heavy downed fire-killed tree on the ground under dense brush that is over ten feet high in places. Note: mid-photo several workers are located, the hard hats are visible. *Photo J. Peabody 6/28/14.*

Currently many areas contain large numbers of snags which are falling at an increasing rate, as well as dense vegetation regrowth with highly variable amounts of natural conifer and oak regeneration. Logged units and pre-fire plantations have mostly been replanted and had brush and grass removed by hand at least once. Surveys show that some of these plantations have failed because the brush and grasses consumed the limited water and nutrients and the seedlings died. Tree survival and growth in the remainder of the plantations are at continued risk of mortality due to high levels of competing vegetation. Some logged areas have not been replanted due to rapid post-fire return of highly competitive vegetation. The primary focus of this project is the 2,500 acres salvage logged along with approximately 600 acres of unsalvaged areas and another 400 acres of pre-fire plantations.

Figure 1.3 Photo of Power Fire where poor stocking of trees has resulted from brush competition. Note planted Ponderosa pine in mid photo on the right (*M. Young 2017*)

There are approximately 10,000 acres in the analysis area where activities are not proposed herein. Of this, approximately 2,500 burned at high intensity and the remaining at low to moderate severity. The 10,000 acre matrix is made up of a variety of conditions including snag patches, portions of pre-existing plantations that survived the Power Fire, and areas of variable natural regeneration often dominated by dense shrub cover. Prescribed fire is planned to occur on about 4,000 of these acres under a separate project, the Power Fire Fuels Maintenance Study Project.

The goal of this project is to move the project area toward the desired future conditions as defined in the Sierra Nevada Forest Plan Amendment (SNFPA) ROD on pages 36 through 48. Removal of some of the dead and dying tree components on the landscape was the first step in reducing long-term fuel loading and restoring the historic Fire Regime Condition Class in the Power Fire Area. This EIS addresses reforestation of conifers and oaks and treatment of noxious weeds on a portion of the landscape.

Figure 1.4 Area of successful reforestation in Power Fire illustrating desired condition. (*M. Young 2017*)

Table 1.1 Land Allocations and Desired Conditions (SNFPA ROD, pgs 45-48)

Land Allocation	Desired Conditions	Management Intent	Management Objectives
Old Forest Emphasis Areas	Forest structure and function generally resemble pre-settlement conditions. High levels of horizontal and vertical diversity exist within 10,000 acre landscapes. Stands are composed of roughly even-aged vegetation groups, varying in size, species composition, and structure. Individual vegetation groups range from less than 0.5 to more than 5 acres in size. Tree sizes range from seedlings to very large diameter trees. Species composition varies by elevation, site productivity, and related environmental factors. Multi-tiered canopies, particularly in older forests, provide vertical heterogeneity. Dead trees, both standing and fallen, meet habitat needs of old-forest-associated species. Where possible, areas treated for fuels also provide for the successful establishment of early seral stage vegetation.	Maintain or develop old forest habitat in: areas containing the best remaining large blocks or landscape concentrations of old forest and/or areas that provide old forest functions (such as connectivity of habitat over a range of elevations to allow migration of wide-ranging old-forest-associated species). Establish and maintain a pattern of area treatments that is effective in: ▪ modifying fire behavior. ▪ culturing stand structure and composition to generally resemble pre-settlement conditions. ▪ reducing susceptibility to insect/pathogen drought-related tree mortality. Focus management activities on the short-term goal of reducing the adverse effects of wildfire. Acknowledge the need for a longer-term strategy to restore both the structure and processes of these ecosystems.	Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior. Maintain and/or establish appropriate species composition and size classes. Reduce the risk of insect/pathogen drought-related mortality by managing stand density levels. Design economically efficient treatments to reduce hazardous fuels.
Wildland Urban Interface (WUI) Threat Zones	Under high fire weather conditions, wildland fire behavior in treated areas is characterized as follows: Flame lengths at the head of the fire are less than 4 feet.	Threat zones are priority area for fuels treatments. Fuels treatments in the threat zone provide a buffer between developed areas and wildlands.	Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior. Design economically efficient treatments to reduce hazardous fuels.

Land Allocation	Desired Conditions	Management Intent	Management Objectives
	The rate of spread at the head of the fire is reduced to at least 50% of pre-treatment levels. Hazards to firefighters are reduced by managing snag levels in locations likely to be used for control in prescribed fire and fire suppression, consistent with safe practices guidelines. Production rates for fire line construction are doubled from pre-treatment levels.	Fuels treatments protect human communities from wildland fires as well as minimize the spread of fires that might originate in urban areas. The highest density and intensity of treatments are located within the WUI.	
WUI Defense Zones	Stands are fairly open and dominated primarily by larger, fire tolerant trees. Surface and ladder fuel conditions are such that crown fire ignition is highly unlikely. The openness and discontinuity of crown fuels, both horizontally and vertically, result in very low probability of sustained crown fire.	Protect communities from wildfire and prevent the loss of life and property. WUI defense zones have highest priority for treatment (along with threat zones). The highest density and intensity of treatments are located within the WUI.	Create defensible space near communities, and provide a safe and effective area for suppressing fire. Design economically efficient treatments to reduce hazardous fuels.
California spotted owl and northern goshawk Protected Activity Centers **(PAC)**	At least two tree canopy layers are present. Dominant and co-dominant trees average at least 24 inches dbh. Area within PAC has at least 60-70% canopy cover. Some very large snags are present (greater than 45 inches dbh). Levels of snags and down woody material are higher than average.	Maintain PACs so that they continue to provide habitat conditions that support successful reproduction of California spotted owls and northern goshawks.	Avoid vegetation and fuels management activities within PACs to the greatest extent feasible. Reduce hazardous fuels in PACs in defense zones when they create an unacceptable fire threat to communities. Where PACs cannot be avoided in the strategic placement of treatments, ensure effective treatment of surface, ladder, and crown fuels within treated areas. If nesting or foraging habitat in

Land Allocation	Desired Conditions	Management Intent	Management Objectives
			PACs is mechanically treated, mitigate by adding acreage to the PAC equivalent to the treated acreage wherever possible. Add adjacent acres of comparable quality wherever possible.
Home Range Core Areas (HRCA)	Within home ranges, HRCAs consist of large habitat blocks having: ▪ at least two tree canopy layers. ▪ at least 24 inches dbh in dominant and co-dominant trees. ▪ a number of very large (>45 inches dbh) old trees. ▪ at least 50-70% canopy cover. ▪ higher than average levels of snags and down woody material.	Treat fuels using a landscape approach for strategically placing area treatments to modify fire behavior. Retain existing suitable habitat, recognizing that habitat within treated areas may be modified to meet fuels objectives. Accelerate development of currently unsuitable habitat (in non-habitat inclusions, such as plantations) into suitable condition. Arrange treatment patterns and design treatment prescriptions to avoid the highest quality habitat (CWHR types 5M, 5D, and 6) wherever possible.	Establish and maintain a pattern of fuels treatments that is effective in modifying wildfire behavior. Design treatments in HRCAs to be economically efficient and to promote forest health where consistent with habitat objectives.

Purpose and Need for Action

The purposes of this project are to:

Reestablish a forested landscape that is fire resilient.

Historically, fires burned in this landscape on a frequent basis (every 11-26 years) and were of low to mixed severity that consumed fuels, killed small trees, and pruned the boles of residual trees (Perry et al. 2011; Van de Water and Safford 2011). These fires are characterized by Fire Regime Condition Class I (Fire Regime Condition Class Interagency Handbook Version 1.0.5). Low to mixed-severity fire regimes typically had large fires but small patch sizes (Agee 2002). Fires burned frequently in these forests, and by regularly consuming fuels, killing small trees, and pruning the boles of residual trees, maintained a relatively fire-resistant landscape (Agee 2002). Forests with significant components of ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) had very small patch sizes, ranging from 0.05 to 0.86 acres (Agee 2002). Over time, as fires were suppressed, vegetation became more dense and surface and ladder fuels increased; the fire regime changed to one characterized by infrequent, mixed severity fires (Condition Class III), with large areas of high mortality, as demonstrated by the Power Fire.

One of the primary objectives of the Power Fire Reforestation Project is to move the project area from its existing condition, which is primarily early-seral conditions, toward the desired future conditions described above.

Currently, trees are at high risk of fire-related mortality due to their small size. Competing vegetation also greatly affects tree growth rates. Control of competing vegetation would increase conifer growth rates. Increased growth would accelerate the development of key habitat and old forest characteristics and reduce the risk of loss to wildland fire (SNFPA ROD, page 49).

Tree mortality is also affected by both the intensity and size of wildfires that occur in the project area. Treatments that reduce fire intensity and rate of spread would reduce tree mortality under wildland fire conditions. Increased fire line production rates would limit the size of wildland fires in the area, further reducing tree mortality, and would allow trees to continue to accelerate their development of old forest conditions .

There is a distinct difference between the desired conditions for forested landscapes and the existing condition of vegetation within the project area. Based on this difference, there is a need to accelerate the reestablishment of a forested landscape that is fire resilient.

Reestablish this forested landscape effectively and efficiently.

Logged units and pre-fire plantations have mostly been replanted and had brush and grass removed by hand at least once. Surveys show that some of these plantations have failed because the brush and grasses consumed the limited water and nutrients and the seedlings died. Tree survival and growth in the remainder of the plantations are at continued risk of mortality due to high levels of competing vegetation. Some logged areas have not been replanted due to rapid post-fire return of highly competitive vegetation. Competing vegetation could persist for the long term, negatively affecting both planted and natural seedling survival, inhibiting tree growth, and delaying the achievement of the LRMP desired conditions.

Currently the establishment of grasses, shrubs, and other vegetation, while variable, is approaching 100% cover over the project area. Establishment of greater than 30% cover of vegetation presents a potential lethal environment to the establishment of conifer seedlings. Currently 20% of the planted areas have failed.

Examination of the planted areas in the project area indicates survival and growth are threatened by competing vegetation. Management of competing vegetation is essential to assure continued survival and growth of the remaining conifer seedlings and to allow planting in units currently understocked to meet desired future conditions for all of the land allocations.

Restore wildlife habitats and provide for the native plant and animal species associated with these ecosystems.

Nearly 50% of the Power Fire burned at high intensity, killing 75-10% of the trees and burning the duff and litter that protects the soil. Another 13% burned at moderate intensity, killing 25-75% of the trees. In the high and moderate intensity areas the fire resulted in loss of old forest habitat for sensitive species. Some dead trees standing today may contribute to the decaying, fallen log component of future old forest and spotted owl habitat. Decomposing logs contribute to the structural complexity of old forests, provide habitat for old forest dependent wildlife species and their prey, and contribute to soil productivity.

A portion of the high and moderate intensity burned area (about 2,430 acres, 18% of the National Forest System lands within the fire area) has been planted with seedlings. Surveys show that over 20% of these plantations have failed. Competition with brush and grasses for the limited soil moisture during the dry summer months caused insufficient growth and mortality in the conifer seedlings. Tree survival and growth in the remainder of the plantations are at continued risk of mortality due to high levels of competing vegetation.

Desired conditions that apply to old forest emphasis areas include dead trees, both standing and fallen, that meet habitat needs of old-forest-associated species. In HRCAs and PACs desired conditions include some very large snags, and higher than average levels of snags and down woody material. Over the long term, desired conditions in PACs and HRCAs include areas of suitable habitat with large trees, and multi-layered, dense canopy cover. Long term desired conditions for old forest emphasis include high levels of structural diversity over large areas comprised of roughly even-aged vegetation groups, varying in size, species composition, and structure. Where possible, areas treated for fuels also provide for the successful establishment of early seral stage vegetation (SNFPA ROD pg. 41).

There is a dramatic difference between the desired conditions and the existing condition of the project area. There is a need to restore/reestablish wildlife habitats and provide for species associated with these ecosystems.

Control or eliminate invasive plant species in the project area to reduce the potential for spread of invasive plants to other areas in the forest.

The project area had documented invasive species infestations prior to the fire. They included yellow starthistle, French broom, skeletonweed, ripgut brome, cheatgrass, medusahead, Klamathweed, bull thistle, woolly mullein, and Himalayan blackberry. After the fire and salvage logging, invasive species infestations increased.

Chapter 1 Goals (desired conditions) for noxious weed management are to manage weeds using an integrated weed management approach according to the priority set forth in Forest Service Manual (FSM) 2902: Priority 1 – prevent the introduction of new invaders; Priority 2 – conduct early treatment of new infestations; Priority 3 – contain and control established infestations; and Priority 4 – proactively manage aquatic and terrestrial areas of the National Forest to increase the ability of those areas to be self-sustaining and resistant to the establishment of invasive species (SNFPA ROD, pg. 36 and FSM 2900). There is a need to control or eliminate invasive species in the project area to move the project area in a trajectory toward the desired condition.

Proposed Action

To meet the purpose and need, the Amador Ranger District of the Eldorado National Forest proposes to plant trees, perform mechanical and chemical treatments to ensure survival and growth of planted and naturally regenerated forests, reduce fuels, enhance oak regeneration and growth, and reduce the occurrence and spread of invasive plants in portions of the Power Fire area.

The proposed action was designed to primarily reforest previously salvage logged areas where the density of snags would not create safety risks for workers. The proposal avoids treatments in designated Wilderness, presently suitable spotted owl habitat, areas with low post fire tree mortality, and areas of moderate to high mortality that were not salvage logged and are too steep for mechanical site preparation, as described above in the Background section.

Decision Framework

Given the purpose and need, the deciding official reviews the proposed action, the other alternatives, and the environmental consequences in order to decide whether to implement the proposed action, the alternative action, or take no action to reforest areas impacted by the Power Fire in the project area. *See Appendix A for a map of the alternatives*.

Forest Plan Direction

The Proposed Action and alternatives are guided by the Eldorado Forest Land and Resource Management Plan (LRMP), as amended by the 2004 Sierra Nevada Forest Plan Amendment (SNFPA). The Forest is subdivided into land allocations (management areas) with established desired conditions and associated management direction (standards and guidelines). Land allocations that apply to this proposal include the following: Wildland Urban Intermix (WUI) – Defense and Threat Zone, General Forest, California Spotted Owl Protected Activity Center (PAC), Northern Goshawk (PAC), California Spotted Owl Home Range Core Area (HRCA), and Riparian Conservation Areas (RCAs).

Public Involvement

The Notice of Intent (NOI) was published in the Federal Register on April 30, 2014. The NOI asked for public comment on the proposal by June 6, 2014. Seven scoping comments were submitted. Comment letters and a summary of comments are found in the project record located at the Amador Ranger District office and electronic files. In addition, as part of the public involvement process, the agency held an open house for the public to learn about the proposed action and provide comments on May 15, 2014. The Amador Calaveras Consensus Group (ACCG), a local citizens group involved in the Collaborative Forest Landscape Restoration Program, provided feedback to the Forest Service during three meetings (July 9, August 5, and September 10, 2014) and one field trip (July 23, 2014).

Using the comments from the public, other agencies, and local governmental officials (see *Issues* section), the interdisciplinary team developed a list of issues to address.

Public Comment Period (30 days) for the Draft EIS Notice of Availability

The 45-day comment period for the Power Fire Reforestation Project Draft Environmental Impact Statement (DEIS) began with publication of the Notice of Availability (NOA) in the Federal Register on April 21, 2017 (80 FR 29701). The Forest Service published a Notice of Availability (NOA) that asked for public comments on the DEIS.

The Forest Supervisor sent a DEIS notification letter to interested parties who submitted unique comments during scoping along with other individuals, permittees, organizations, agencies, and Tribes interested in this project and requesting specific written comments by the filing deadline of June 5, 2017. The Forest Service also published the DEIS on the internet [http://www.fs.usda.gov/project/].

Interested parties submitted 7 comment letters on the DEIS including 6 unique individual letters. The Response to Comments (Appendix B), identifies specific comments and the Forest Service responses to comments. The project record contains the letters received commenting on the DEIS. Responses to public comments were finalized during the development of the FEIS. Responses reflect work done after publication of the DEIS.

Issues

The Forest Service separated the issues into two groups: significant and non-significant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant issues were identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations explain 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 project record located at the Amador Ranger District office and electronic project file.

As for significant issues, the Forest Service identified the following issues during scoping:

Issue 1: Intensive site preparation and reforestation efforts limit both the diversity and the duration of complex early seral forests. Tree planting and herbicides will adversely impact the composition of early successional shrubs, forbs, and grasses within the post-fire habitat, thereby impacting the many species which require complex early seral forest. Ecological integrity and biodiversity are best maintained by protecting shrub habitat and allowing natural succession to proceed unimpeded. Plantations increase fire hazards, decrease forest biodiversity and reduce adaptive resiliency for wildlife. This issue is addressed by Alternative 2, the No Action alternative, partially by Alternative 3, and in the effects discussion in Chapter 3.

Issue 2: Broadcasting herbicide over large areas will immediately reduce cover of native vegetation, permanently reduce the percent of native vegetation in treated plantations, and increase cover of alien grasses and forbs. This is because alien grasses and forbs are stimulated to grow when shrubs are killed; creating highly flammable fuel beds that may burn more frequently, though less intensely, than the native vegetation. Subsequent fires may increase the probability of a reburn intense enough to kill young conifers. Alternative 3 was designed to address this issue.

Issue 3: There is no evidence that the proposed action will result in forests that are more resistant to fire or more resilient to fire effects. The density of planting will increase the potential for yet another stand-replacement fire and proposed plantations will face greater disturbances and risks for large-scale losses due to climate change. In addition, the proposed action fails to emulate the spatial heterogeneity of forest conditions that would have been created by topography's influence on fire frequency and intensity. Alternative 3 was designed to address this issue.

Issue 4: The herbicide risk assessments utilized by the Forest Service, the SERA reports, and the 1989 Regional Vegetation Management EIS do not provide sufficient information regarding potential effects of the chemicals and mixtures proposed for use in the Power Fire area to allow the Forest Service to make an informed decision. This issue is addressed by Alternative 2, No Action, partially by Alternative 3, and in the analysis of effects pertaining to herbicides in Chapter 3.

CHAPTER 2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

Introduction

This chapter describes and compares the alternatives considered for the Power Fire Reforestation Project. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative (i.e., different release methods) and some of the information is based upon the environmental, social and economic effects of implementing each alternative (i.e., the effect on tree growth as a consequence of competing vegetation levels).

Alternatives Considered in Detail

The Forest Service developed three alternatives, including the No Action and Proposed Action alternatives, in response to issues raised by the public.

Changes to the Proposed Action since Public Scoping

Due to new information received since public scoping occurred a change was made to the proposed action. At the time of public scoping USFWS had designated "Proposed Critical Habitat" for the SNYLF. Approximately 500 acres of proposed treatment units fell within the Proposed Critical Habitat area which was defined as a large block of land containing much of the Cole Creek Watershed. In 2014, the project was designed to eliminate effects from herbicides to Proposed Critical Habitat by only using alternated methods of release (hand or mechanical) within the entire Cole Creek watershed. On September 26, 2016, the USFWS finalized the designation of Critical Habitat for the SNYLF which clarified that only areas meeting the definition of "suitable habitat" (areas within 82' of a perennial or intermittent stream, meadow, seep, spring or pond) within the larger watershed designated area would be considered as "critical." In other words, the entire landscape within the Cole Creek watershed would not meet the definition of designated Critical Habitat. Approximately 500 acres have now been changed from hand or mechanical to herbicide release following the same design criteria as the rest of the project area which will result in no effect to suitable habitat in turn having no effect to designated Critical Habitat, or the SNYLF.

Alternative 1

The Proposed Action

Hand planting and inter-planting would occur on approximately 1,598 acres. Inter-planting by hand would occur on approximately 516 acres within the 2,500 acres previously planted. Approximately 1,080 acres would be newly planted by hand. Planting would be accomplished using one of three tree planting arrangements described below. Additional acres would be inter-planted if monitoring shows desired stocking levels have not been met on any of the plantations. *See Appendix A for a map of the alternatives*.

Planting Arrangement 1.A is designed to accelerate the development of old forest conditions without establishing dense, homogenous stands that are at greatest risk to loss in future fires. The prescription is also designed to allow for development of structural diversity over the next several decades as planted areas grow into mature stands. For this purpose trees are planted in small clusters at wider spacing, which would allow for the inclusion of small openings and shrub habitats within planted areas. This arrangement is intended to provide for an interspersion of habitats used by wildlife associated with early forest conditions and for development of heterogeneity in mature forest stands.

The following guidelines for planting would apply on *about* 1,348 acres in areas outside of California spotted owl Protected Activity Centers, sensitive plant occurrences and potential habitat areas, deer critical winter range, and riparian areas: Plant approximately 200 to 400 trees per acre by hand. Trees would be planted in groups of 2 to 4 trees approximately 21 feet apart from the center of the clusters. Planting would be reduced on unproductive ridge tops.

Planting Arrangement 1.B is designed to establish habitat suitable for California spotted owl nesting. Accelerating the development of dense, old forest conditions is the primary objective in these areas. Conifers would be planted at denser spacing to ensure sufficient survival for establishing dense canopied, old forest habitat in a relatively rapid timeframe.

The following guidelines for planting would apply in the approximately 182 acres that are within currently unsuitable habitat occurring in California spotted owl PACs: Plant approximately 300 to 350 trees per acre by hand. Trees would be planted individually at a spacing of approximately 10 to 15 feet.

Planting Arrangement 1.C is designed to accelerate development of more open forest conditions and provide shrub and oak habitats important for wildlife associated with early forest habitats. The Power Fire occurred within a State Game Refuge that includes critical deer winter range for the Salt Springs Deer Herd. This planting arrangement is intended to maintain high quality foraging within this area.

The following guidelines for planting would apply on *approximately* 68 acres of critical deer winter range and a portion of the winter range, and areas that are within sensitive plant occurrences and potential habitat: Plant 100 to 150 trees per acre in identified sensitive plant potential habitat areas, and deer winter and critical winter range areas. Individual trees would be planted on 17 to 20 foot wide spacing.

Conifer Species: Within all planting arrangements a mixture of conifer species (ponderosa pine, Jeffrey pine, sugar pine, Douglas fir, incense cedar, white fir, and red fir) would be planted depending on elevation and seedling availability. Planted seedlings would be grown from seed produced from Region 5 seed orchards or seed of local origin (collected within the same seed zone and 500 foot elevation band as the planting site). Seedlings grown from these sources would exhibit higher levels of genetic variability and broader adaptability. When unavailable, seed would be transferred in compliance with seed transfer rules based on California Tree Seed Zones (1971, J. Buck, et al) and in reference to Region-5 Forest Service Handbook (FSH) 2409.26, Section 42.2.

Inter-planting would be implemented where seedling mortality threatens plantation failure (less than 60% stocking at 100 trees per acre within planting Arrangements 1.A and 1.C or 60% stocking at 200 trees per acre within planting Arrangement 1.B). Opportunities to provide patches of early seral vegetation less than one acre in size by limiting inter-planting on some sites with high seedling mortality would be evaluated.

Site preparation (mechanical and chemical treatment prior to planting) is proposed on approximately 1,080 acres. Mechanical methods include mastication and tractor piling and burning on approximately 630 acres. Chemical site preparation would involve targeted area ground application of glyphosate or aminopyralid/glyphosate on approximately 448 acres prior to planting. Prior to chemical application, brush may be cut on portions of units for access.

Chemical application would be restricted to ground-based methods. Colorants would be added to the herbicide mixtures to provide visibility for applicators to track coverage. Adjuvants would be added to herbicide mixtures to improve herbicide effectiveness. The herbicides, application rates, and additives proposed for use, plus herbicide exclusion zones adjacent to streams and other aquatic features, are described in the Design Criteria.

Herbicide Formulations and Applications

The use of chemical applications for site preparation, release and invasive species treatments would follow the formulation, application rates, and additives listed in Table 2.1. Glyphosate and triclopyr would *primarily* be used for site preparation and release. Aminopyralid and clopyralid would *primarily* be used for control of invasive species.

Table 2.1 Herbicide Formulations, Application Rates and Additives

Herbicide Formulation	Application Rate (a.e/acre.)	Additives
Glyphosate (Rodeo® or equivalent formulation)	2.7 - 4.8 lbs/acre	NPE-based, MSO-based, or silicone/MSO based blend surfactant, dye
Aminopyralid (Milestone® or equivalent formulation)	0.11 lbs/acre	NPE-based, MSO-based, or silicone/MSO based blend surfactant, dye
Triclopyr (Garlon 4® or equivalent formulation)	3.0 lbs/acre	NPE-based, MSO-based, or silicone/MSO based blend surfactant, dye
Clopyralid (Transline® or equivalent formulation)	0.25 lbs/acre	NPE-based, MSO-based, or silicone/MSO based blend surfactant, dye

Release of conifer seedlings from competing vegetation would involve targeted area ground application (application directed to target species) of herbicide by hand on approximately 3,508 acres. Prior to herbicide application, brush may be cut on portions of units for access. Follow-up herbicide applications would occur if monitoring results show competing vegetation (grasses and/or brush) is projected to exceed 40% ground cover of the plantation within 3 to 5 years of planting. Follow-up applications would include the following methods by vegetation type:

Table 2.2 Follow-up Application Methods by Vegetation Type

Competing Vegetation Type	Follow-up Herbicide Application Method
Bearclover/grass	Targeted area ground application.
Whitethorn and manzanita	First follow-up would be targeted area ground application within an 8 foot radius of trees.
Deerbrush	First follow-up would be targeted area ground application and additional follow-up would be ground application within an 8 foot radius of trees.

Hand grubbing or cutting would be used to release conifer seedlings within no spray buffers.

Control of invasive plant species would follow integrated pest management principles including manual, mechanical, and chemical control methods. Chemical control methods may include directed foliar using clopyralid, aminopyralid, or glyphosate.

Oak stand improvement would include oak pruning/thinning or fencing as needed to improve oak regeneration and growth within approximately 900 acres of deer winter range and critical winter range. Conifer trees (up to 10 inches diameter at breast height, dbh) within 20’ feet of existing oaks within the deer winter and critical winter ranges would be cut, lopped, and scattered. Fencing would be used to protect individual oaks from deer and cattle browsing with small cages 2-4’ in diameter or by fencing areas ¼ acre to 2 acres in size.

Alternative 2

No Action

Under the No Action alternative, current management plans would continue to guide management of the project area. Actions approved under other NEPA decision documents would continue to be implemented. No reforestation and other activities as described herein would be implemented to accomplish the purpose and need. The No Action alternative addresses Issues 1 and 4. Aside from other approved projects, which includes previous planting and hand release on approximately 2,500 acres, as well as the prescribed burning primarily conducted outside of reforestation areas, the trajectory of early seral forest development would continue unimpeded by management actions.

Alternative 3

Alternative 3 was designed to address Issues 2, 3, and partially address Issue 4. With the exception of grass and bearclover, this alternative employs a radial spray approach to herbicide application for release in order to enhance native plants when compared to the Proposed Action. Under this alternative, the amount of herbicide spray would be reduced as compared to the proposed action. Except where noted, vegetation is treated only within a designated radius of each planted tree to reduce competition while allowing existing native vegetation to grow in-between planted trees thereby maintaining a seed bank and habitat diversity. In addition, this alternative addresses Issue 3 by varying the planting density to emulate the spatial heterogeneity of forest conditions that would have been created by topography's influence on fire frequency and intensity. This alternative differs from the Proposed Action primarily in planting arrangements, planting density (trees per acre), and type and methods of release. *See Appendix A for a map of the alternatives*.

Hand planting and inter-planting would occur on approximately 1,598 acres. Inter-planting would occur on approximately 516 acres within the 2,500 acres previously planted. Approximately 1,080 acres would be planted by hand using one of five tree planting arrangements (Table 2.2). Additional acres would be inter-planted if monitoring shows desired stocking levels have not been met on any of the plantations.

Planting levels are designed to meet the long term desired stocking of each condition/topographic pattern listed below. Initial planting levels are based on the long term desired stocking, recent district and Forest seedling survival data by conifer species, and site conditions. Trees would be planted individually and in groups (or clusters) to initiate the development of the long term desired stocking levels shown in Table 2.3. Tree placement on the landscape would utilize local microsite conditions to initiate heterogeneity enhancement. Species composition would be based on the local conditions (topography, aspect, elevation).

Table 2.3 Planting Arrangements Proposed Under Alternative 3

Planting Arrangement	Condition/Topographic Pattern	Long Term Desired Stocking (TPA)
3.A	Low Sites, Oak dominated areas	0-40
3.B	Strategic Fire Management Zones, Broad Ridges	40-80
3.C	Upper Slopes, Broad Ridges	70-100
3.D	Mid Slopes	80-120
3.E	Lower Slopes	130-250

Planting Arrangement 3.A would apply on about 140 acres. Plant approximately 40-80 trees per acre by hand. Trees would be planted as singles or in groups of 2 to 10 trees.

Planting Arrangement 3.B would apply on about 448 acres. Plant approximately 80-160 trees per acre by hand. Trees would be planted individually or in groups of 2 to 10 trees.

Planting Arrangement 3.C would apply on about 740 acres. Plant approximately 140-200 trees per acre by hand. Trees would be planted individually or in groups of 2 to 10 trees.

Planting Arrangement 3.D would apply on about 217 acres. Plant approximately 150-250 trees per acre by hand. Trees would be planted individually or in groups of 2 to 10 trees.

Planting Arrangement 3.E would apply on about 53 acres. Plant approximately 250-450 trees per acre by hand. Trees would be planted individually or in groups of 2 to 10 trees.

Inter-planting would be implemented where seedling mortality threatens meeting the long term desired stocking level.

No planting would occur within 40 feet of the drip line of mature living oaks, or within 20 to 40 feet of the dominant stem of stump sprouting oaks, or oak sapling stems greater than or equal to one inch in diameter. Applicable distance is generally 40 feet from black oak and 20 feet from live oak species.

Site preparation and Release – Methods and types of site preparation and release would be based on primary competing vegetation types.

Site preparation (mechanical and chemical treatment prior to planting) is proposed on approximately 1,082 acres. Mechanical methods include mastication and tractor piling and burning on approximately 630 acres. Targeted area ground application of herbicides for site preparation would be implemented on approximately 448 acres prior to planting. Prior to chemical application, brush would be cut on about 105 acres where deerbrush is the primary competing vegetation type.

Release of young conifers from competing vegetation would involve ground application of herbicide on approximately 3,508 acres. Prior to herbicide applications, brush would be cut on units where whitethorn and deerbrush is the primary competing vegetation types.

Initial and follow-up applications would include the following methods by vegetation type:

Table 2.4 Application Methods for Release by Vegetation Type

Competing Vegetation Type	Herbicide Application Method
Bearclover/grass	Same as Proposed Action
Whitethorn, manzanita, and deerbrush	Initial and follow-up herbicide applications would be a 5 foot radial ground application

Control of invasive plant species and oak stand improvement are the same as described above for Alternative 1.

Design Criteria Common to All Action Alternatives

The Forest Service developed the following design criteria applicable to all of the action alternatives. Design criteria are measures to ensure meeting purpose and need while minimizing environmental effects.

Aquatics and Hydrology

Implement Best Management Practices (BMPs) to protect soil and water quality. Include BMPs in project contract specifications and maps and adhere to them during project implementation. These measures are required to meet State of California water quality standards. BMP checklists will be developed to track implementation during appropriate project phases.

To limit herbicides from entering surface waters through overland flow, or through leaching, chemical treatments would not occur during rainfall, or preceding forecasted rainfall. Above 4500’ elevation there would be no project activities within 82’ of perennial and intermittent streams, and special aquatic features (springs, meadows, wetlands, etc.).

Below 4500’ for perennial streams, no planting would occur within 25 feet of streambanks or associated riparian vegetation. For special aquatic features, no planting would occur within 50 feet of the edge of the features or within 20 feet of associated riparian/wetland vegetation, whichever is greater. For intermittent streams, no planting would occur within 20 feet of associated riparian vegetation (if present). There would be no planting within 20 feet of natural regeneration for perennial or intermittent streams. There are no restrictions on planting near ephemeral streams.

Table 2.5 Exclusion Zones for Herbicide Application

Aquatic Feature Type	Herbicide Formulation	Distance (Feet) above 4,500 foot Elevation	Distance (Feet) below 4,500 foot Elevation
Perennial Streams and Special Aquatic Features	Aminopyralid	107	100
	Glyphosate	107	50
	Triclopyr	107	100
	Clopyralid	107	100
Intermittent Streams	Aminopyralid	107	100 if wet, 50 if dry
	Glyphosate	107	50 if wet, 25 if dry

Aquatic Feature Type	Herbicide Formulation	Distance (Feet) above 4,500 foot Elevation	Distance (Feet) below 4,500 foot Elevation
	Triclopyr	107	100 if wet, 50 if dry
	Clopyralid	107	100 if wet, 50 if dry
Ephemeral Streams	Aminopyralid	50 if wet, 25 if dry	50 if wet, 25 if dry
	Glyphosate	25 if wet, 10 if dry	25 if wet, 10 if dry
	Triclopyr	50 if wet, 25 if dry	50 if wet, 25 if dry
	Clopyralid	50 if wet, 25 if dry	50 if wet, 25 if dry

Table 2.6 Riparian Conservation Areas (RCAs) and Equipment Exclusion Zones (EEZs) adjacent to streams and other aquatic features

Aquatic Feature Type	RCA Width (each side)	EEZ Width (each side below 4500')	EEZ Width (each side above 4500')
Perennial Streams	300 feet	100 feet	100 feet
Intermittent Streams	150 feet	50 feet	100 feet
Ephemeral Streams	100 feet	25 feet	25 feet
Special Aquatic Features (meadows, springs, reservoirs, wetlands, etc.)	300 feet	100 feet	100 feet

There would be no mechanical equipment entry within entire RCA where slope is greater than 35%.

All equipment traveling through suitable Sierra Nevada yellow legged frog (SNYLF) habitat will only occur on Forest System roads.

If SNYLF is sighted within the project area, cease operations in the sighting area, and inform project aquatic biologist of the sighting immediately. Before commencing activities, consultation may need to occur with United States Fish and Wildlife Service (USFWS), if there are anticipated effects to this listed species.

Tightly woven fiber netting, plastic mono-filament netting, or similar material shall not be used for erosion control or other purposes in suitable SNYLF habitat.

All distances are slope distance.

Water Drafting

Water Drafting Assessment - An aquatic biologist will assess the water drafting sites for sensitive and listed species and flow levels prior to using. If sensitive, threatened, or endangered species are identified at a potential water drafting site, that site would not be used for water drafting.

Pump Intake Screens - In perennial and intermittent streams, pump intake screens shall have openings not exceeding 3/32-inch (0.09375 inch) and be sized according to the pump intake capacity. Place hose intake into bucket in the deepest part of the pool. Use a low-velocity water pump and do not pump natural ponds to low levels beyond which they cannot recover quickly (approximately one hour).

Water Drafting on Fish-Bearing Streams - For water drafting on fish-bearing streams: do not exceed 350 gallons per minute for streamflow greater than or equal to 4.0 cubic feet per second (cfs); do not exceed 20% of surface flows below 4.0 cfs; and cease drafting when bypass surface flow drops below 1.5 cfs.

Water Drafting on Non-Fish-Bearing Streams - For water drafting on non-fish-bearing streams: do not exceed 350 gallons per minute for stream flow greater than or equal to 2.0 cfs; do not exceed 50% of surface flow; and cease drafting when bypass surface drops below 10 gallons per minute. Water sources designed for permanent installation, such as piped diversions to offsite storage, are preferred over temporary, short-term-use developments. Locate water drafting sites to avoid adverse effects to instream flows and depletion of pool habitat.

In-Channel Water Drafting Locations- In-channel water drafting locations will include rocking of approaches, barrier rock, straw bales, or other measures to prevent overflow and leaks from entering the watercourse.

No drafting out of Cole Creek (occupied SNYLF habitat).

Cultural Resources

Cultural resource sites would be flagged and avoided during planting and herbicide spraying. Follow standard protection measures outlined in Appendix E of the Region 5 Programmatic Agreement. No ground disturbing activities will occur within flagged site boundaries. Work within the Mokelumne Canyon Archaeological District shall follow guidelines in the LRMP Special Management Area guidelines for Management Area 4.

Fence the sensitive area at the end of Forest Service road 7N01, approximately 2.5 acres, for resource protection.

Wildlife

No trees would be planted within the Mokelumne Wilderness Area or presently suitable California spotted owl habitat.

A limited operating period (LOP) for California spotted owls (March 1 through August 15) and for northern goshawks (February 15 through September 15) would restrict activities for units, or portions of units, that are located within ¼ mile of spotted owl or goshawk nests, unless surveys confirm that owls or goshawks are not nesting. In the absence of recent nest location data, units, or portions of units, or within ¼ mile from PAC boundaries have been covered by the LOPs. Depending on the tools used (hand tools vs. power tools, or machinery), pre-implementation surveys, and distance, these LOPs may be lifted if activities are determined by the district biologist to be unlikely to affect nesting activity within the potentially affected PACs.

Except as described above for Alternative 3, Planting Arrangement 3.E, which is more restrictive, no planting would occur within 20 feet of the drip line of mature living oaks, the dominant stem of stump sprouting oaks, and oak sapling stems greater than or equal to 1 inch in diameter.

Botanical Resources

All known sensitive and watch list plant occurrences will be flagged on the ground and included on project area maps prior to project initiation. All occurrences of sensitive plants within 500 feet of chemical site preparation or release units will be flagged for avoidance with a buffer of 50 feet, and monitored.

All activities will be excluded from sensitive and watch list plant occurrences unless approved by the project botanist in advance of implementation. Reforestation activities would be excluded from any newly discovered sensitive and watch list plant occurrence. All potential habitat for sensitive plant species will flagged and avoided during reforestation activities unless area has been surveyed for sensitive plants.

Hand thinning of overgrown *Calochortus clavatus* var. *avius* populations may occur at the direction of a Forest Service botanist when the botanist has determined thinning would be beneficial to the population.

New infestations of barbed goatgrass (*Aegilops triuncialis*) and medusahead (*Elymus caput-medusae*) would be treated using a combination manual, mechanical, and/or herbicides (aminopyralid, clopyralid, or glyphosate). Other priority 1, 2, or 3 invasive plant species would be treated based on forest-wide invasive plant strategies and methods analyzed in the Eldorado National Forest Invasive plant Eradication and Control decision.

Invasive plant occurrence found within the project area will be marked with flagging and mapped. Where feasible, all invasive plant occurrences would be excluded from direct ground disturbance or other project related activities other than control as described in the alternatives in order to reduce the potential spread of invasive plants within the project area.

All off-road equipment would be cleaned to insure they are free of soil, seeds, vegetative matter, or other debris prior to entering National Forest System land. Equipment would also be cleaned prior to moving from infested to unifested areas within the project area.

Native seed mixes and/or certified weed free straw will be used when needed for erosion control purposes.

Sand, gravel and fill material would come from weed-free sources. Consult with the Forests Botanist for sources of weed-free material.

Broadcast seeding of native grass and forb species would be considered three years after initial herbicide release if the cover of native grasses and forbs is < 40% within proposed reforestation units. Broadcast seeding would adhere to Forest Service native material policy which requires the use of a mix of genetically appropriate native materials. Seeding would not occur when grasses are expected to be targeted during future herbicide release.

Project area would be monitored annually for invasive plant species for the first 5 years following initial site preparation.

Consult annually with American Indian tribes as treatments are scheduled so that tribal members may provide input and/or be notified prior to gathering cultural plants. Any areas identified for avoidance will be buffered similar to the design criteria for Sensitive Plants or an alternative, non-herbicide method for treatment will be utilized.

Alternatives Considered but Eliminated from Detailed Study

NEPA requires that Federal agencies rigorously explore and objectively evaluate all reasonable alternatives and 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 and internal scoping suggested a number of alternative approaches to the Proposed Action. Some of the suggested alternatives were outside the scope of the need for the proposal, duplicative of the alternatives considered in detail, did not meet the Forest Plan, or contained components that would cause unnecessary environmental harm. The following alternatives are based on scoping comments and were considered but dismissed from detailed consideration for reasons summarized below:

No Herbicide Alternative

A no herbicide alternative was alluded to in some comment letters. This alternative was considered but not in detail because it would not meet the Purpose and Need for the project. This alternative is summarized below:

- Limited planting would occur in 1 to 2 acre patches within a minimum of 2,000 feet from an existing seed source and 1,000 feet from other planted patches.
- No herbicide release for planted seedlings.
- Forest Plan Amendment to allow for unplanned ignitions to be managed for multiple natural resource benefits.

- Prescribed fire would be used to provide for site preparation treatments and for maintenance treatments into the future

This alternative was considered but eliminated from detailed study because it does not meet the purpose and need and for reasons described below:

- This alternative does not meet the Purpose and Need identified for this project which is to reestablish this forested landscape effectively and efficiently. Under this alternative, the brush and grasses would continue to consume the limited water and nutrients and the seedlings would continue to die. Tree survival and growth in the remainder of the plantations would endure continued risk of mortality due to high levels of competing vegetation. Some logged areas would not be replanted due to rapid post-fire return of highly competitive vegetation. Competing vegetation would persist for the long term, negatively affecting both planted and natural seedling survival, inhibiting tree growth, and delaying the achievement of the LRMP desired conditions.
- This alternative does not meet the purpose and need to restore wildlife habitats and provide for the native plant and animal species associated with these ecosystems. In the areas that burned at high and moderate intensity, the fire resulted in loss of old forest habitat for sensitive species. Tree survival and growth in the remainder of the plantations with growing trees would remain continued risk of mortality due to high levels of competing vegetation. The dramatic difference between the desired conditions and the existing condition of the project area would remain unchanged. The need to restore/reestablish wildlife habitats and provide for species associated with these ecosystems would be unmet.
- This alternative does not meet the purpose and need to control or eliminate invasive plant species in the project area to reduce the potential for spread of invasive plants to other areas in the forest. The documented invasive species infestations prior to the fire would persist. These include yellow starthistle, French broom, skeletonweed, ripgut brome, cheatgrass, medusahead, Klamathweed, bull thistle, woolly mullein, and Himalayan blackberry.

Prescribed Fire, Natural Regeneration, Limited Cluster Planting Alternative

The objective of this alternative is to reintroduce fire to the landscape, rely principally on natural regeneration, provide a conifer seed source in areas unlikely to naturally regenerate within 20 years (founder stands), and utilize mulching or mastication to aid in reintroduction of fire.

This alternative is similar to the alternative described above but includes mastication and modifications in the planting strategy as described below:

- Actively manage early seral forests using prescribed fire.

- Forest Plan Amendment to allow for unplanned ignitions to be managed for multiple natural resource benefits.
- Only plant where natural regeneration is unlikely to occur within the next 20 years.
- Implement cluster planting strategy: 1) in areas greater than 1,000 feet from a seed source; and 2) if there is no successful regeneration in areas greater than 500 feet of a seed source after 5 years.
- Plant 2-10 acre blocks on sites likely to support forest in the foreseeable future based on climate change and ecological considerations.
- Do not plant more than 20 percent of contiguous seed deficient polygons.
- Planted blocks (Founder stands) are heavily managed for fire resilience with 25’-50’ buffers of limited vegetation to secure successful survival.
- Utilize one or more mulching masticator machines for short term (replanting) and longer-term maintenance of the site.

This alternative does not meet the purpose and need for the project to effectively and efficiently reestablish a forested landscape that is also fire resilient. This alternative is designed to restore fire over the landscape, and maintain and manage to some degree complex early seral forest conditions, rather than actively restore forest cover and late seral wildlife habitat. Thus it is fundamentally designed to achieve a different purpose and need than articulated herein for this project. The Forest Service agrees that the reintroduction of fire is desirable at some point in the future in this project area to aid in fuel reduction, wildfire resilience, and ecological restoration, and is proposing the Power Fire Fuels Maintenance Study which is intended to treat fuels including restoring fire to the landscape on approximately 4,000 acres of mixed conifer and red fir forests that burned at low to moderate severity during the 2004 Power Fire. This is a separate project from the Power Fire Reforestation Project addressed in this EIS (refer to Chapter 3, Table 3.1).

The existing condition within the project area has developed over the past 13 years post Power Fire. The vegetation consists of areas of naturally regenerated and planted trees within a matrix of shrubs, forbs, and grass; and areas of shrubs where trees are generally absent. The fire area also contains large areas of standing and fallen snags with an understory of shrubs, forbs, and grasses where salvage harvest did not occur, and no reforestation is proposed. There are approximately 10,000 acres in the analysis area where activities are not proposed. Of this approximately 2,500 were burned at high intensity and the remaining at low to moderate. The 10,000 acre matrix is made up of a variety of conditions including snag patches, portions of pre-existing plantations that survived the Power Fire, and areas of variable natural regeneration often dominated by dense shrub cover.

A recent study applying prescribed fire to plantations in the Sierra Nevada concluded that prescribed fire can be effective in reducing fuel and increasing wildfire resiliency (Kobziar 2009), however the plantations in the study were 25 to 30 years old, approximately 12" in dbh, with a height to live crown pre-burn of approximately 8 to 13 feet. Applying prescribed fire in the project area under the current vegetation conditions is likely to lead to extensive mortality of existing conifer regeneration where it exists.

Canopy base height (CBH) is the lowest height above the ground at which there is a sufficient amount of canopy fuel to propagate fire vertically into the canopy (Scott and Reinhardt 2001). When the height from the surface fuels to the bottom of the tree crown is low, for example only 5 feet or less, which is the current condition, a relatively short flame length will ignite the crown. A greater height from the ground would require a larger flame length to ignite. Thus to apply prescribed fire without substantial tree mortality, the canopy base height must be sufficiently high to avoid initiation of a crown fire. In addition, the planted and naturally regenerated trees in the Power Fire area are less than ten years old and susceptible to death from cambium scorch due to thin bark. As the trees grow and age, the bark will thicken, particularly on Ponderosa pines. Mastication can increase canopy base height but it also increases surface fuel loading and fire intensity over the short term.

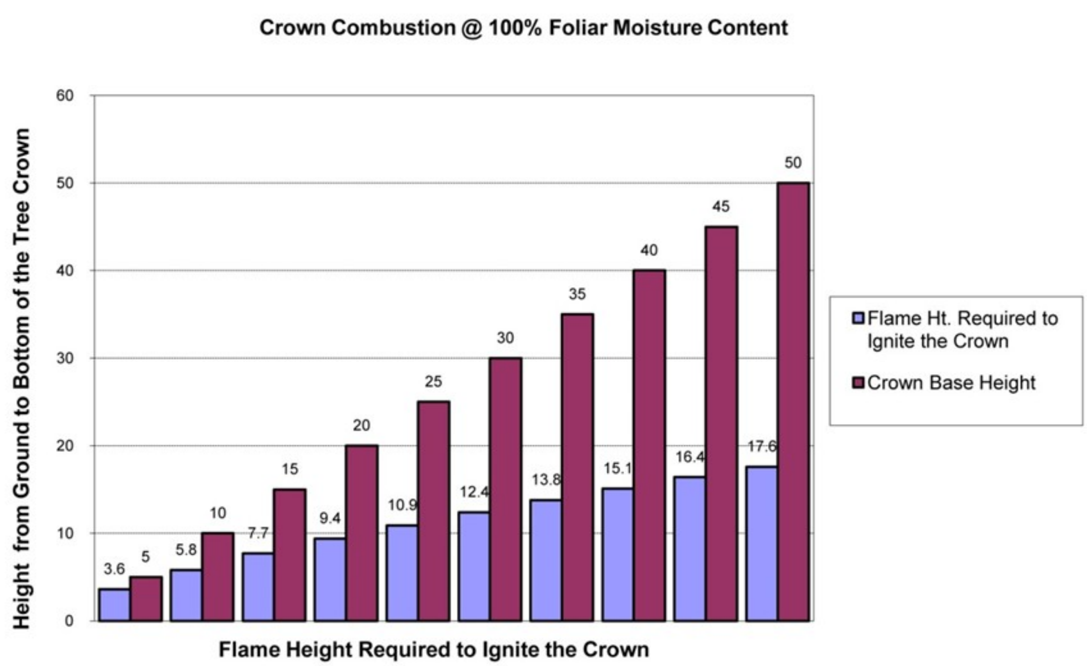

Figure 2.1 Flame height required to ignite tree crowns

Once a fire begins burning in the crowns of the trees, whether that crown fire ignition is sustained or not is determined by surface fire rate of spread, and crown bulk density (Alexander 1988, Van Wagner 1977).

Field review of the proposed treatment areas shows that while some variety does exist, most of the areas have filled in with grass and shrubs. There are some small diameter trees within some of the units as a result of planting or natural regeneration. Modeling of potential fire behavior and existing tree mortality shows that current rates of spread and fire intensity ranges from moderate to high, with very high mortality to regenerating trees. It is unlikely that restoring fire to the landscape in the short term could be accomplished without killing most of the naturally regenerating and planted forests. The most effective way to restore fire to the landscape in the shortest time is to increase the canopy base height and reduce ladder fuels by controlling competing shrubs, grasses, and forbs to encourage tree growth. This alternative would prolong the current vegetative condition and prolong the time to effectively reintroduce fire without extensive conifer mortality.

As part of project development, many alternatives to herbicide use were proposed and considered which included mastication, mulching or mowing. To document the evaluation of these alternatives, the project Silviculturist wrote a report titled “Review of Alternative Silvicultural Methods” (Carroll, 2016), which can be found in the project file and is hereby incorporated by reference. Based on the findings documented in this report and the scientific research it was based on, the decision maker chose not to analyze an alternative in detail that excluded the use of herbicide.

As described in “Review of Silvicultural Methods”, the following is presented on mastication or brush cutting:

> “Mechanical mastication of non-sprouting manzanita is more successful with larger plants than smaller ones. Thin stems are resistant to severing because they are so “whippy”. Even if severed, sprouting can occur from lower on the stem. Hand cutting can be effective on small plants if cut below the root collar, but high costs and large number of acres makes this infeasible. Very little non-sprouting manzanita is present on the Power Project Area.
>
> Mechanical or hand cutting of sprouting manzanita is only effective for seedlings, and only if the cuts are made at or below the root collar.
>
> Machine cutting of deer brush is effective in the short-term on large plants, but vigorous resprouting is a major problem. Hand cutting can be effective with seedlings less than 3-4 years old, but only when the soil is moist and the top portion of the roots can be can be removed. This is often impractical as thousands of seedlings can germinate per acre and repeated hand cutting is costly and inefficient. Mechanical shredding is part of the proposed action where it is appropriate.
>
> This treatment has little effect on bear clover because it resprouts rapidly. The roots of the bear clover, which compete for moisture with conifer seedlings, extend at least four feet into the soil, and therefore cannot be grubbed out. Past experience with this species indicate that resprouting is so vigorous on some

sites that contract specifications for removal cannot be met as resprouts can occur before the contract is even completed.

Mowing as a conifer release tool is hampered by terrain limitations. Rocks, logs, and other native materials scattered through the treatment areas create additional difficulties for mowing. Mechanical removal involving mastication or uprooting is not feasible where seedlings are planted as seedlings would be difficult to see and suffer a high degree of mechanical damage/death. Most of the species in the project area would readily resprout if mown and live vegetation were left above ground, allowing these plants to continue to compete for moisture with conifer seedlings."

Because resprouting brush will not die and continue to be competition with trees, mastication was not analyzed in detail since it would not meet the purpose and need. In addition, there is also a cost associated with such treatments. Based on estimates given in the economic analysis for the alternatives studied in detail, the cost for mechanical site prep which could include the use of mastication is $600/acre. In comparison a targeted area treatment with herbicide is estimated at $400/acre. Given that in order to keep resprouting brush at desired levels for fire and fuels it would need to be re-treated every 3-5 years with mastication, it would cost an estimated $1,800/acre over a 15 year period. At the end of the 15 year period the brush would still be alive and be in need of continual maintenance. In contrast, although herbicide may need to used twice over the same 15 year time period, primarily to deal with new plants coming up from seed, at a cost of $800/acre the brush will be effectively killed and not in need of continual treatment. This is a difference of $1,000/acre.

Where trees have not been previously planted this alternative would rely on additional natural regeneration for conifer stocking. Some conifers have seeded in and would continue to seed in from scattered trees that survived the Power fire. Seed germinating from these sources would encounter substantial competition for moisture because the temporary reduction in competing vegetation as a result of the fire has dissipated over the past 13 years. Conifer survival would be low due to moisture competition and a vegetative overstory of grasses and shrubs, resulting in a sparse conifer component within a 100% cover of shrubs. Shade tolerant conifer species (incense cedar, Douglas fir, and white fir) would be more likely to eventually be established under a brush understory, however overall tree cover would be low due to lack of nearby seed sources and vigorous competition. Shade intolerant conifers (ponderosa pine and sugar pine) would be less likely to establish under a brush overstory and would not be released. Planting founder stands in areas that have not regenerated or are not likely to regenerate naturally would delay development of forest cover by decades or possibly centuries because the founder trees must first grow sufficiently to develop cones and then the seed must spread 500 to 1000 feet and germinate in areas fully occupied by competing vegetation as discussed above.

Research suggests that secondary succession from shrub-dominated vegetation to conifer forest (especially mature forest) can require longer than 100 years without human intervention. While studies have observed conifer regeneration in high-severity patches (Shatford et al. 2007), seedling density is often lower following high- severity fire than in lower severity burns (Crotteau et al. 2013). Similarly, Russell et al. (1998) reported that successful post-fire establishment of conifers among shrubs required 30 to 50 years and then several additional decades before conifers overtook the site. The findings of Conard and Radosevich (1982b) and Nagel and Taylor (2005) also suggest that development of conifer forest in areas dominated by shrubs is slow and requires well over 100 years in the absence of fire. This slow succession results from a low abundance of conifer seed sources and intense shrub competition that slows the growth of conifer seedlings. Crotteau et al. (2013) found that about 60% of conifer seedlings were overtopped by shrubs 10 years after a high-severity fire in a mixed-conifer forest. Shatford et al. (2007) concluded that following high- severity fire, shrubs would likely overtop and slow development of conifer seedlings for about 20 years, and beyond 20 years, establishment of conifer forest would be unpredictable. Nagel and Taylor (2005) observed white fir seedlings growing among shrubs that had grown only one foot over the span of 30 years. Most importantly, shade-tolerant conifers such as white fir often dominate conifer regeneration following large high-severity fires (Collins and Roller 2013; Crotteau et al. 2013; Shatford et al. 2007), which is an indication that large high-severity fires are causing an ecosystem type shift (Collins and Roller 2013; Crotteau et al. 2013).

An inventory of natural regeneration and survival near seed sources on the Fred’s Fire in the Eldorado National Forest (Bohlman & Safford, 2015) found that the highest abundance of regeneration occurred in the areas of low basal area mortality and that the lowest levels of tree regeneration occurred when basal area mortality was greater than 75 percent. Additionally, an exponential reduction in regeneration was seen as distance to nearest seed source increased beyond 100 feet. While average seedling and sapling density appears high throughout the plots established in the Fred’s Fire, it was found that for all species, in all severity classes, with the exception of ponderosa pine, the median number of trees per acre was zero, indicating that while some areas had prolific regeneration, in most areas low or no regeneration is occurring.

Bohlman et al. (2016) found that at 22 and 41 years after fire, the areas that were not reforested in the Cleveland and Pilliken fires on the Eldorado National Forest had very few trees per hectare and median tree densities in their plots were zero. Planted areas on the other hand supported high median stand densities, as well as higher numbers of native species. The study found native plant species richness following the Fred’s Fire, Pilliken Fire, and Cleveland Fire was significantly higher in planted areas where shrub cover was lower and planted trees successfully established than in untreated sites. Lower plant species richness was associated with higher shrub cover and higher plant species richness was associated with higher soil moisture. Forty-one years after fire soil moisture was significantly lower in untreated plots dominated by shrubs than in treated plots dominated by trees. Areas that were not reforested in these older sites are often occupied by tall, dense stands of montane chaparral. Some of these stands are up to 13 feet tall and are dominated by a few shrub species (e.g., Ceanothus integerrimus, Arctostaphylos viscida, Ceanothus cuneatus). If these sites do not re-burn, such low diversity stands of fire-initiated montane chaparral can persist for many years, until they are eventually shaded out by conifers that can tolerate decades of low light (usually shade-tolerant, fire-sensitive species like white fir). In an area such as the Mokelumne River canyon, there is a reasonable likelihood that shrub-dominated landscapes will re-burn before conifers are able to repopulate them.

Re-burns of these chaparral stands tend to burn at high severity, further inhibiting conifer regeneration, leading to a potentially permanent type-conversion to shrubfields.

Figure 2.2 Photo of the Star Fire of 2001 on the Tahoe National Forest taken 14 years post fire. Despite the visible seed source and planting and hand grubbing that took place, very little conifer regeneration is evident. (*P. Ferrell, 2015*)

Figure 2.3 Photo of the Power Fire in 2017. Despite the visible seed source no conifer regeneration is evident. (*M. Young, 2017*)

As discussed above for the No Herbicide alternative, this alternative would also not meet the purpose and need to restore habitat for old forest dependent species, nor control or eliminate invasive plant species in the project area.

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 2.7 Proposed Actions in Each Alternative and Summary of Effects.

	Alternative 1: Proposed Action	Alternative 2: No Action	Alternative 3
Planting Arrangement			
3.A: 40-80 TPA (low sites, oak dominated areas)	0	0	140 acres
3.B: 80-160 TPA (strategic fire management zones, broad ridges)	0	0	448 acres
1.C: 100-150 TPA (open forest condition with shrub and oak habitats)	68 acres	0	0
3.C: 140-200 TPA (upper slopes, broad ridges)	0	0	740 acres
3.D: 150-250 TPA (mid slopes)	0	0	217 acres
1.B: 300-350 TPA (dense old forest conditions suitable to California spotted owl nesting)	182 acres	0	0
1.A: 200-400 TPA (old forest conditions with structural diversity)	1,348 acres	0	0
3.E: 250-400 TPA (lower slopes)	0	0	53 acres

	Alternative 1: Proposed Action	Alternative 2: No Action	Alternative 3
Total acres planted	1,598	0	1,598
Inter-planting	As needed (when less than 60% stocking achieved)	0	516 acres previously planted; more as needed
Acres with adequate stocking 5-10 years after planting	3,508	1,500	2,918
Site Preparation			
Mechanical	630 acres	0	630 acres
Chemical	448 acres	0	448 acres, with brush cutting on 105 acres
Conifer Release Using Herbicide			
Treatment of bearclover/grass cover	Initial and Follow-up: Targeted area ground application	None	Initial and follow-up: Targeted area ground application
Treatment of whitethorn, manzanita	Initial: Targeted area ground application; Follow-up: 8 foot radial ground application	None	Initial and follow-up: 5 foot radial ground application
Treatment of deerbrush	Initial and first follow-up:: Targeted area ground application; Additional follow-up: 8 foot radial ground application	None	Initial and follow-up: 5 foot radial ground application
Acres with competing vegetation levels below 30% (total live ground cover)	3,508	None	1,874

	Alternative 1: Proposed Action	Alternative 2: No Action	Alternative 3
Growth (height, diameter) at age 15	22 ft, 7 in.	11 ft, 3 in.	11ft, 3 in
Growth (height, diameter) at age 50	74 ft, 20 in.	35 ft, 9 in.	40 ft, 11 in
Cost per acre, total	$1,099/ac, $4,499,681	$0	$1,346/ac, $5,510,708
Fire & Fuels			
Flame lengths of treated area (feet)	7	17	17
% mortality of trees at age 20 (moderate fire conditions)	8	91	90
% mortality of trees at age 50 (moderate fire conditions)	8	90	88
% mortality of trees at age 20 (worst fire conditions)	23	90	90
% mortality of trees at age 50 (worst fire conditions)	10	90	90
Projected fuel model - 10 years post treatment.	GS2: Shrubs are 1 to 3 feet high, moderate grass load. Spread rate high; flame length moderate	SH7: Very heavy shrub load, depth 4 to 6 feet. Spread rate high; flame length very high	SH2/SH7; SH2: Moderate fuel load, depth about 1 foot, no grass fuel present. Spread rate low; flame length low
Control of Invasive Plants			
Approach to control invasives	Integrated pest management using manual, mechanical, and chemical options	None	Integrated pest management using manual, mechanical, and chemical options

	Alternative 1: Proposed Action	Alternative 2: No Action	Alternative 3
Chemical options to control invasives	Directed foliar and radius application using clopyralid, aminopyralid, or glyphosate	None	Directed foliar and radius application using clopyralid, aminopyralid, or glyphosate
Oak Stand Regeneration			
Approach for oak regeneration	Pruning/thinning and fencing, conifer removal	None	Pruning/thinning and fencing, conifer removal
Acres of oak regeneration	900	None	900
Water Quantity and Quality			
Water quantity	No detectable changes in peak flows are expected.	No change from existing. Delay in post-fire re-regulation of stream flows.	Same as Alternative 1
Water quality	Sedimentation could increase slightly in the short-term, but no long term impacts are expected. Herbicides may affect water quality in the short-term from acute/accidental exposures, but no long term impacts are expected.	No change from existing. Ground cover will continue to be limited in some areas, delaying the balance of sediment yields	Same as Alternative 1

	Alternative 1: Proposed Action	Alternative 2: No Action	Alternative 3
Stream channel shape and function	No discernible effects	No change from existing. Channels may take longer to reach a dynamic equilibrium of erosion and deposition.	Same as Alternative 1
Riparian areas and floodplains	No change to streamside cover. No impacts to water quality are expected from riparian treatments.	No change from existing. Slower development of large woody material sources for instream and aquatic habitat.	Same as Alternative 1
Cumulative watershed effects	Average ERA for all watersheds 2.5%	Average ERA for all watersheds 2%	Same as Alternative 1
Wildlife Habitat			
Future late seral wildlife habitat	Planting arrangement 1.A (1,348 acres) would provide foraging and potentially nesting habitat in the future. 1.B units (182 acres) would provide suitable foraging habitat in the next 15-25 years, and may contribute to nesting habitat into the more distant future. 1.C would not be expected to provide high quality nesting habitat in the future	no increased rate of suitable habitat development	Planting arrangements 3.A and 3.B, and most of 3.C would not be expected to develop high quality habitat; 3.D and 3.E (270 acres combined) should provide long term foraging habitat, and arrangement 3.E (53 acres) is the most likely to develop spotted owl and goshawk nesting habitat character

	Alternative 1: Proposed Action	Alternative 2: No Action	Alternative 3
Shrub habitat	reduced amount of larger, older shrub dominated habitat for the foreseeable future	No change	reduced amount of larger, older shrub dominated habitat for the foreseeable future
Oak habitat	Not anticipated to create or remove habitat, but should improve habitat capability	No change	Not anticipated to create or remove habitat, but should improve habitat capability
Effects on sensitive species with potential to occur within project area	May affect individuals, but is not likely to lead to a trend towards federal listing or loss of viability for the western bumble bee, fringed myotis, Townsend's big-eared bat, pallid bat, American marten, northern goshawk, California spotted owl, foothill yellow-legged frog, western pond turtle	No effect on sensitive species	May affect individuals, but is not likely to lead to a trend towards federal listing or loss of viability for the western bumble bee, fringed myotis, Townsend's big-eared bat, pallid bat, American marten, northern goshawk, or California spotted owl.
Effects on threatened species with potential to occur within project area	No effect on Sierra Nevada yellow-legged frog	No effect on Sierra Nevada yellow-legged frog	No effect on Sierra Nevada yellow-legged frog
Human Health			

	Alternative 1: Proposed Action	Alternative 2: No Action	Alternative 3
Herbicide hazard quotient and risk	All exposure scenarios for clopyralid, aminopyralid, and glyphosate do not exceed a level of concern. Most exposure scenarios for triclopyr do not exceed a level of concern. Safe handling procedures, use of personal protective equipment, colorant, and signing will limit exposure for workers and public.	No risk	All exposure scenarios for clopyralid, aminopyralid, and glyphosate do not exceed a level of concern. Most exposure scenarios for triclopyr do not exceed a level of concern. Safe handling procedures, use of personal protective equipment, colorant, and signing will limit exposure for workers and public.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in the alternatives chapter.

Past, Present, and Reasonably Foreseeable Actions

According to the Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations, "cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such actions (40 CFR 1508.7). Only future actions that have reached the stage of being "identified proposals" meet the definition of "reasonably foreseeable future actions" in the Forest Service's NEPA regulations [36 C.F.R. § 220.3, 220.4(a)(1)]. In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that affected the environment and might contribute to cumulative effects. The Power Fire of 2004 had the most dramatic impact to resources, and reset the trajectory of forests at a landscape scale. In determining cumulative effects, the existing condition and the following present and foreseeable future actions were added to the direct and indirect effects of the proposed action and alternatives as applicable.

Table 3.1 Foreseeable Future Actions Contributing to Cumulative Effects

Project or Activity name	Project Description	General Project Location	Date Activities are Expected to Occur
Power Fire Fuels Maintenance Study	Conduct prescribed fire treatments on approximately 4,000 acres of mixed conifer and red fir forests that burned at low to moderate severity during the 2004 Power Fire.	Between Lower Bear River and Salt Springs Reservoirs, and selected areas on the southwest and northwest portions of the Power Fire.	2017 and 2018

Project or Activity name	Project Description	General Project Location	Date Activities are Expected to Occur
Cole Forest Health Project	Reduce hazardous fuels, improve forest health, enhance watershed conditions, and re-establish a sustainable landscape on approximately 500 acres by commercially and pre-commercially thinning, understory burning, and reconstructing roads.	South of Highway 88 and Bear River Reservoir.	2018-2020
Panther Forest Health Project	Reduce hazardous fuels, improve forest health, enhance watershed conditions, and re-establish a sustainable landscape on approximately 500 acres by commercially and pre-commercially thinning, understory burning, and reconstructing roads.	South of Highway 88 in the vicinity of Panther Ridge.	2018-2020
Ongoing/ Periodic Management Activities	Road maintenance and use, grazing within approved allotments, recreation, noxious weed monitoring and control per ENF Invasives Environmental Assessment (2013)	Project area	Ongoing

Timber harvest on private lands is overseen by the California Forest Practices Act. The California Department of Forestry website (CDF 2016) was checked for planned timber harvest plans (THPs) on private lands in the watersheds where this project is located. The timber harvest plan listing did not indicate any timber harvest plans within the project area.

Air Quality

Relevant Laws, Regulations, and Policy

Federal clean air laws require areas with unhealthy levels of ozone, inhalable particulate matter, carbon monoxide, nitrogen dioxide, and sulfur dioxide (SO_2) to develop plans, known as State Implementation Plans (SIPs). SIPs are comprehensive plans that describe how an area will attain national ambient air quality standards (NAAQS). SIPs are not single documents. They are a compilation of new and previously submitted plans, programs (such as monitoring, modeling, permitting, etc.), district rules, State regulations and Federal controls. California has developed SIPs for ozone and particulate matter ($PM_{2.5}$) non-attainment areas and visibility for all Class I areas that are located in the state. Class I areas are designated for the most stringent degree of protection from future degradation of air quality through prevention of significant deterioration (PSD) provisions of the Clean Air Act.

The 1990 amendment of the Clean Air Act published the General Conformity Rule. It states that in Federal non-attainment areas, before actions can be taken on Federal lands that have the potential to emit pollutants to the atmosphere, a determination must be made that the action conforms to the SIP. Pursuant to 40 CFR 93.153 (i), prescribed fire conducted in accordance with a smoke management program is presumed to conform to the SIP.

Affected Environment

The Mokelumne Wilderness is a Class I area under the Clean Air Act and is adjacent to the project area to the east. No communities are near the project area. El Dorado and Amador Counties are currently in Federal non-attainment status for ozone, a product of volatile organic compounds (VOCs) or nitrogen oxides (NOx) largely due to transport of emissions from the Sacramento Valley and $PM_{2.5}$. While there are no published emissions factors that isolate ozone, standards have been set for the ozone precursors such as hydrocarbons and oxides of nitrogen.

Environmental Consequences

Effects Analysis Methodology

For this analysis, the air quality issues of concern entail compliance with the Clean Air Act (CAA), State of California air quality standards and regulations, and the Wilderness Act. Air quality standards primarily address human health. Under the CAA, Federal land managers have an affirmative responsibility to protect Class I air quality related values (AQRVs) from degradation. The Wilderness Act requires that congressionally designated wilderness areas be managed for their protection and preservation from human-caused degradation.

Indicators used in this analysis include the following:

- Compliance with NAAQS and PSD;
- Potential impacts to AQRVs which includes visibility impacts to Class I Wilderness Areas; and
- Potential impact of fire management prescribed burning to particulates.

Assumptions

The following assumptions were made in this air quality analysis:

- The project area lies within the Amador County Air District (ACAD). A smoke management plan (SMP) would be submitted to and approved by involved agencies prior to any burning activity that would occur within the project area.
- During the implementation of the pile burning, any required air quality coordination would take place between the Forest Service and the ACAD. This air quality coordination would follow the Smoke Management Guidelines for Agricultural and Prescribed Burning contained in Title 17 of the California Code

of Regulations. These Guidelines are intended to provide for the continuation of agricultural burning, including prescribed burning, as a resource management tool, and provide increased opportunities for prescribed burning and agricultural burning while minimizing smoke impacts to the public. The regulatory actions called for are intended to assure that each air district has a program that meets air district and regional needs.

- Using best available control measures (BACM) which provide guidelines that would reduce the negative effects of burns and are based on the EPA's Prescribed Burning Background Document and Technical Information Document for Prescribed Burning Best Available Control Measures (EPA, 1992).
- Emissions are based on estimated outputs for equipment assuming half of the site preparation would be completed by a dozer with brush rake and half by an excavator, either masticating or piling.
- Smoke from pile burning assume that all 630 acres are piled, when in fact some acres may be masticated.
- Weather, resource availability, smoke dispersion, and other conditions necessary for implementation of a prescribed fire are based on models that have associated uncertainties. Any project acres of prescribed or wildland fire managed to meet resource benefits or objectives are based on the assumption that the smoke management plan has been submitted and authorization has been received from the applicable regulatory agency.

Air Quality Indicators

Activities that affect air quality in the analysis area are as follows: a) emissions from equipment that is used for machine piling, b) minor dust from the surface of roads (both permanent and temporary) from contractor and administrative vehicle traffic, and c) smoke emissions from the burning of machine piles generated for site preparation.

Equipment and smoke release particulate matter (PM_{10}, $PM_{2.5}$), carbon monoxide (CO), nitrogen oxides (NOx), and volatile organic carbons (VOCs). These are regulated by the Environmental Protection Agency and are the indicators of effects used in this analysis.

The following is a brief description of these pollutants as defined by the EPA:

- PM_{10} and $PM_{2.5}$ are small particles suspended in the atmosphere that can penetrate deeply into the lung where they can cause respiratory problems (Smoke Management Guide 2001). Even though emission levels are not mandated in the analysis area for these pollutants, efforts to reduce particulates will be implemented due to the health threat and possible deterioration of visibility to a Class I Airshed. PM_{10} and $PM_{2.5}$ emissions are commonly associated with motor vehicles, dust, and burning.
- Carbon monoxide (CO) is a colorless, odorless gas emitted from combustion processes. The majority of CO emissions to ambient air come from mobile

sources. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues.

- Ground-level or "bad" ozone is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Emissions from motor vehicle exhaust is a major source of NOx and VOC. Breathing ozone can trigger a variety of health problems, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma. Ground-level ozone can also have harmful effects on sensitive vegetation and ecosystems
- Nitrogen dioxide (NO2) is one of a group of highly reactive gasses known as "oxides of nitrogen," or "nitrogen oxides (NOx)." Other nitrogen oxides include nitrous acid and nitric acid. EPA's National Ambient Air Quality Standard uses NO2 as the indicator for the larger group of nitrogen oxides. NO2 forms quickly from emissions from cars, trucks, and off-road equipment. In addition to contributing to the formation of ground-level ozone and fine-particle pollution, NO2 is linked with a number of adverse effects on the respiratory system.

Models and Data Sources

The BlueSky Tool: Customized Fuels, Consumption and Smoke Modeling, was used to design the likely dimensions of the machine and hand piles, estimate smoke emissions, and plume direction. The BlueSky modeling framework combines state-of-the-art emissions, meteorology, and dispersion models to generate predictions of smoke impacts across the landscape. Outputs include fire consumption, fire emissions, plume rise, and smoke concentrations. This program uses the Consume smoke emissions model.

Emissions estimates for machine piling were determined from the ENF air quality calculations for timber operations developed by Jeff Barnhart, 2001.

Alternatives 1 and 3

Direct and Indirect Effects

Direct air quality effects would be the production of emissions from equipment used to implement project work, road dust, and pile burning.

Burning of the piled units will occur over an estimated one to three year period after the piling operations depending on the length of time needed for project implementation and prescribed burning conditions to be met, both for fuels to be dry enough to produce a minimum amount of smoke and for availability of approved burn days.

Smoke from burning piles can impact human health, particularly for the ground crews at the site. Temporary and short-term visibility impacts can be expected in the immediate project area during actual ignition and would be affected by inversions as well as wind speed and direction. The localized effects of burning in the project area would be short-term degradation of air quality, primarily during the burnout stage, and during nighttime inversions. While ozone is a byproduct of fire, potential ozone exposures are infrequent (Sandberg et al., 2002). Carbon monoxide is rapidly diluted at short distances from a burning area, as fires are generally spatially and temporally dispersed, and pose little or no risk to public health (Sandberg et al., 2002).

Smoke emissions would be minimized by implementation of the Smoke Management Plan, including best available control measures, which is part of the Prescribed Burn Plan. By adhering to a Smoke Management Plan approved by the ENF Supervisor and the ACAD, particulate matter emissions from pile burning would not violate California air quality emission standards. Short-duration production of smoke and associated emissions would occur during pile burning.

Best available control measures are based on avoidance, dilution, and emission reduction strategies. Smoke mitigation techniques include consideration of atmospheric conditions, season of burn, fuel and duff moisture, diurnal wind shifts, appropriate ignition techniques, and rapid mop-up. Following these BACMs is anticipated to prevent negative air quality effects.

All piling equipment is diesel powered. Because of the relatively small number of vehicles from all forms of activities in the project area, the potential for adverse effects from emissions from motor vehicles is very low. The project area is located in a remote environment and has a high level of air quality year-round. Timber management activities will be widely dispersed temporally and spatially on both National Forest and private lands. The Federal and State requirements designed to protect and maintain air quality for diesel and other motor vehicle engines are applicable to all the equipment that operate within the project area. Therefore, any adverse effects from the exhaust associated with diesel and other motor vehicles are expected to be minimal to the point of non-significance.

Table 3AQ.1 Total for Criteria Pollutants (tons), Machine Piling

ALT	CO	NOx	VOC/EH	PM10
1	0.28	0.86	0.07	0.06
2	0	0	0	0
3	.028	0.86	0.07	0.06

Smoke from prescribed burning may temporarily reduce visibility from one day to several days at a time in Class 1 Mokelumne Wilderness Area. Project visibility impacts would be temporary and transient compared to visibility that is reduced from stationary and mobile sources. The limited volume of potential pollution outputs from prescribed fire smoke and the distance and topography would make any significant impact to the Mokelumne Wilderness unlikely.

The tables below show the total predicted emissions based on the BlueSky model. Since burning may be conducted over multiple years (possibly one to three years for pile burning), the annual emissions would be substantially less. The alternatives are in conformity with the state implementation plan and, therefore, further air quality analysis is not required.

Table 3AQ.2 Total Predicted Pile Burning Emissions by Alternative

ALT	PM_{10}	$PM_{2.5}$	CO	CO_2	CH_4
1	6.2	5.4	30.37	1331.25	2.24
2	0	0	0	0	0
3	6.2	5.4	30.37	1331.25	2.24

Cumulative Effects of Alternatives 1 and 3

All prescribed burning operations on public and private lands are coordinated with the State and local air quality boards to ensure that atmospheric stability and mixing heights are advantageous for dispersion of emissions. The smoke management plan would prescribe weather conditions such as mixing heights and transport wind direction that would mitigate negative effects. Although prescribed fire would contribute to cumulative effects, the effects would not exceed State and local air quality standards.

Alternative 2

Direct, Indirect, and Cumulative Effects

Under this alternative, no direct, indirect, or cumulative effects to air quality are anticipated.

Aquatic Wildlife

Relevant Laws, Regulations, and Policy

Direction to maintain the viability of Region 5 endangered, threatened, , and sensitive species is provided by the Forest Service Manual (FSM), Eldorado National Forest Land and Resource Management Plan (USDA 1989), and the Sierra Nevada Forest Plan Amendment (USDA 2004). An Aquatics Biological Assessment and Evaluation (BE/BA) was prepared for this project in accordance with the standards established in the Forest Service Manual direction (FSM 2672.43) and the legal requirements set forth under regulations implementing Section 7 of the Endangered Species Act of 1973 (DeVault and Chow 2016).

The Sierra Nevada yellow legged frog (SNYLF) analysis addressed in the BE/BA document complies with the blanket direction afforded to all Threatened, Endangered, and FS-Sensitive species in the FSM, USDA 1989 and USDA 2004. On June 16, 2014, on the heels of the listing of the SNYLF, Forest Service Region 5 submitted a Programmatic Biological Assessment (BA) requesting consultation with the United States Fish and Wildlife Service (USFWS) for the Endangered SNYLF (USDA 2014). This Programmatic BA analyzed the adverse effects of nine forest programs (which included many of the actions proposed in this project) on this listed species. A programmatic Biological Opinion (BO) was signed into effect on December 19, 2014 (USDI 2014). In this BO, the USFWS reiterates the Forest Service Standards and Guidelines and BMPs deemed directly applicable to the conservation of the SNYLF as Programmatic Conservation Measures and Program Specific Conservation Measures (USDI 2014).

Affected Environment

Of the federally listed threatened, endangered, and candidate species, only the SNYLF have the potential to be within or adjacent to the project area; however, design criteria and mitigations will be enforced to eliminate all impacts. Forest Service sensitive species that have the potential to be affected by project activities are Foothill yellow-legged frog (FYLF) and western pond turtle (WPT).

California Red-legged Frog (CRLF)

Distribution, Abundance, and Habitat

The species elevation range (up to 4,000 ft. elevation) falls within one mile of the project area with mapped isolated potential breeding sites located on non-forest land.

Existing Surveys and Sightings:

Aquatic surveys and habitat assessments (survey data available in project record) conducted by forest service biologists (AQs within NRIS Database 2017) on reaches directly upstream of potential sites have been determined to be unsuitable based on ground surveys, due to: lack of back eddy pools, lack of off-channel pools, lack of riparian vegetation cover (predominantly conifer) and turbulent stream flow.

Status of the Habitat / Existing Condition

CRLF suitable and designated critical habitat, observations and potential habitat occur outside of the project and analysis area (Eldorado GIS CRLF habitat layer USFWS Critical Habitat layer). When potential breeding is present, dispersal habitat (up to 4,500 ft.) extends one mile from the breeding site; however, as no breeding habitat occurs in the project area, no dispersal habitat would be affected. The nearest historical sightings are over 3 miles from the project boundary. There is no critical habitat designated within 5 miles of the project area.

Based on habitat assessments, lack of a known source population, no critical habitat within 5 miles of the project area; no individuals, suitable habitat (breeding or dispersal), or designated critical habitat would be impacted by project activities for all alternatives. CRLF will not be further analyzed in this document.

Foothill Yellow-legged Frog (FYLF)

Distribution, Abundance, and Habitat

Found in or adjacent to rocky streams in a diversity of habitats such as valley-foothill hardwood, valley-foothill hardwood- conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and various wetland types in California, west of the Cascades and the length of the western flank of the Sierra Nevada Mountains to Kern Co., California. The documented elevation range is from sea level to 6,370 ft in the Sierra Nevada (Jennings and Hayes 1994). However, of the 220 FYLF detections[1] on or adjacent to the Eldorado National Forest, a single detection was above 5,000 ft, and was unconfirmed whether it was actually a SNYLF or FYLF. The mean elevation for these detections was approximately 2,583 ft. Given this information, the maximum upper elevation extent for FYLF on the Eldorado National Forest is believed to be closer to 5,000 feet.

Existing Surveys and Sightings

FYLF has been documented along the project area boundary as well as sited within the 7th field watersheds that comprise the analysis area (Figure 3AW.1). Observations were recorded from 1997 to 2001 and included adult and juvenile individuals.

Status of the Habitat / Existing Condition

For the purposes of analysis, potential FYLF habitat is defined as 100 feet on either side of any perennial stream, intermittent stream, meadow, or lake occurring between sea level and 5,000 feet within the analysis area (Figure 3AW.1). Only the first 100 feet of habitat on either side of waterbodies was defined as habitat for FYLF because they are highly aquatic. Within the analysis area, there are 3,244 acres of potential FYLF habitat. There are 16.83 stream miles of FYLF habitat within the project area. Only a very small subset of this habitat (83 acres) occurs within or directly adjacent to treatment units (Figure 3AW.1). Wherever FYLF habitat occurs, species presence is assumed.

[1] Detections may include more than one individual and/or more than one life stage.

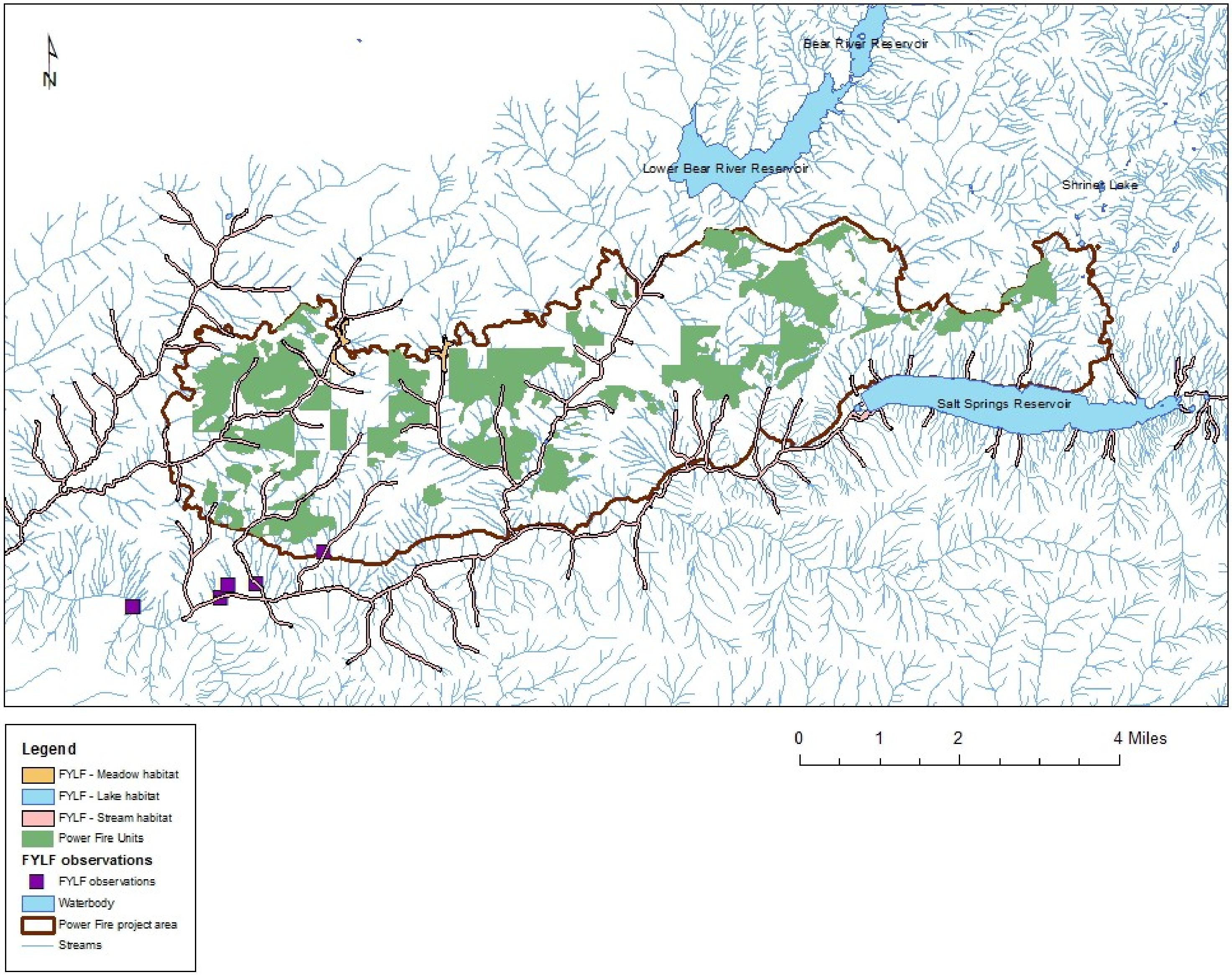

Figure 3AW.1 Foothill yellow-legged frog observations and habitat within the Power Fire analysis area

Western Pond Turtle (WPT)

Distribution, Abundance, and Habitat

The western pond turtle (WPT), one of only two species of freshwater turtle native to west coast of the United States, is found from sea level to approximately 1,525 m (5,000 ft.) in elevation; and is uncommon to common throughout California. The WPT can occur in and adjacent to a variety of aquatic habitats, both lotic (moving water, streams and rivers) and lentic (still water, ponds and lakes). Perennial water is preferred, but there is an indication that the turtle can persist in environments where water is seasonally available by means of a process referred to as aestivation (Holland 1994, Rathbun et al. 2002). Basking is an important part of WPT ecology because several physiological processes are dependent upon increased internal body temperature (Boyer 1965, Hammond et al. 1988). Jennings and Hayes (1994) and Holland (1994) suggest habitat suitability may be higher where basking sites are more available. The WPT primarily uses terrestrial habitats for overwintering, nesting, and aestivation. The turtle is wary of human presence and readily retreats from basking structures into the stream where it takes refuge in deep pools or under rocks or overhanging banks.

In streams, the WPT typically leaves the aquatic habitat in fall to overwinter in areas near the water. These overwintering sites are typically within 200 meters (650 feet) but can occur at distances up to 400 meters (Holland 1994, Reese 1996, Reese and Welsh 1997, Rathbun et al. 2002). Based on the citations above, upland habitat suitability for overwintering is variable in terms of vegetation composition, but must be able to provide the turtle a duff layer into which it can embed itself into. Hillslope and aspect do not appear to play a significant role in the selection of overwintering sites (Reese 1996) and there is some indication of turtles returning to the same site annually.

Nesting habitat is also somewhat variable, but mainly consists of herbaceous dominated areas on low angle slopes facing south or west with well-drained soils (Holland 1994, Reese 1996, Reese and Welsh 1997, Rathbun et al. 2002). Nests can be several hundred meters from the aquatic feature, but more typically nesting occurs within 100 meters of the aquatic habitat (Holland 1994, Reese 1996, Rathbun et al. 2002). Habitats used for aestivation (upland use when water is not present) are essentially the same as for overwintering and mainly requires leaf duff or thatch to bury themselves.

Aquatic habitats are required for mating, eating, and the development of hatchlings. Mating and eating must occur underwater. Once the hatchlings emerge from the nest in the spring, they make their way to water. Hatchlings require warm, shallow, still water for thermoregulation and foraging (Holland pers. comm. in Jennings and Hayes 1994). If the streamflow of a river is regulated by upstream dams (and hydropower generation), shallow water habitat suitable for rearing hatchlings is either limited or not present at all due to fluctuating water surface and cold temperatures from hypolimnetic releases.

Existing Surveys and Sightings

No WPT have been recorded within the project area; WPT were observed just outside of the project area (Figure 3AW.2), roughly 0.6 miles to the south within the analysis area. Recorded observations of adult WPT occurred in 2002 and 2009. These observations occurred during above water surface surveys. Habitat for WPT does occur within the project and analysis area since there are low gradient lakes, streams, ponds and intermittent streams below 5,000 feet; 400 meters on either side of these water bodies is considered habitat for the WPT. Although WPT have not been observed in the project area, their presence is assumed wherever their habitat occurs

Status of the Habitat / Existing Condition

6,895 acres of WPT habitat are found within the analysis area for this project (Figure 3AW.2). The majority of these acres are outside of treatment units. WPT habitat within the project area is 1,856 acres.

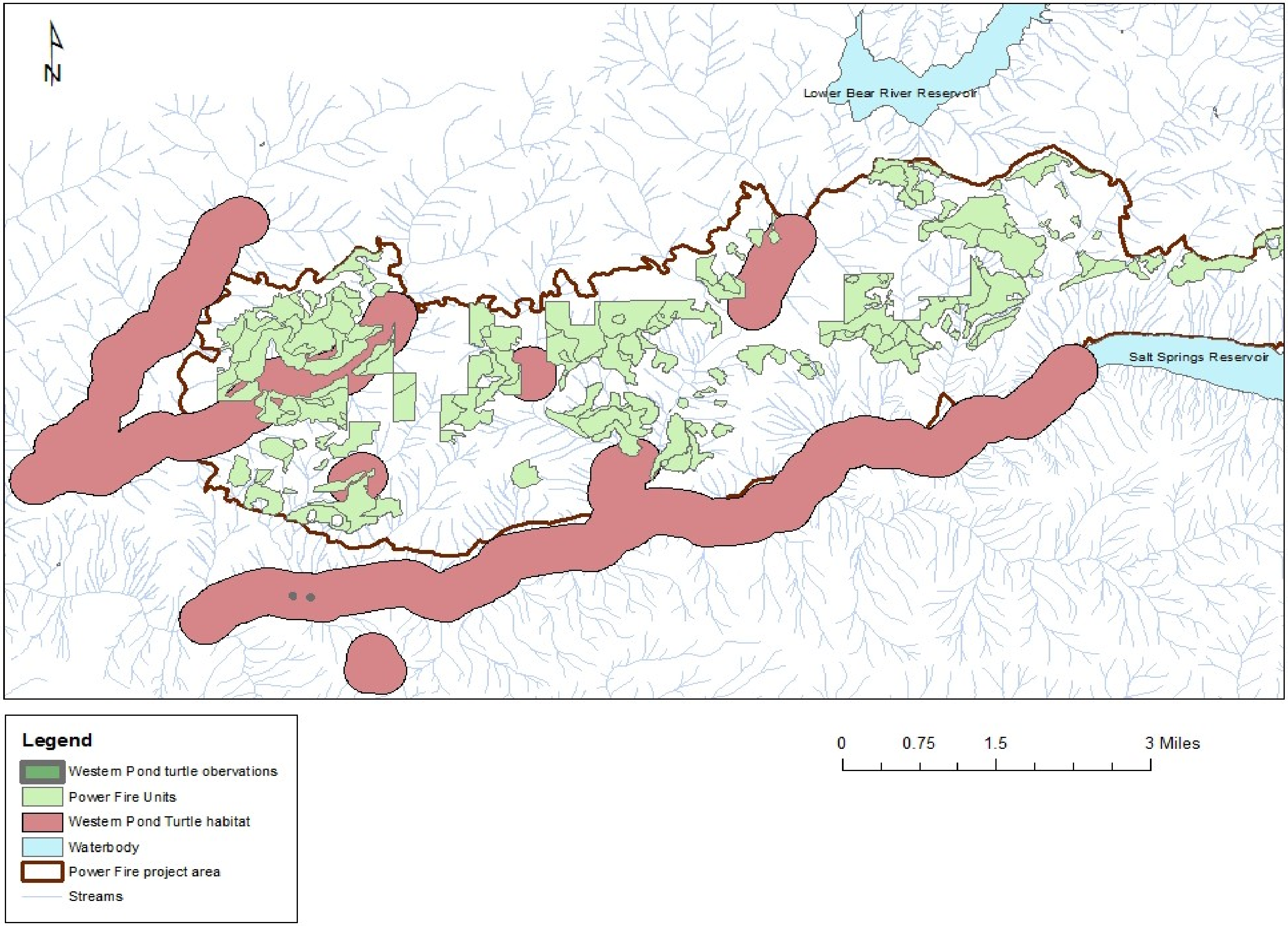

Figure 3AW.2 Western Pond Turtle observations and habitat within the Power Fire analysis area

Sierra Nevada Yellow-legged Frog (SNYLF)

Distribution, Abundance, and Habitat

The SNYLF is associated with a variety of aquatic habitats including wet meadows, streams, and lakes (Vredenburg et al. 2005). Highest summer densities and overall total numbers are found in lakes lacking introduced fish, more than 1 meter in depth, and near-shore habitat with warm water temperatures (Matthews and Pope 1999). Deep water habitats (greater than 5.4 feet (1.7 meters)) provide the best opportunity for annual survival of adults and their multi-year tadpoles because complete freezing, very low dissolved oxygen conditions, and regular drying are factors that affect the ability of a water body to support all life stages.

Egg masses are attached to streambed substrates or submergent/emergent vegetation or under banks. Once the embryos develop into tadpoles, the tadpoles utilize shallow, warm water for thermoregulation, foraging, and growth. If disturbed, the tadpoles rapidly retreat from shallow water and hide in deeper water, in mud, under rocks, or in vegetation. As noted earlier, deep water that does not freeze regularly to the bottom of the water body is required to allow the tadpoles to develop to metamorphosis. During the active season (May through October), post-metamorphic individuals use a variety of habitats ranging from shallow snowmelt pools to streams connecting lakes and ponds to deep water lakes. Matthews and Preisler (2010) indicated site fidelity was high among individuals found in breeding, foraging, and overwintering habitats. Dispersal between these sites is not limited to aquatic routes. Although these frogs are often seen within a meter or two of water they can make terrestrial movements between suitable habitats up to one kilometer. Post-metamorphic individuals have been locally observed basking in full sun or on the water's surface, hiding under streambanks, logs, or in herbaceous riparian vegetation, and lying at the bottom of lakes/ponds in deeper water. Adult and subadult frogs likely avoid freezing in the winter by utilizing underwater crevices in deep waters (Matthews and Pope 1999).

SNYLF home range varies throughout the year and by individual. In August, home range can vary from a little under 20 square meters to over 1,000 square meters. Home ranges are largest in September (53 to 9,807 square meters) which likely accounts for foraging movements. By October, home ranges are very small (3.2 to 82 square meters) as frogs settle into overwintering habitat (Matthews and Pope 1999).

Additional information defining suitable habitat has been provided by the Federal Register (2013) and is briefly summarized here. The three essential habitats required by the frog include suitable aquatic breeding, aquatic non-breeding, and upland habitat. Suitable aquatic breeding habitat includes: 1) permanent water bodies (or those connected or close to permanent waters) that are 2) deep enough to prevent freezing in winter, 3) support a natural flow pattern, 4) be free of fish or other introduced predators, 5) regularly maintain water persistence to allow for tadpole development and 6) contain shallow zones, open basking areas, aquatic refugia, and sufficient food resources for tadpoles. Aquatic non-breeding habitats share many of the characteristics breeding habitats do, but they may lack adequate water depth to allow for completion of the species life cycle. Upland habitats include both immediate riparian areas around aquatic habitats (25 meters / 82 feet from the edge of water) and areas between suitable breeding habitats, and watershed-wide areas that provide the quantity and quality of water needed by the frog.

Critical Habitat (CH)

A proportion of suitable habitat in the project area was included in the SNYLF CH published in the Federal Register (USDI2016). In the Critical Habitat (USDI 2016) designation the USFWS described the characteristics essential to the conservation of the SNYLF. These characteristics define primary constituent elements (PCEs) of Critical Habitat. The PCEs specific to SNYLF are described in detail in the BE/BA and are incorporated herein by reference.

Surveys and Sightings:

SNYLF has been found throughout the Eldorado National Forest at elevations between 5,187 feet and 8,986 feet in records dating as far back as 1939. Surveys have recorded detections in streams, in streams or potholes in meadows, and in lakes. The highest frequencies of SNYLF occurrences on the ENF occur in high elevation lake habitats. The Power Fire Reforestation Project lies within the known elevation range of the SNYLF on the ENF.

According to the ENF's forest wide wildlife Geographical Information System (GIS) layer, SNYLF individuals were sighted within the Cole Creek watershed. Surveys conducted in 2013 and 2014 within the Cole Creek watershed detected multiple adult frogs.

Status of the Habitat / Existing Condition

A GIS layer of suitable habitat for SNYLF was generated by the Region 5 Regional office. This layer is the basis for the location of suitable habitat within the Power Fire project area (Figure 3AW.3). Also included in the definition of suitable habitat is all land within a 25 m (82 ft.) buffer. This habitat buffer is assumed to provide suitable terrestrial habitat. Since the SNYLF is highly aquatic, the potential for impacts beyond the 25m (82 ft.) buffer of suitable habitat is very low and would result in no effects to the species. Designated Critical Habitat is included in Figure 3AW.3.

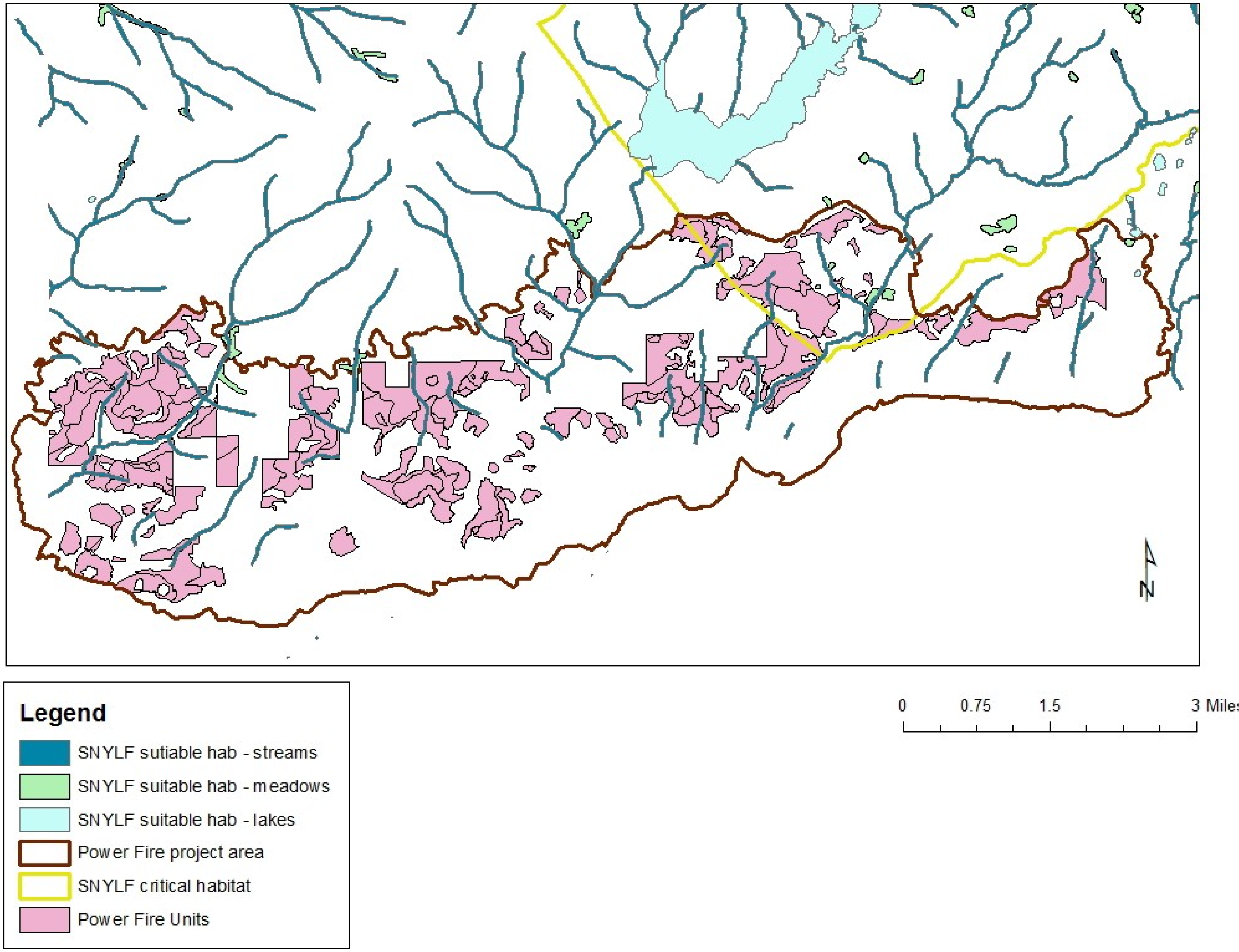

Figure 3AW.3 Suitable and Critical Habitat for Sierra Nevada yellow-legged frog within the Power Fire project area.

A proportion of the suitable habitat in the project area occurs within CH. Because a CH does not signal that habitat outside the area is unimportant or not needed for recovery of the species (as described in the Current Management Direction), the types of potential effects explored during analysis includes suitable habitat both within and outside CH. The term suitable habitat will be used throughout the analysis of effects to collectively describe the potential effects to habitat within and outside of CH.

Suitable SNYLF habitat and designated Critical Habitat occurring within 1-mile of Project proposed actions is reported in Table 3AW.1. The 1-mile buffer was chosen as a way to quantify habitat availability within the vicinity of the project area. There is no ecological relevance to the chosen 1-mile buffer, although it provides a more focal look at the extent of habitat connectivity in the vicinity of the proposed actions

Table 3AW.1 A summary of SNYLF suitable habitat and Critical Habitat found within 1 mile of the Project Area/units.

Habitat Type	Acres
SUITABLE HABITAT (includes critical habitat)	1,404
CRITICAL HABITAT (within suitable habitat)	646

There are 16.9 miles of perennial, 23.8 miles of intermittent and 147.1 miles of ephemeral streams within the 17,000 acre Power Fire project area. Main stems include the Bear River, Beaver Creek, Camp Creek, Cole Creek, and the East Panther Creek. Nearly 50% of the 2004 Power Fire area burned at high intensity, killing 75% to 100% of the trees and burning the duff and litter that protects the soil. The fire resulted in high rates of soil erosion, and sedimentation to streams (Arias 2016). Field observations (Arias, 2013) showed that post-fire effects still prevail mostly along ephemeral channels which had significant amounts of sediment deposited. Stream aggradation is particularly visible along areas where side slopes have limited ground cover and vegetation. Several culverts in these ephemeral drainages are partially filled with sediment as well. This sediment unbalance has consequently affected the stability of higher order streams, as evidenced by channel head-cuts observed in intermittent streams (Arias 2016).

Environmental Consequences

The analysis area for this project is water features (streams, ponds, meadows etc.) in the 7th Hydrologic Unit Code (HUC) watersheds (refer to the Hydrologic Resources section below in this EIS) that are within and downstream of where project activities occur. Short-term effects are 1 to 3 years after project implementation. Long-term/cumulative effects is 4 to 30 years after project implementation.

Alternatives 1 and 3

Foothill Yellow-legged Frog, Western Pond Turtle, and Sierra Nevada Yellow-legged Frog

Foothill Yellow-legged Frog (FYLF)

Direct Effects

Direct impacts to FYLF could potentially occur from mortality or injury from mechanical equipment harvest and planting personnel. However, the 100-foot mechanical equipment buffer along perennial streams and the 50 foot buffer along intermittent streams should prevent injury or mortality of individual frogs. There could be direct impacts to individuals from planting crews within the riparian areas. There is a 25 foot buffer on perennial streams and a 20 foot buffer on intermittent streams which should help to minimize human-frog interactions since this species is highly aquatic. FYLF individuals have been observed within the analysis and project area but not within treatment units (Figure 3AW.1). Individual frogs may be present near or within the analysis area but the population sizes are likely to be small given the small number of observations, assuming that survey coverage in the area has been adequate.

Indirect Effects

Planting

Hand-planting within riparian areas could disturb soil and vegetation thereby altering FYLF habitat. The amount of disturbance from planting should be minimal (Arias 2016). With minimal disturbance to soil and therefore FYLF habitat the indirect effect to FYLF should also be minimal.

Site Preparation, release and invasive plant control

Indirect effects to FYLF habitat could potentially occur from changes in sedimentation rates to streams that may affect pool structure, pool depth, and forage base. Loss of canopy structure may lead to warming of, and earlier drying out of streams. Loss of future large woody debris for cover and in streams that impounds sediment, reduces stream velocity, and creates pool habitat.

No mechanical equipment will operate within 100 feet of perennial streams or within 50 feet of intermittent streams. No canopy would be removed from the riparian area. Trees removed would be smaller trees that would not provide large woody debris (LWD) in the short-term. A Water Erosion Prediction Project (WEPP) model was run to estimate the amount of sediment generated from project activities. The model found that there is a probability of sediment yield of 0.1 tons/acre in the short term or within one year, followed by a reduction to zero after five years (Arias 2016). These results show that as vegetation matures and contributes to ground cover, sediment delivery is quickly reduced to background levels. Hatchett et al.(2006) showed that ground cover in the form of grass or woodchips dramatically reduced sediment loss after mechanical mastication (Arias

2016). Therefore there could be short-term increases in sediment in FYLF habitat causing habitat alteration and indirect effects to frogs. These effects should be minimized by design features and only persist in the short-term. Under this proposed project, vegetation removal would not result in detectable changes in the magnitude and timing of stream flow. (Arias 2016)

Chemical treatment of invasive plants could potentially affect FYLF and its habitat; herbicides could move beyond their intended targets and enter riparian habitat. All herbicides proposed has an application exclusion zone of 100-ft for FYLF suitable habitat with the exception glyphosate (50-ft wet and 25-ft dry). The 100-ft application exclusion zone applied is similar to the 107-ft SNYLF exclusion zone and will eliminate all direct and indirect impacts to FYLF. Therefore, FYLF and its habitat are only impacted from herbicide application within the 50-ft application exclusion zone (only glyphosate).

The proposed chemical control methods include directed foliar and radius application using clopyralid, aminopyralid, triclopyr or glyphosate. A Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model (GLEAMS calculates the amount of chemical lost in runoff water and sediment and percolated below the root zone) was run for this project to assess the potential herbicides entering riparian areas (Refer to Table 3H.9 in the Hydrology section). The results show concentrations of 0.0005 mg/L or much less for all herbicides. Concentrations this small in riparian areas should have little to no effect to individual frogs. A 2010 study of the effects of Roundup (glyphosate) on amphibians found toxicity occurred at a minimum of 0.43 mg/L for a variety of frog species (King and Wagner 2010). The concentrations of herbicides reaching the riparian zone would be less than 1% of a toxic dose.

The proposed treatments with chemicals and its metabolites are not expected to accumulate or negatively affect water quality in the project area or downstream (Arias 2016). Additionally, surfactants would be used to break up surface tension of herbicides and increase the ability for plants to absorb the herbicide (Arias 2016). Herbicides can negatively affect frogs in a variety of ways including mortality and injury as well as reduced forage and cover. With the proposed chemical treatments not negatively affecting water quality it’s unlikely that there will be a large enough effect to frogs in the riparian area to be measurable. Frogs in the upland could potentially be affected by chemical treatments. However due to the frog’s affinity for the riparian area this effect would be minimal.

Oak Stand Improvement

These activities would occur outside of the riparian area. Any sediment from ground disturbance associated with these activities is unlikely to reach FYLF habitat. No indirect effects from oak stand improvement activities to FYLF habitat are expected.

Cumulative Effects

When considered with past, present, and reasonably foreseeable future activities, any cumulative impacts to FYLF or its preferred habitat as a result of implementing Alternative 1 (proposed action) are expected to be minor for the following reasons:

- No treatments within or adjacent to known occupied streams.
- Short (< 5 yr.) duration of project level effects.
- Established stream buffer exclusion zones.
- Overall restoration of forest old growth canopy cover and understory.
- Reduction in future wildfire risk as a result of planting arrangement.
- Non-native invasive vegetation management.

Overall, actions of Alternatives 1 and 3 will ultimately benefit FYLF by a reduction in future wildfire risk, promotion of riparian habitat, restoration of open forest conditions and restoration of open forest conditions creating more terrestrial upland habitat. Since response of amphibians depends on the type and magnitude of disturbance, the amount and configuration of remaining habitat, as well as their life-history characteristics, project activities may still impact this species even when the outcome is positive.

Western Pond Turtle (WPT)

Direct Effects

Direct impacts to WPT could potentially occur from mortality or injury from mechanical equipment, piling, and planting. Western pond turtle have been observed within the analysis area. Additionally, there is WPT habitat within the analysis area and treatment units. The 100-foot mechanical buffer along perennial streams and the 50 foot mechanical buffer along intermittent streams should prevent injury or mortality to most turtles. Potential direct effects to WPT from herbicides include mortality from direct application to an individual, which is unlikely to occur except when individuals are outside of protection buffers. While this species is highly aquatic, turtles utilize upland habitat in the late summer/fall while searching for food and nesting (Holland 1994, Reese 1996, Reese and Welsh 1997, Rathbun et al. 2002). Therefore, there could be some direct effects to individual turtles

Indirect Effects

Planting

Indirect effects to WPT habitat could result from increased sediment in habitat due to planting activities and alteration of upland habitat by seedling planting. The change in sedimentation and habitat is likely to be minimal and in the short-term from hand-planting efforts (Arias 2016). Indirect effects to WPT from this activity will likely be minimal.

Site preparation, release and invasive plant control

Indirect effects to WPT habitat could potentially result from the removal of downed woody debris for cover habitat of adults and hatchlings. Changes in sedimentation rates to streams that may affect pool structure, depth, and forage base. Loss of canopy structure may lead to warming of nests on hillslopes and earlier drying of streams in riparian areas. The loss of future large woody debris on hillslopes for cover and in streams that impounds sediment, reduces stream velocity, and creates pool habitat.

Removal of brush and trees will occur within WPT upland habitat. This would result in alteration of cover habitat within treatment units. The tree removal will be a small portion of WPT habitat and only in the short-term. In the long term trees planted will provide additional cover and habitat.

Effects from mechanical equipment and potential for sediment delivery to streams are the same as described for FYLF.

Potential indirect effects to WPT from herbicide application include: mortality and decreased growth as a result of contact, ingestion of contaminated forage and prey (macrophytes and invertebrates). Decreased growth due to reduction in the amount of forage base (macrophytes and invertebrates). Increased risk of predation from reduced aquatic vegetation (cover). A 2006 study of the effects of glyphosate on red-slider turtles found effects occurring at a minimum of 15 mg/L (Sparling et al.2006). The concentrations of herbicides potentially reaching the riparian area would be less than 0.01% of an effective dose. Concentrations this small in the riparian area should have little to no effect on riparian turtle habitat.

As described above for FYLF, since the proposed treatments are not expected to accumulate in or negatively affect water quality in the project area or downstream, the effects to WPT habitat from herbicide treatment should be minimal and short-term

Oak Stand Improvement

Oak stand improvement could affect upland turtle habitat in the short term by soil disturbance during tree removal and fence installation. However, in the long term upland habitat would be improved for turtles. Fencing in the long-term could hamper turtle movement.

Cumulative Effects

Cumulative effects to WPT are the same as described above for FYLF.

Sierra Nevada Yellow-legged Frog (SNYLF)

Direct, Indirect, and Cumulative Effects

Impacts from tree planting, site preparation, control of invasive plants and oak stand management are not expected to occur to suitable habitat or frogs because of the design criteria and standard BMPs that will mitigate for any disturbance or sediment delivery/

run-off to upland or aquatic habitat. The exclusion zone of 100 ft. (for mechanical treatment) and 82 ft. for planting ensures protection of suitable habitat as disturbance and habitat alteration would not be expected to occur. Ensuring proposed activities occur outside of the 82 ft. defined suitable habitat removes the potential for direct impacts; and the additional 18 ft. and enforcement of standard BMPs eliminates potential for indirect effects from sediment or soil disturbance. The additional 18 ft. acts as safety net in an event that sediment run-off or soil disturbance from mechanical equipment use were to occur. An additional 18 ft. of protection is not necessary for tree planting as all planting will be done through hand-work with very minimal to negligible soil and ground disturbance in a localized area. Sediment delivery or habitat alterations are not expected from planting work directly outside of the 82 ft. suitable SNYLF habitat. Therefore, because all planting within suitable habitat is excluded, there would be no direct or indirect impacts.

No herbicide application would occur in SNYLF suitable habitat. Given the relatively uniform and directed application of herbicides achieved by the use of back-pack type sprayers and the minimization of drift through the use of best management practices, the proposed applications would not result in mortality of plants outside of a 25-foot buffer. Thus, the herbicide exclusion buffer of 107 ft. from any suitable water feature will minimize the potential of both direct effects from application (no application would occur within the 82 ft. suitable SNYLF habitat), and potential indirect effects by avoiding modification of potential SNYLF habitat through off-site plant mortality. The designed treatment is consistent with Region 5 guidance entitled "*Pesticide-Use Projects Guidance for No Effect Determinations for Three Sierra Nevada Amphibians*" (Bakke 2014) and would have no effect on this species. Oak management work will be conducted by hand and will not occur within suitable habitat. Any sediment and ground disturbance from hand-crews will be very minimal and localized. Sediment delivery or habitat alteration would not occur from oak management work directly outside of the 82 ft. suitable SNYLF habitat.

The SNYLF behaves very similarly to FYLF in having a strong affinity to the water. Since behavior is similar, both species would likely react similarly to the proposed treatments. There are mechanical exclusion zones are the same for both species (see Table 2.6); however, planting is allowed to occur within 50-ft of special aquatic features and 25-ft of perennial and intermittent streams in FYLF habitat (below 4,500-ft). The increased buffers and protection of habitat in SNYLF habitat, in effect completely avoiding SNYLF suitable habitat, eliminates all potential effects that are described in the FYLF effects section above. Since there are no direct or indirect effects to SNYLF or their habitat, these alternatives do not contribute to cumulative effects.

Alternative 2

Foothill Yellow-legged Frog, Western Pond Turtle, and Sierra Nevada Yellow-legged Frog

Direct, Indirect, and Cumulative Effects

No activities would be authorized with this alternative. SNYLF, FYLF and WPT individuals would not be directly impacted by project activities. The existing condition of aquatic habitats would persist. Since no actions would be authorized by this alternative there would also be no indirect effects to SNYLF, FYLF, and WPT populations or habitats. With no direct or indirect effects occurring to these species or their suitable habitat there would be no cumulative effects.

Botanical Resources

Relevant Laws, Regulations, and Policy

Endangered Species Act (16 U.S.C. 1536 (c))

A Botany biological evaluation (BE) and a biological assessment (BA) (Miller 2017) was prepared for this project in accordance with legal requirements set forth under Section 7 of the Endangered Species Act and is incorporated by reference herein and included in the administrative record. No formal or informal consultation with the USFWS has been conducted because there is no potential for federal threatened, endangered, or proposed plant species or their critical habitats to occur in or near the project area.

Executive Order 13112 of February 3, 1999

The Order documents Presidential direction to affected federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive (plant) species cause. Refer to the Noxious Weed Risk Assessment prepared for this project (Miller 2017)

Forest Service Manual and Handbooks (FSM 2670 and 2900)

Forest Service Manual 2672.42 specifies that a BE/BA be prepared to determine if a project may affect any USDA Forest Service (FS) sensitive species and US Fish and Wildlife Service (USFWS) threatened, endangered, or proposed species and their designated or proposed critical habitat.

Forest Service Manual direction (FSM 2670) also requires that activities be reviewed for potential effects on rare species, avoid or minimize impacts to species whose viability has been identified as a concern, maintain viable populations of all native and desired nonnative plant species, and analyze the significance of adverse effects on populations or habitat.

Forest Service Manual 2900 (USDA Forest Service 2011) contains national direction to minimize or eliminate the possibility of establishment or spread of invasive species on the National Forest System, or to adjacent areas.

Eldorado National Forest Land and Resource Management Plan, as amended by the 2004 Sierra Nevada Forest Plan Amendment

In the Eldorado National Forest Land and Resource Management Plan (LRMP, USDA FS 1989), under Management Practice 49, direction is to provide for protection and habitat needs of sensitive plants so that Forest activities would not jeopardize the continued existence of such species.

Special Interest Plants

The Eldorado National Forest (ENF) maintains a watch list of botanical species that are of conservation concern, but have not been designated as Sensitive by the Regional Forester. This list includes species that are newly described; locally rare; range extensions or disjunct populations; plants of specific public interest; or species with too little information to determine their appropriate status. According to the Regional Forester, Watch List species should be considered during project planning with corresponding documentation maintained in the planning file (USDA Forest Service 2006). These species make an important contribution to forest biodiversity and should be protected under the provisions of the National Forest Management Act (NFMA) (1976).

Methodology

The project analysis for sensitive plant species in the BE is based on current information for the project area including current California Natural Diversity Database (CNDDB) records for the project area, recent sensitive plant surveys in the Power Fire Reforestation Project area, as well as historic plant site records maintained by the Forest Service. Project surveys include surveys in 2008 (Henley Ridge), 2009 (Power Fire Invasives), 2012 (Power Fire), 2014 (Bear River Allotment Meadow) and 2015 (Power Fire Maintenance Burn).

Affected Environment

Sensitive Plants

As described in the BE, the following species of sensitive plants have known occurrences or potential habitat in the project area.

Three-bracted onion (*Allium tribracteatum*)

Three-bracted onion is known only from the Stanislaus National Forest occurring on thin volcanic soils along the ridges near Crandall Peak and along Highway 108 in Tuolumne County. However one occurrence has been confirmed on rhyolite on private land near Wilseyville in Calaveras County indicating a larger range than was previously known, and that this species may occur on the ENF. Three-bracted onion is found in lower and upper montane coniferous forests on gravelly lahar (volcanic mud flow soils, often referred to as "lava caps"). This habitat is open and very vulnerable to disturbance.

Moonworts (6 *Botrychium* species)

Six species of moonworts are listed as sensitive species. Moonworts are listed as a group because 1) most species in this genus are rare in California; 2) individual species are very difficult to distinguish from each other; and 3) all have similar habitat preferences (wet or moist soils such as in meadows and fens or along the edges of lakes and streams). From the California Native Plant Society (CNPS) online inventory (CNPS 2011):

- Upswept moonwort (*Botrychium ascendens*): lower montane coniferous forest, meadows, seeps, 4,900 to over 7,500 feet
- Scalloped moonwort (*Botrychium crenulatum*): Fens, lower montane coniferous forest, meadows, seeps, freshwater marshes, 4,900 to over 10,500 feet
- Mingan moonwort (*Botrychium minganense*): Fens, lower and upper montane coniferous forest, 4,900 to 6,750 feet.
- Mountain moonwort (*Botrychium montanum*): Lower and upper montane coniferous forest, meadows, seeps, 4,900 to 7,000 feet.
- Paradox moonwort (*Botrychium paradoxum*): Lower and upper montane coniferous forest and meadows.
- Stalked moonwort (*Botrychium pendunculosum*): Lower and upper montane coniferous forest and meadows.

Botrychium species are widely distributed in North America and elsewhere. In California they occur infrequently in a variety of moist habitats throughout the Sierra Nevada and other portions of the state. Most moonwort species show a marked affinity for neutral substrates with high mineral content, especially soils developed on limestone bedrock or otherwise containing high calcium content. High elevation habitats suitably moist and cool are abundant throughout the Sierra Nevada and northern California mountains, but these mountains are mostly composed of granites, volcanics, and crustal basalts not rich in soluble calcium. However, leaf litter from incense cedar may favorably modify soils for some moonworts.

Documentation of population numbers and distribution patterns are incomplete largely because members of this genus are difficult to distinguish, and very uncommon and sporadic in distribution (Wagner and Wagner, 1993).

Two occurrences of B. *crenulatum,* three occurrences of *B. minganense* and two occurrences of *B. montanum* were found in the project area during project surveys.

Pleasant Valley Mariposa Lily (*Calochortus clavatus* var. *avius*)

Three occurrences of Pleasant Valley Mariposa lily are found in the project area. Pleasant Valley Mariposa lily is most often found on rocky, south-facing slopes in sparse stands of conifers, oaks, and manzanita and/or bear clover, at elevations of 2,800 to 5,700 feet. With a single exception in Calaveras County, Pleasant Valley Mariposa lily is endemic to the ENF and adjoining private lands in the area between Union Valley Reservoir and the North Fork of the Mokelumne River and is currently known to occur at 140 locations within this roughly 420 square-mile area (FS Sensitive Plant records 2016, CNDDB). Population size ranges from a few plants into the thousands.

The presence of Pleasant Valley Mariposa lily in open stands of conifers may indicate an intolerance of deep shade and/or thick duff. Fire is a key habitat component, as evidence of past fires at nearly all occurrences on the ENF. Pocket gophers may also influence the local distribution of Pleasant Valley Mariposa lily by eating the bulbs. Rocky substrates may provide refugia from such herbivory as well as providing a sunny site with few competitors. The soils, though rocky, often contain considerable clay.

Mountain Lady's Slipper (*Cypripedium montanum*)

Mountain lady's slipper is an uncommon orchid in California. It grows throughout the northwest: From Alaska to California and east to Montana. In California, it reaches as far south as Santa Cruz County along the coast and Madera County in the Sierra Nevada. The species is known from the Stanislaus and Plumas NF, but has not been documented on ENF lands.

Mountain lady's slipper grows in both moist and dry conditions at elevations between 600 and 6,700 feet, although less common above 4,800 feet. It grows in moist sites near streams or sometimes near the edge of small seeps but also in relatively dry conditions on hillsides in mixed conifer forests. Potential habitat is extensive across the ENF and in the proposed project area. Surveys for this species have been ongoing since 1998 yet no occurrence has been found on the Forest. The known occurrence within the project area is on a private inholding. The occurrence is found on northwest and northeast aspects, and is located at an elevation of 5,200 feet.

Kellogg’s and Hutchison’s lewisia (*Lewisia kelloggii* ssp*. kelloggii* and ssp. *hutchisonii*)

Kellogg’s and Hutchison’s lewisia usually occur on ridgetops or relatively flat open areas with widely spaced trees in partial to full sun. Most soils are reported to be sandy granitic to erosive volcanic with granitic boulders. Kellogg’s and Hutchison’s lewisia are spring ephemeral perennial herb, thus the survey window for the species is restricted to June and July when the plants produces fleshy leaves and flowers.

Plants are most susceptible to impact from trampling during the spring months before the plant becomes dormant. During dormancy the plant can tolerate some disturbance as it is under the soil surface and relatively protected from trampling and other direct impacts.

Broad-nerved hump-moss (*Meesia uliginosa*)

Meesia uliginosa also has a worldwide distribution. The majority of the California occurrences are in the Sierra Nevada. Its distribution is sporadic throughout the Sierra Nevada. There are no known occurrences of *M. uliginosa* on the ENF but potential habitat does exist.

M. uliginosa grows in bogs and fens in cold, permanently saturated, spring-fed meadows and fens at elevations between 4,200 to 9,200 feet. It often grows in association with *Sphagnum* moss, *Drosera* (sundew), and *Vaccinium* (huckleberry). These meadows are generally in the upper levels of mixed conifer to subalpine forests.

Yellow-lip pansy monkeyflower (*Mimulus pulchellus*)

Habitat for this annual plant is vernally wet to moist sites which are open and flat or slightly sloping. The plant is typically found on lava caps but soils can be clay, volcanic, or granitic. It sometimes grows in disturbed with clay. Its elevation range is 2,200 to 6,400 feet.

Yellow-lip pansy monkeyflower was discovered on the Eldorado NF very recently, in 2016, and some areas of suitable habitat could be present in the project area.

Adder's Tongue (Ophioglossum pusillum)

CNPS inventory notes the California distribution as El Dorado, Lake, Mendocino, and Siskiyou counties. On the ENF, the one known occurrence was recorded on Sierra Pacific Industries' lands near Loon Lake. Adder's tongue is known to occur in wet seeps and springs, meadows, and edges of ponds (3,700-6,200 feet). Like *Botrychium* species this cryptic fern is likely to be easily overlooked in wet meadows and other potential habitat. No occurrences are known in the project area, but suitable habitat could be present.

Veined water lichen (*Peltigera gowardii*)

Veined water lichen is infrequently reported. Where populations occur, the number of individuals is generally few. Surveys for this species have been conducted in support of projects on the Forest since 2006 when this lichen was added to the ENF Sensitive plant list. In 2008 multiple populations of veined water lichen were discovered on the ENF however no occurrences are known in the project area, but suitable habitat could be present.

Within the Sierra Nevada, this species is found in cold, unpolluted streams in mixed conifer forests between 2,500 and 8,000 ft. The water is very clear and peak flows are not of the intensity that would lead to scouring. The streamlets have a rich aquatic bryophyte flora and are rarely more than 8 inches deep.

According to the 2010 R5 Conservation Assessment (Peterson 2010), veined water lichen is known almost exclusively from streams with little sedimentation or scouring. During high water events, scouring might occur from gravel and rock movement, or even from sediment abrasion. The thin, gelatinous thallus of veined water lichen is presumably quickly abraded or completely removed from substrates during such events. Sedimentation may also be detrimental to veined water lichen colonies by physically covering thalli, reducing photosynthesis. Watershed-disturbing activities leading to sedimentation at and above occurrence sites can threaten populations.

Veined water lichen populations are known to correspond to habitat characteristics outside of the stream channel, including canopy cover (shading) and presence of old growth forest. Threats for veined water lichen are generally factors that affect habitat quality, through changes in water quality, stream hydrology, or habitat conditions (Peterson 2010).

Olive phaeocollybia (*Phaeocollybia olivacea*)

Olive phaeocollybia is a species of fungi that occurs in Washington, Oregon, and California, in a patchy distribution where it grows in the humus layer in conifer and hardwood forests. It is usually in mixed oak and pine forests, occasionally in pure conifer stands. The currently known populations are relatively stable, but the advent of the "sudden oak death" *Phytophthora* imperils those in mixed forests. On the Eldorado NF, it is recently reported on a private inholding and it may occur in many places on the Forest, including the project area.

Watch List Plants

The watch list for the Eldorado National Forest was last revised in February 16, 2016 and includes 35 species, three of which are known to occur within the project area. None occur within any proposed treatment units, but an occurrence of each is found within 500' of proposed treatment units.

Sierra bolandra (Bolandra californica)

Sierra bolandra is a perennial herb that is endemic to California, and is usually associated with wetlands. In California it is known from Alpine, Amador, Calaveras, El Dorado, Madera, Mariposa and Tuolumne counties. Communities that it can be found in include Red Fir Forest, Yellow Pine Forest and wetland-riparian. One occurrence was found in 2016 along a perennial creek in the Cole Creek area.

Little grapefern (*Botrychium simplex*)

Little grapefern is a small perennial fern found in wet meadows, fens, and riparian areas throughout the Sierra Nevada (0-6,000 ft). Habitat is as described above for moonworts. There are two known occurrence of *Botrychium simplex*: one within Lower Bear Meadow and one within a wet meadow in the Cole Creek area. Both were found during 2016 surveys.

Cutleaf monkey flower (*Mimulus laciniatus*)

Cutleaf monkey flower is an annual herb found in seeps on granite outcrops, within chaparral and lower and upper montane coniferous forest communities. It is a California endemic, known mostly from the High Sierra Nevada bioregion. There are two occurrences reported for the project area. One is at Salt Spring reservoir while the other is along Cole Creek. Both were found in 2015. NatureServe (2015) reports that threats to this species are probably low due to its high-elevation habitat, but it is dependent on granite seeps which could be impacted by changes in Sierra snowmelt.

Invasive Weeds

One goal of the proposed actions is to monitor and treat invasive noxious weeds, both existing and any newly established occurrences, throughout the project area. Invasive 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, or being nonnative or new to or not common to the United States or parts thereof.

The project area is mostly forested, with openings of meadows, rock outcrops, and recently burned or harvested areas. Many forests and shrubfields have a dense canopy, possibly hindering the intrusion of many invasive plants. Early seral forest communities are susceptible to establishment of invasive species because of the increase in bare ground and loss of canopy closure after a fire. Intact upland conifer forests are largely resilient to invasion by invasive species on the forest.

Invasive plant inventories are complete. Documented invasive plants in the Power Fire Reforestation Project include barbed goat grass, diffuse knapweed, spotted knapweed, yellow star-thistle, rush skeletonweed, Scotch broom, eggleaf spurge, fennel, French broom, common St. Johnswort, yellow sweetclover, medusahead and cheatgrass. Their total infestation area is about 83 acres of the 4430 acres to be treated (approximately 2%).

Barbed goat grass (*Aegilops triuncialis*)

Barbed goat grass is a winter annual grass often found growing along roadsides and disturbed areas on the ENF (4,500-8,000 ft). A single plant can produce 130 to 3,000 seeds. The seeds are easily transported on clothing, vehicles, and livestock. Annual grass infestations displace native species, reduce habitat quality for wildlife, and can increase fire risk by producing fine fuels. Small infestations can be mechanically treated by removing plants and seed heads or mowing. Non-selective herbicides can also be effective for small infestations when treatments are followed with seedings of native species. In the Power Fire Reforestation Project area, barbed goat grass is found along three roads and three project units. One location is within the overall project boundary, but within a private inholding.

Cheat grass (*Bromus tectorum*)

Cheat grass is a non-native annual grass that has rapidly spread throughout much of the western United States. Cheat grass seeds are spread by water, livestock, wildlife, and mechanized equipment. The major concern with cheat grass and other annual grasses is the increase in fine flashy fuels when annual grasses become established in natural plant communities. This altered fuelbed has been shown to increase the intensity, and frequency of fires within the stand, eventually resulting in a “type conversion” from forest and woodlands to annual grassland or shrubland (Zouhar 2003). There are very few options to control existing infestations. Small infestations can be treated by mowing or weedeating prior to seed maturation in the spring. Maintaining sufficient cover of native species would likely prevent annual grasses from spreading within the project area

(Keeley and McGinnis 2007, Zouhar 2003). Cheatgrass is present at undocumented infestations throughout the project area, usually in disturbed openings, landings, and roadsides. Cheatgrass occurred in over 50% of fixed plot plantation surveys (294 of 554 53.07 percent). It averaged about 25% cover (Project Silviculture Report) in the fixed plot plantation surveys.Spotted knapweed (*Centaurea maculosa*)

Spotted Knapweed is a biennial to short-lived perennial, up to 3 feet tall, widespread across the western US. Plants may produce up to 40,000 seeds per plant. Most seeds or seed heads of all *Centaurea* species fall near the parent plant, and some can disperse to greater distances with human activities, vehicles, heavy machinery, water, soil movement, and by clinging to shoes, clothing, tires, and feet, fur, or feathers of animals. Knapweeds are excellent pioneer species and rapidly establish in disturbed roadside, rangeland, wildland, or recreation areas. It can be found in disturbed open sites, grasslands, overgrazed rangelands, roadsides and logged areas. It crowds out native species and forage for livestock, and can invade undisturbed native bunchgrass stands (CIPC 2016). Herbicide treatments applied during the bolt or bud stage are most effective, as compared to application in the rosette, flowering and after flowering stages. Two locations are found in the project area along roadsides within treatment units.

Yellow starthistle (*Centaurea solstitialis)*

Yellow Starthistle is an annual invasive herb found along roadsides, landings, and disturbed areas throughout the ENF (up to 6,500 ft). A single starthistle flower head can produce over 50 seeds. However, the seeds have no wind-dispersal mechanisms so few seeds move more than a few feet from the parent plant without assistance. Therefore, animals and human influences, such as vehicles, contaminated crop seed, hay or soil, and road maintenance, contribute greatly to the plant’s rapid and long-distance spread. As the plant infests an area, it chokes out the native plants, reducing biodiversity and wildlife habitat and forage. Another concern associated with the plant is “chewing disease” that develops in horses that have eaten yellow starthistle. Small infestations can be treated by pulling plants before seeds are dispersed. Herbicide treatments are effective when treating large infestations. Yellow starthistle occurs at five locations in the project area, mostly along roads. Three of these locations also occur in treatment units.

Rush skeletonweed (*Chondrilla juncea*)

Rush Skeletonweed is a perennial invasive herb often found along roadsides and in recently disturbed areas. A single skeletonweed can produce 15,000 to 20,000 seeds in a season which are spread by wind, livestock, wildlife, and mechanical equipment. Rush skeletonweed infestations crowd out native vegetation, degrade range quality, and are highly competitive for water and nutrients. Mechanical treatments are only effective during the first year of plant growth. Once the plants become established they will sprout from deep taproots after treatments. For well-established infestations integrated weed management involving 1) chemical treatments 2) biocontrols and 3) revegetation with native species is the best strategy to control rush skeletonweed. There are two infestations in Power Fire Reforestation project. Both on are along roads, but outside of treatment units. One of these infestations is found on private property within the overall project area.

Scotch broom (*Cytisus scoparius*)

Scotch Broom is a perennial shrub often found in disturbed areas. The seeds for Scotch broom are large and are distributed naturally by gravity (i.e. rolling down hill) or on mechanized equipment. Scotch Broom is undesirable because it forms dense stands which crowd out native species, destroy wildlife habitat, and increase fire hazard. Mechanical treatment is effective for removing mature plants. The seedbank however, is long-lived and will continue to produce plants for many years. There are three infestations of Scotch broom in the project area. Two are within units and along roadsides. One is along a road, but outside of an active unit.

Eggleaf spurge (*Euphorbia oblongata*)

Eggleaf spurge is a perennial herb found sporadically in California. This plant may be toxic to humans. It is inedible to wildlife and inhibits the growth of surrounding plants (CIPC 2016). Two infestations are along roads in the project area. One of these infestations is also within a treatment unit.

Fennel (F*oeniculum vulgare*)

Fennel is an erect perennial herb. It can drastically alter the composition and structure of many plant communities, including grasslands, coastal scrub, riparian, and wetland communities. It is still unclear whether culinary varieties of fennel are invasive. One known infestation is found within a treatment unit and along a roadside.

French broom (*Genista monspessulana)*

French broom is a perennial shrub found in the Coast Ranges, Sierra Nevada foothills, Transverse Ranges, Channel Islands and San Francisco Bay area. It was introduced as a landscape ornamental, along with Scotch and Spanish broom. French broom is an aggressive invader, forming dense stands that exclude native plants and wildlife. Broom is unpalatable to most livestock except goats, so it decreases rangeland value while increasing fire hazards (CIPC 2016). These leguminous plants produce copious amounts of seed, and may resprout from the root crown if cut or grazed. There is one infestation of French broom in the project area along a road, but outside of any treatment units.

Common St. Johnswort (*Hypericum perforatum*)

Common St. Johnswort is a perennial herb, widespread in the United States and common along roadways. Common St. Johnswort spreads both by underground rhizomes, above-ground creeping stems, and by seeds that are dispersed by wind and animals. One plant can produce up to 100,000 seeds per year that are viable for 10 to 30 years. By 1940, more than 1 million hectares of California were infested by St. Johnswort, but biological control agents have eliminated most populations below 1500 m elevation (CIPC 2016).

There are several infestations of common St. Johnswort within the overall project boundary. Five infestations are located along Flume Creek Canal, but are not within treatment units or roads connected to the project. An additional infestation is likewise located along a powerline corridor, but is not within treatment units or roads connected to the project. Four infestations are found along roadsides in the project area, but outside of treatment units. One additional infestation is only found within a treatment unit.

White sweetclover (*Melilotus albus*) and Yellow sweetclover (*Melilotus officinalis*)

Sweetclovers are biennial herbs common along roadsides in the rural western US. A prolific seed producer, it readily invades open areas. Natural or human-caused fires make excellent growing conditions by scarifying seeds, stimulating germination, and reducing competition. Yellow sweetclover is found along a roadside within a treatment unit in the project area.

Medusahead (*Taeniatherum caput-medusae*)

Medusahead is an aggressive winter annual grass that can quickly outcompete native species because of it prolific seed production and by forming a dense, silica rich thatch which does not readily breakdown. Medusahead is a major concern to the range livestock industry because it can suppress desirable vegetation. Because of its high silica content medusahead is generally considered unpalatable for livestock and wildlife. This high silica content may be partially if not entirely responsible for medusahead's unpalatability and its resistance to decomposition (Archer 2001). Medusahead maintains its dominance on sites where native vegetation has been eliminated or severely reduced by overgrazing, cultivation, or frequent fires (Archer 2001). Seven infestations occur within treatment units along roadsides in the Power Fire Reforestation Project Area. One additional infestation is found along a roadside, but outside of treatment units.

Environmental Consequences

Sensitive and Watch List Plants

The spatial boundary for analyzing the direct, indirect, and cumulative effects to botanical resources is the active units buffered by 500 feet. Direct effects relevant to these resources would occur and remain within the active units. However, a 500 foot buffer ensures the analysis of indirect and cumulative effects including effects associated with project implementation and changes in human behavior.

The temporal boundary for analyzing the effects begins from the time of project implementation to 20 years afterward. Effects to vegetation would be expected to have occurred or become evident within one or two years of disturbance and this constitutes the short term. Effects that linger beyond 2 years are considered long term effects, and may extend to decades or centuries. Long term effects beyond 20 years become increasingly difficult to predict due to unknown interactions and the many environmental variables with numerous possible outcomes.

Alternative 1

Direct and Indirect Effects

Negative effects of the proposed project are not expected for sensitive and watch list plants since design criteria have been included to prevent direct and indirect effects to known occurrences. New occurrences of sensitive and watch list plants found during implementation of the project would also have design criteria applied to prevent project effects. Specific risks from project activities to habitats and undiscovered populations are described below.

Hand planting and inter-planting

Hand planting and inter-planting can directly affect sensitive or watch list plants by workers trampling undiscovered populations and planting trees. Indirectly, planting would result in the establishment of canopy conditions that would likely inhibit the dominance of the shrub layer in the forest floor. Species with suitable habitat that prefer open habitats might be negatively affected by the increase in canopy. However, undiscovered populations in planting areas are likely undergoing heavy competition for sunlight and other resources due to the heavy shrub and herbaceous layer found throughout most of the project area. Only one occurrence of a sensitive species (Pleasant Valley mariposa lily) is found within a planting unit. This occurrence would be flagged for avoidance. Four other occurrences of sensitive plants (moonworts and Pleasant Valley mariposa lily) and three occurrences of watch list plants are found within 500 feet of a hand planting unit, but these occurrences are not expected to be affected.

Mechanical Site Preparation

Mechanical site preparation could impact sensitive or watch list plants if mechanical equipment damages or uproots plants, compact soils, or alters overstory condition. Activities associated with prescribed fire (line construction and pile burning) can lead to adverse indirect effects for undiscovered plant occurrences. Fire-line construction can directly impact terrestrial sensitive or watch list plant occurrences by potentially uprooting, crushing, or altering habitat condition (canopy closure, microsite hydrology, covering plants, etc.) if fire-line is constructed through an occurrence.

No plants were found in units listed where mechanical site preparation is planned to occur. All known terrestrial sensitive or watch list plant occurrences greater than 100 feet from proposed mechanical site prep units are not expected to be directly impacted by proposed project activities.

Chemical Site Preparation

All of the proposed herbicides are highly effective at killing plants. By the nature of their action herbicide can be non-selective or selective. Non-selective herbicides can kill all types of plants whereas selective herbicides kill certain groups of plants while not impacting other groups of plants. There are several ways to prevent herbicides from getting on plants of concern. Spatial separation, physical barriers, and method of herbicide application are the most practical. As the distance between application site and plants of concern increases, the likelihood of harming the plants of concern decreases. Physical barriers such as buckets, tarps, or plastic sheeting can be utilized to prevent herbicides from reaching plants of concern. Drift can be reduced by controlling droplet size, spray pressure and ceasing application in high winds.

Aminopyralid provides mainly post-emergence control of many annual, biennial, and perennial invasive plant species, including brooms and yellow starthistle. It is selective and it does not injure many broadleaf species, though it can injure legumes *(Fabaceae)* and members of the sunflower family *(Asteraceae)*. For some species, aminopyralid can provide residual (preemergence) control, thereby reducing the need for retreatment. Within the soil, aminopyralid does not persist for long (<2 weeks) and is relatively immobile.

Glyphosate is one of the most widely used herbicides available. It is non-selective (broad spectrum), so it may injure non-target plants. It provides only post-emergent control and is not absorbed through roots. It is non-persistent and relatively immobile in soil. Plants treated with glyphosate can take several weeks to die; repeat application is often necessary to remove plants that were missed during the first application.

The indirect effects of herbicides on rare plant species can include accidental spills, spray drift, surface runoff, or a combination of these factors. In general, the primary hazard to non-target terrestrial plant species is herbicide drift, which are minimized by project design features including avoidance through buffers.

The proposed herbicide application presents different risk scenarios for known terrestrial and aquatic sensitive species within the Power Fire Reforestation project area. For terrestrial sensitive plants, the primary risk is the potential for off-target movement of glyphosate through drift as well as direct application of herbicides to sensitive plant occurrences. For aquatic veined lichen with suitable habitat in the project area the primary risk is exposure to glyphosate entering occupied streams.

The potential risk due to off-target application of herbicides was assessed using standardized risk models developed for broadcast boom applications in an agricultural setting, which is expected to overestimate the potential drift compared to the proposed activities. According to the SERA risk assessment there is some risk for off-target affects from glyphosate up to 500 feet from application area (SERA National Risk Assessment for glyphosate, 2011) based on a standard drift coefficient, max application rate of 4 lbs. per acre, and a No Observable Effect Concentration (NOEC) of 0.0013 lbs/acre. The risk at 500 feet was still valid when project specific worksheets used 4.8 lb/acre and a NOEC of 0.0013 lbs/acre to examine HQs for sensitive plants to drift. Under this scenario a HQ of 2 was found at 500 feet. This indicates that there is some potential for adverse effects to sensitive plants within 500 feet of proposed glyphosate application.

The SERA risk assessment for aminopyralid (SERA 2007) states that: of the indirect exposure scenarios (i.e., drift, runoff, and wind erosion), drift appears to present the highest risks to sensitive species of plants. At distances from about 25 feet to about 300 feet downwind, HQs for sensitive plant species are in the range of about 2 to 10 for ground applications and 2 to about 80 for aerial applications.

Project specific SERA worksheets ran for the project indicate the risk for adverse effects from aminopyralid (0.11 lb/acre with a NOEC of 0.0002 lb/acre) diminishes after 50 feet (HQ =2).

However, it is worth noting that the drift models used in the SERA risk assessment are based on broadcast boom applications in an agricultural setting which is expected to exceed the actual drift observed from backpack applications in a forested area (SERA 2011). Applications of glyphosate in 0 to 5 mile per hour (mph) winds using a backpack sprayer have demonstrated that droplets can drift as far as 23 feet; applications made in a 15 mph wind have the potential to drift up to 68 feet (SERA 2011). Similarly, Marrs et al. (1989) found buffers on the order of 16-32 feet (5 to 10) meters adequate for “ground based sprayers to minimize the risk of herbicide impacts.” The stated risk from drift is also contrary to general observations from past herbicide projects on the Eldorado National Forest conducted over the past 20 years where impacts to non-target vegetation from glyphosate drift have never been noted > 25 feet from application areas. Based on this direct experience from herbicide applications on the forest, and the inclusion of design features to limit drift, adverse effects are not expected for sensitive plant species from the proposed action.

Two occurrences of Pleasant Valley mariposa lily are found within 500 feet of chemical site preparation units. One occurrence (CACLA_051) is found within a chemical site preparation unit. Chemical site preparation would involve ground application of glyphosate or aminopyralid/glyphosate on approximately 450 acres prior to planting. Prior to chemical application, brush may be cut on portions of units for access.

Per design criteria, these occurrences will be flagged for avoidance with a buffer of 50 feet. As a further precaution, these sensitive plant populations will be monitored to validate the conclusion of no adverse effects from drift.

Mechanical Release

Hand grubbing or cutting could result in adverse effects to undiscovered populations if workers trample plants. No impacts are expected to occur to known sensitive or watch list plants due to mechanical release activities. Three occurrences of sensitive plants are within a mechanical release unit and would be flagged for avoidance. One other occurrence is found within 500 feet of a hand planting unit. None of the occurrences are expected to be affected indirectly through project access to the units.

Chemical Release

The effects of herbicide application would be similar to the analysis of chemical site preparation. One difference would be that the chemical triclopyr would be added for chemical release treatments. Triclopyr provides pre- and post-emergence control of woody and broadleaf plants and re-sprout control as stump treatment on woody plants. It is selective and has little impact on grasses. It can reside in soils for up to 6 months.

The SERA risk assessment for triclopyr (SERA 2011) states: for sensitive plant species, drift will be an issue, and the hazards associated with drift will vary with the application method, being greatest for aerial application and least for backpack application. The drift estimates used in the current risk assessment are generic, while actual drift during a field application could vary substantially from these estimates, based on a number of site-specific conditions. Project specific worksheets indicate that risk for adverse effects from triclopyr at 3 lb/acre with an NOEC of 0.0028 lb/acre diminishes after 100 feet (HQ =3). At 300 feet the HQ reduces to 1.

Five species are found within 500 feet of chemical release treatment units. Seven sensitive plant occurrences are within 500 feet of where the HQ for drift to terrestrial plants is above a threshold of concern (HQ = 2 or more) for chemical release activities. Per design criteria, these occurrences will be flagged for avoidance with a buffer of 50 feet and monitored to validate the conclusion of no adverse effects from drift.

Control of Invasive Plants

The SERA risk assessment for clopyralid (SERA 2004) indicates that clopyralid is an effective herbicide, at least for a number of different broadleaf weeds, and adverse effects on some non-target plant species due to drift are likely under certain application conditions and circumstances. Off-site drift of clopyralid associated with ground and aerial applications may cause damage to sensitive plant species at distances of about 300 feet from the application site. The closer that the non-target species is to the application site, the greater is the likelihood of damage. Whether or not damage due to drift would actually be observed after the application of clopyralid would depend on a several site-specific conditions, including wind speed and foliar interception by the target vegetation. In other words, in some right-of-way applications conducted at low wind speeds and under conditions in which vegetation at or immediately adjacent to the application site would limit off-site drift, damage due to drift would probably be inconsequential or limited to the area immediately adjacent to the application site. Tolerant plant species would probably not be impacted by the drift of clopyralid and might show relatively little damage unless they were directly sprayed.

Project specific worksheets indicate that risk for adverse effects from clopyralid at 0.025 lb/acre with an NEOC of 0.0005 lb/acre diminishes after 50 feet (HQ =2). At 100 feet the HQ reduces to 1.2.

Two occurrences of sensitive plants are within 500 feet of invasive plant treatments. Both occurrences will be flagged and avoided for chemical release treatments as well as monitored for project effects. No sensitive plant populations are within 50 feet of known invasive plants. Since chemical treatments for known invasive species are small in both geographical area and duration there are no anticipated adverse effects from this project activity to sensitive species. Controlling noxious weeds is anticipated to have beneficial effects to sensitive species by reducing the potential competition with noxious weeds.

The establishment of noxious weeds in sensitive plant habitat can compete with native species for resources. Historic logging, grazing, mining, and off-highway vehicle (OHV) travel have already introduced noxious weeds, primarily nonnative annual grasses, into portions of the project area. The grasses are common in both natural and developed openings such as lava caps, landings, and roadways throughout the Eldorado NF.

Release and site preparation activities are likely to either encourage the spread of known noxious weeds into recently treated units, or encourage the spread of undiscovered occurrences within the project area. Sensitive plants occupy habitat in or adjacent to areas that will become more susceptible to noxious weed invasion as a result of canopy levels being reduced to 20% cover and below.

Proposed design criteria for the project, including post project monitoring, eradication of known priority infestations, and treatment of newly discovered infestations in newly established plantations is expected to reduce the risk to sensitive and watch list plants from introducing and spreading high priority noxious weeds in the project area.

Oak stand improvement

One occurrence of Pleasant Valley mariposa lily *(Calochortus clavatus var. avius)* is within the oak stand improvement area. Per the design criteria, this occurrence will be flagged on the ground, included on project area maps prior to project initiation, and activities excluded unless approved by the project botanist in advance of implementation. The potential adverse effects of oak stand improvement would include the crushing of undiscovered populations with foot traffic during thinning/pruning and fence building, crushing of plants by fence building, and changed animal use patterns near the fence lines. Removal of small conifer trees has the potential to keep habitat more open, which could favor early seral species.

Cumulative Effects

Adverse impacts to sensitive plants from recent (1989-2011) activities have largely been minimized by the use of design criteria, mainly the use of avoidance of plant occurrences. Ongoing and future management activities in the project area would likely include trail maintenance, road maintenance and grazing. It is anticipated that future impacts to sensitive plants would continue to be minimized through the use of avoidance for the above foreseeable actions. Avoidance or other means of mitigating impacts to sensitive plant occurrences is consistent with direction contained in the ENF LRMP, which includes under Standard and Guideline 49 (p. 4-91), "provide for the protection and habitat needs of sensitive plants so that Forest activities would not jeopardize the continued existence of such species."

Within the grazing allotment, this project may contribute to increase grazing by cattle within treated units by reducing shrub density that impeded cattle movement. Direct impacts to sensitive plants from cattle include defoliation and browsing, uprooting, trampling and exposure to urine and feces. Grazing can also potentially affect sensitive plant taxa indirectly through the introduction and spread of invasive plant species that can outcompete native species.

Alternative 2

Direct and Indirect Effects

No new proposed activities would occur under the no action alternative so there are no direct, indirect, or cumulative effects to the species anticipated. The amount of suitable to marginally suitable habitat would continue to be available. Habitat would continue to be dominated by an excess of dense vegetation in the herbaceous and shrub layer. The project area will continue to remain in an early seral condition. This would result in less suitable habitat for species that prefer mature canopies.

Alternative 3

Direct and Indirect Effects

Planting Arrangements and Planting Density

Planting arrangements and densities that enhance heterogeneity in the landscape should be an improvement for the entire suite of sensitive and watch list species with suitable habitat in the project area. However, project units already have a preponderance of early seral habitat dominated by brush and herbaceous species. Planting strategies that enable the development of mature forests will be the most beneficial to sensitive and watch list species throughout the project area in the long term. Silviculture analysis for the project indicates that Alternative 3 will likely not be as successful for restoring mature forest canopies as Alternative 1.

Type and Methods of Release

Alternative 3 differs from Alternative 1 by cutting deerbrush on 105 acres before application of herbicides for site preparation. Effects would be similar to those discussed for mechanical site preparation and would not add additional adverse effects to any known sensitive or watch list species occurrences. It would slightly increase the amount of ground disturbance in the project area. While this could increase the risk of noxious weed invasion, the follow up application of herbicides should ameliorate any increased risk. Chemical release units will also have brush cut before treatment when whitethorn or deerbrush are the competing vegetation types. All bear clover/grass areas would receive two release treatments (same as proposed action) but all other vegetation types (radius treatments) could receive a total of three. This may result in these areas being more susceptible to noxious weed invasion for a longer duration compared to the proposed action. Increased ground disturbance and the potential for noxious weed invasion should be reduced by the follow up application of herbicides in the units.

Cumulative Effects

The project footprint does not change between Alternatives 1 and 3. The biggest difference in cumulative effects would result from increased ground disturbance in Alternative 3, which could result in an increased risk of noxious weed establishment in those units. All other cumulative effects are expected to remain the same between action alternatives.

Invasive Noxious Weeds

In addition to chemical treatment of sites before planting and release of seedlings from competing vegetation, this project proposes to monitor and treat existing and any newly occurring invasive noxious weeds throughout the project area.

Alternatives 1 and 3

Direct, Indirect, and Cumulative Effects

The proposed activities could have varying effects on noxious weed invasion as a result of habitat alteration. Planting and inter-planting would have small localized effects of exposing a potential seed bed of mineral soil at each planting site in the short-term (within two years). Long term results from planting would result in the establishment of a mature canopy that is resilient to noxious weed invasion. The majority of the noxious weeds in the project area are not competitive in mature canopy and need open habitats to thrive. However, the period of time until a mature canopy is developed is expected to extend from 20-25 years in the future.

Mechanical site preparation would result in the most disturbance of any of the proposed project activities. The current dense canopy of brush would be masticated and in some areas piled and burned. This activity results in the greatest risk from noxious weed invasion because the equipment utilized that can cause soil disturbance by moving throughout the units, the equipment has the potential to bring in weeds from outside areas and the activity results in the removal of canopy. These treatments can increase the amount of light reaching the ground and in some instances the exposure of bare mineral soil. This is important because seeds of potential and known invasive plants all require sunlight and contact with mineral soil for germination and growth (Zouhar, 2008). Burning could benefit noxious species by: inducing seed germination, temporarily reducing or eliminating competition from native plants, and increasing nutrient availability for noxious weeds. All these factors combine to make conditions ideal for weed seed to germinate and flourish immediately following fire and mechanical site preparation (Asher et al., 2001).

Chemical site preparation would have similar effects to those described for mechanical site preparation, but would be less impactful because treatments would be carried out mostly on foot. Short- term effects from release treatments with herbicides are expected to reduce some risk from noxious weeds since these species will be affected by herbicide treatments. However, single treatments of undiscovered noxious weeds are likely to be outweighed by the opportunity of those populations to colonize newly available habitat.

Release treatments would typically occur within 1-3 years of treatment on 3,508 acres (68% of the project area). It is expected that at least one additional treatment and possibly one more will occur over the life of the project. These treatments will result in a reduced canopy (whether shrub or herbaceous) that will likely be 20% cover or less. As a result, large portions of the project area could be vulnerable to the spread of noxious weeds for the first ten years of the project. Short- term effects from release treatments with herbicides are expected to reduce some risk from noxious weeds since these species will be affected by herbicide treatments. However, single treatments of undiscovered noxious weeds are likely to be outweighed by the opportunity of those populations to colonize newly available habitat.

Oak stand improvement would include the removal of small conifers up to 10 inches dbh. This treatment type is expected to open the canopy to a lesser degree since the focus is on removing competing conifers and reducing cattle and wildlife browsing.

A majority of known infestations within the project area are included in either/or proposed chemical site preparation and chemical release units. After project implementation these infestations are at a high risk for spreading into recently disturbed areas, and should be annually monitored and treated to prevent the spread of these infestations.

Noxious weed treatments as a part of the proposed action would follow integrated pest management principles including manual, mechanical, and chemical control methods. Chemical control methods may include directed foliar and radius application using clopyralid, aminopyralid, or glyphosate. These treatments would allow for the reduction of the risk from known noxious weeds to spread into newly opened habitats, but also for a more robust response to any new infestations detected as a result of project implementation.

The proposed project would temporarily increase potential weed vectors due to the increase in project related vehicle use (masticator and other work vehicles). Potential introduction of invasive may occur when equipment is first brought into the project area or if equipment travels or is used within existing infestations in the project area. Even if infestations are treated prior to implementation existing seedbanks could be spread further into the project area during ground disturbing project activities.

Erosion control material such as straw and seeds can also introduce new noxious weeds into the project area. Design criteria have been incorporated into the project to reduce or eliminate the likelihood of most vector opportunities related to the proposed project.

The project is within post-fire forest communities with a moderate risk for invasion, but in a portion of the Eldorado National Forest with few high priority noxious weed infestations. As described above, the project involves activities that could introduce or spread existing noxious weeds by removing existing native vegetation and establishing conifer plantations with a high risk for future spread of invasive species. These risks are mitigated by including treatment of noxious weeds and the eventual restoration of a mature forest canopy that will increase the long term resilience of the project area to weed invasion, and by including the design criteria described in Chapter 2. It is therefore anticipated that the risk of spreading and/or introducing noxious weeds would be low.

The threat of noxious weed (current and future) introduction cannot be completely eliminated for the proposed project combined with other expected activities in the area, such as road maintenance, OHV and recreation use, mechanical thinning, and prescribed fire. Therefore it is necessary to continue to monitor and control high priority infestations that already occur or may develop in the project area. The Eldorado National Forest noxious weed program is expected to continue monitoring and managing noxious weeds and would take necessary actions to address new infestations if they are discovered in the project area. Continued surveys for noxious weeds are also expected to occur during future projects in the analysis area.

Alternative 2

Direct, Indirect, and Cumulative Effects

No project related direct, indirect, or cumulative effects on the introduction and spread of noxious weeds would occur. Noxious weeds within the project area could continue to spread, however as described above, the ENF noxious weed program is expected to continue monitoring and managing noxious weeds even in the absence of project activities. Habitat would continue to be dominated by an excess of dense vegetation in the herbaceous and shrub layer, impeding the spread of weeds to some degree. The project area will continue to remain in an early seral condition longer than under Alternative 1 or 3, delaying the establishment of a mature canopy that is resilient to noxious weed invasion. The period of time until a mature canopy is developed is expected to extend from 20-25 years in the future.

Climate Change

Relevant Laws, Regulations, and Policy

The Environmental Protection Agency reports on the current state of knowledge on climate change through their website: https://www.epa.gov/climatechange. Here it outlines what is known and what is uncertain about global climate change. The following elements of climate change are known with near certainty:

- Human activities are changing the composition of Earth's atmosphere. Increasing levels of greenhouse gases like carbon dioxide (CO2) in the atmosphere since pre-industrial times are well-documented and understood.
- The atmospheric buildup of CO2 and other greenhouse gases is largely the result of human activities such as the burning of fossil fuels.
- The global average temperature has increased by more than 1.5°F since the late 1800s. (IPCC, 2013) Some regions of the world have warmed by more than twice this amount.
- Most of the warming of the past half century has been caused by human emissions of greenhouse gases. (USGCRP, 2014)
- The major greenhouse gases emitted by human activities remain in the atmosphere for periods ranging from decades to centuries. It is therefore virtually certain that atmospheric concentrations of greenhouse gases will continue to rise over the next few decades.

Effects Indicators

As for impacts to North American forests:

- Warming temperatures generally increase the length of the growing season. It also shifts the geographic ranges of some tree species. Habitats of some types of trees are likely to move north or to higher altitudes. Other species will be at risk locally or regionally if conditions in their current geographic ranges are no longer suitable.
- Carbon dioxide is required for photosynthesis, the process by which green plants use sunlight to grow. Given sufficient water and nutrients, increases in atmospheric CO_2 may enable trees to be more productive, which may change the distribution of tree species. Growth will be highest in nutrient-rich soils with no water limitation, and will decrease with decreasing fertility and water supply.
- Climate change will likely increase the risk of drought in some areas and the risk of extreme precipitation and flooding in others. Increased temperatures alter the timing of snowmelt, affecting the seasonal availability of water. Although many trees are resilient to some degree of drought, increases in temperature could make future droughts more damaging than those experienced in the past. In addition, drought increases wildfire risk, since dry trees and shrubs provide fuel to fires. Drought also reduces trees' ability to produce sap, which protects them from destructive insects such as pine beetles.

Methodology

This section addresses climate change scenarios through the indirect effects on forest health as they relate to the severity and frequency of insect outbreaks and droughts, and their effects on the success of reforestation efforts and adaptive forest management.

Affected Environment

As for what the future holds, the EPA reports changes are expected to include a warmer atmosphere and larger changes in precipitation patterns. However, the changes in precipitation are less certain than the changes associated with temperature.

Anthropogenic caused increases in temperatures and changes in precipitation are likely to impact both ecosystem structure and ecosystem processes (IPCC, 2007). Climate controls many ecosystem processes including species distribution and abundance, regeneration, vegetation productivity and growth, and disturbance all of which could affect species on the Eldorado National Forest. While there is some uncertainty regarding the scale, rate, and direction of future climatic conditions in the western United States and the Sierra Nevada (North et al., 2009) some general observation regarding past changes and expected future changes are generally agreed upon.

Climate change effects on precipitation and mean temperature have been difficult to predict with considerable variation between different models. According to Dettinger (2005), the most common prediction among the most recent models for California is temperature warming by about 9°F by 2100, with precipitation remaining similar or slightly reduced compared to today. Most models agree that summers would be drier than they are currently, regardless of levels of annual precipitation. Current estimates of predicted climate change on vegetation patterns forecast that forest types and other vegetation dominated by woody plants in California would migrate to higher elevations as warmer temperatures make those areas suitable for colonization and survival (Lenihan et al. 2003). However, rare and uncommon species are expected to experience a number of barriers when adjusting to a rapidly changing climate because of the combination of a small number of occurrences, narrow elevational ranges, and requirements for specific soils types. Communities confined to outcrops of special soils are generally expected to have a far lower chance of successful migration to suitable new sites and thus far greater risks of extinction in the face of climate change, than those that are not restricted to specific soil types (Harrison 2009). Because of the uncertainty in scale, direction, and rate of future climate change, current management of sensitive species on the Eldorado NF would focus maintaining viable populations throughout the species known range.

Environmental Consequences

Given what is and is not known about global climate change, the following discussion outlines the effects of this project on carbon sequestration and effects of climate change on reforestation, precipitation, and forest insect and diseases.

Alternative 1 and 3

Direct and Indirect Effects

Carbon Sequestration: Carbon sequestration was estimated using FVS under each alternative. Alternative 1 yields the highest amount of carbon sequestered at all ages modeled. Carbon sequestration amounts associated with this project are extremely small in the global context, making it impossible to measure the incremental cumulative impact on global climate from carbon sequestration associated with this project.

Table 3CC.1. Projected Carbon Sequestration (tons per acre) at 50, 100, and 150 years.

	Age 50		Age 100		Age 150	
	Above-ground Live	Total Stand Carbon	Above-ground Live	Total Stand Carbon	Above-ground Live	Total Stand Carbon
Alternative 1	46.1	66.1	80.1	134.5	90.6	157.6
Alternative 2	2.3	6.9	25.0	36.6	50.7	71.3
Alternative 3	5.2	11.3	37.3	53.9	47.9	97.2

Reforestation: Rapid climate change over the next century would likely render many species and local varieties less genetically suited to the environment in which they are currently found. Establishing regeneration may become more difficult since seedlings are often more sensitive to environmental conditions than mature trees (Skinner 2007).

Reforestation under Alternative 1 relies on both natural regeneration and planting. Planting prescriptions specify a high diversity of tree species including ponderosa, Jeffrey, and sugar pine, red and white fir, Douglas fir, and incense cedar. The use of seedlings grown from seeds of local origin or transferred in compliance with seed transfer rules based on California Tree Seed Zones, (J. Buck et al. 1971; also refer to R-5 FSH 2409.26, Section 42.2) insures high genetic diversity of seedlings. As seedlings will be grown from seed collected from this, or adjacent seed zones, they have the potential to be of higher genetic diversity than seedlings from the immediate project area and may be better suited to the new local environment (Skinner 2007). Replanting diverse species with high genetic diversity means that, overall, reforested stands would have the potential to better adapt to changing conditions over time. Reductions in genetic diversity would likely result from relying entirely on natural regeneration in the no action alternative.

Precipitation: Variations in yearly precipitation have the potential to affect seedling survival in the short term and growth rates in the longer term. Short term droughts, which are not infrequent in the project area, may reduce the total amount of water on a site. It is the available soil moisture to trees, however, that is the limiting factor affecting seedling survival and growth. Effective control of competing vegetation of during seedling establishment is the key to increasing available soil moisture to trees. Estimates of seedling survival and growth, above, show that Alternative 1 would have a higher seedling survival and growth rates than Alternative 3 in the current climate of long, moisture-free summers. The effect of drought is more likely to affect seedling survival under Alternatives 3 due to excessive moisture stress caused by reductions in available soil moisture to seedlings from competing plants.

Changing precipitation regimes in the longer term may result in changes in forest or tree productivity. Decreased precipitation results in higher stress levels within trees as they are not able to obtain the resources necessary for vigorous growth. Established, mature trees are often able to withstand a wide range of environmental conditions and will be able to survive for many years with effects primarily appearing as altered levels of productivity (Skinner 2007). Once trees are established and free to grow, precipitation variability would likely affect tree growth rates under all alternatives more or less equally.

Forest Insect and Diseases: Factors which improve a stands' ability to better withstand insect and disease outbreaks include a diverse mix of species, high genetic diversity within species, vigorously growing trees, and stocking levels low enough to allow trees to have access to full site resources. Vigorous, healthy trees have a greater ability to successfully ward off insect attacks, and resist diseases. As described above, diverse mix of species, high genetic diversity within species, and vigorously growing trees would be better met under Alternative 1 than Alternative 3. Maintaining appropriate stocking levels to resist insect and disease outbreak beyond the implementation of this project is beyond the scope of the EIS.

Cumulative Effects

There would be no new ground-disturbing activities from mechanical and hand thinning or herbicide use within the Power Fire boundaries and therefore no direct or indirect effects would occur with Alternative 2. See Table 3CC.1 above.

Cultural Resources

Relevant Laws, Regulations, and Policy

Activities associated with the action alternatives of this project will comply with the National Historic Preservation Act of 1966, as amended, and its implementing regulations 36 CFR 800. Activities associated with the action alternatives of this project will also be in accordance with provisions of the *Programmatic Agreement among the USDA Forest Service, Pacific Southwest Region (Region 5), the California State Historic Preservation Officer and the Advisory Council on Historic Preservation Regarding the Processes for Compliance with Section 106 of the National Historic Preservation Act for Management of Historic Properties by the National Forests of the Pacific Southwest Region* (Region 5 PA) (USDA FS, 2013). The procedures and stipulations within the Region 5 Programmatic Agreement include the identification and treatment of at-risk historic properties. An "at-risk" historic property is a cultural resource site that has been identified as susceptible to being adversely affected as a result of activities associated with this project. An adverse effect to a cultural resource site is found when an undertaking may alter the characteristics of an historic property that qualify it for inclusion in the NRHP or in a manner that would diminish the integrity of the property's location, setting, materials, workmanship, feeling, or association. [36 CFR 800.5(a)(1)].

A property is identified as "at-risk" based on that property's characteristics, proximity to project activities, types of project activities, and landscape features.

Effects Indicators

Indicators of direct effects include:

- Damage or displacement of surface and subsurface artifacts and features as a result of activities associated with the action alternatives of this project.
- The degree to which such damage or displacement of artifacts and features diminishes either the characteristics that qualify sites for inclusion in the NRHP or the integrity of sites.

Indicators of indirect effects include:

- Foreseeable damage or displacement of surface and subsurface artifacts and features as a result of natural processes, primarily due to natural tree fall of dead and fire-weakened trees.
- Increased likelihood that fuel buildup on cultural resource sites would result in adverse effects during subsequent wildfires.
- Increased likelihood that integrity of setting and feeling at cultural resource sites would be diminished where landscape conditions will not be restored to their historic conditions or appearance at the time of Native American presence.

Indicators of cumulative effects include:

- Direct and indirect effects combined with anticipated impacts to cultural resources as a result of past, present, and foreseeable future projects.

Methodology

The project analysis for cultural resources is based on pre-field research, consultation efforts with tribes, a review and assessment of previous inventories and an identification of areas needing surveys. The Area of Potential Effect (APE) for this project varies depending on the action. In areas with proposed mechanical and planting activities, the APE extends approximately one meter in depth as well as to surface areas. In areas limited to proposed herbicide applications, the APE extends only to the surface. Areas situated within the project boundary, but with no actions proposed, are considered "outside the APE."

Affected Environment

A pre-field review determined that approximately 3,258 acres within the analysis area had been previously surveyed for cultural resources through various other projects and 743 acres still need to be surveyed. The remaining 1,378 acres are over 30% slope and do not require survey transects. These past archaeological surveys have resulted in coverage of the majority of the analysis area. Several prior surveys would not currently be considered acceptable due to unreliable documentation and due to survey transect spacing having been insufficient to locate all at-risk cultural resources.

A total of 65 sites have been identified within the analysis area. Of this total, 19 of the sites are considered eligible to the National Register and 44are unevaluated, and therefore must be considered potentially eligible to the National Register. Two are not eligible but should be avoided due to their proximity to the Mokelumne River Canyon Archaeological District. Approximately 60 sites fall within the Mokelumne River Canyon Archaeological District are in the project's APE.

Approximately 62% of the APE encompasses the Mokelumne River Canyon Archaeological District. As stated in the nomination document: "The combination of village sites, base camps, temporary camps, milling stations, and lithic scatters that has been recorded within the North Fork Mokelumne River Canyon represents a comprehensive view of prehistoric settlement and subsistence patterns within the District. Although many of the individual sites lack distinction (e. g., isolated bedrock milling stations), and would probably not be considered eligible to the NRHP on their own merit, these resources, in proper context, are integral to the overall understanding of prehistory and past use of the canyon environment." (USDA Forest Service 1991:28) This District has been determined to be eligible for inclusion in the National Register of Historic Places. Due to its high archaeological significance, the Mokelumne Canyon is designated as a Special Interest Area within the Eldorado's Land and Resource Management Plan. The statement of significance concluded that the "Mokelumne Canyon is one of the most significant archaeological areas within the Eldorado National Forest. The density and variety of site types is greater than any other area identified in the Forest thus far." (McLemore 1980). Sixty sites are within both the boundaries of the Mokelumne River Canyon Archaeological District and within the APE. Fifty-nine of these sites are recommended to avoid except one which have been determined not eligible. Not eligible sites that are contributing to the district evaluation will be protected at this time as per the district nomination.

Environmental Consequences

Alternative 1 and 3

Direct and Indirect Effects

Direct effects to cultural resources are those that physically alter, damage, or destroy all or part of a resource; alter characteristics of the surrounding environment that contribute to the resource's significance; introduce visual or audible elements out of character with the property or that alters its setting; or resource neglect to the extent that it deteriorates or is destroyed. Under the action alternatives, new direct effects would not likely occur because the known sites would be avoided and if there are unanticipated discoveries, all work in the area will stop. The proposed action does not have the potential to directly affect the cultural resources within the proposed project area.

No indirect effects to historic properties are anticipated as a result of implementation of either of the action alternatives.

Cumulative Effects

No cumulative effects to historic properties are anticipated as a result of implementation of either of the action alternatives.

Alternative 2 (No Action)

Direct and Indirect Effects

There would be no new ground-disturbing activities from mechanical and hand thinning or herbicide use within the Power Fire boundaries and therefore no direct effects would occur with Alternative 2.

However, indirect effects to cultural resources would be likely through inaction. This alternative would do nothing to reduce the risk to cultural resources from future high-severity fires within sites due to increased fuel loading from the accumulation of dense brush fields. Foreseeable damage due to increased fuel loading is of particular concern to those sites within dense, high mortality timber stands.

Compared to Alternatives 1 and 3, the lack of management activities in Alternative 2 would also do nothing to restore the integrity of setting at specific site locations and across the landscape to better reflect historic conditions or appearance during the time of Native American presence and during periods of historic use.

Cumulative Effects

As stated above, Alternative 2 is likely to have an indirect effect to cultural resources where lack of treatments within and around cultural resource sites would increase the potential for ground disturbance and damage to site features through natural processes, increased likelihood that fuel build-up on cultural resource sites would result in adverse effects during subsequent wildfires, and increased likelihood that ecological setting of cultural resource sites would not foreseeably be restored to historic conditions. Other projects in the future may affect cultural resources, however there are no actions associated with Alternative 2 that would directly add to these effects.

Fire/Fuels

Relevant Laws, Regulations, and Policy

Land and Resource Management Plan

The Eldorado National Forest Land and Resource Management Plan (LRMP) as amended by the Sierra Nevada Forest Plan Amendment Record of Decision (SNFPA ROD, 2004) provides for ecosystem restoration following catastrophic events. These restoration activities are included in all land allocations and call for managing disturbed areas for long term fuel profiles, and restoring habitat.

Management Area

In addition to Forest-wide direction, the SNFPA provides programmatic management direction for site-specific projects, including designating five Land Allocation areas that fall within the project area.

Old Forest Emphasis Area

Desired Conditions:

- Forest structure and function generally resemble pre-settlement conditions.
- High levels of horizontal and vertical diversity exist within 10,000 acre landscapes.
- Stands are composed of roughly even-aged vegetation groups, varying in size, species composition, and structure. Individual vegetation groups range from less than 0.5 to more than 5 acres in size.
- Tree sizes range from seedlings to very large diameter trees.
- Species composition varies by elevation, site productivity, and related environmental factors.
- Multi-tiered canopies, particularly in older forests, provide vertical heterogeneity.
- Dead trees, both standing and fallen, meet habitat needs of old-forest-associated species.
- Where possible, areas treated for fuels also provide for the successful establishment of early seral stage vegetation.

Management Intent:

- Establish and maintain a pattern of area treatments that is effective in modifying fire behavior.

Applicable Management Objectives:

- Establish and maintain a pattern of area treatments that is effective in modifying fire behavior.

Wildland Urban Interface Threat Zones

Desired Conditions:

Under high fire weather conditions, wildland fire behavior in treated areas is characterized as follows:

- Flame lengths at the head of the fire are less than 4 feet.
- The rate of spread at the head of the fire is reduced to at least 50% of pre-treatment levels.
- Hazards to firefighters are reduced by managing snag levels in locations likely to be used for control in prescribed fire and fire suppression, consistent with safe practices guidelines.
- Production rates for fire line construction are doubled from pre-treatment levels.

Applicable Management Intent:

- Establish Threat zones are priority area for fuels treatments.
- Fuels treatments in the threat zone provide a buffer between developed areas and wildlands.
- Fuels treatments protect human communities from wildland fires as well as minimize the spread of fires that might originate in urban areas
- The highest density and intensity of treatments are located within the WUI.

Applicable Management Objectives:

- Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior.
- Design economically efficient treatments to reduce hazardous fuels.

Wildland Urban Interface Defense Zones

Desired Conditions:

- Stands are fairly open and dominated primarily by larger, fire tolerant trees.
- Surface and ladder fuel conditions are such that crown fire ignition is highly unlikely.
- The openness and discontinuity of crown fuels, both horizontally and vertically, result in very low probability of sustained crown fire.

Management Intent:

- Protect communities from wildfire and prevent the loss of life and property.
- WUI defense zones have highest priority for treatment (along with threat zones).
- The highest density and intensity of treatments are located within the WUI.

Applicable Management Objectives:

- Create defensible space near communities, and provide a safe and effective area for suppressing fire.
- Design economically efficient treatments to reduce hazardous fuels.
- The openness and discontinuity of crown fuels, both horizontally and vertically, result in very low probability of sustained crown fire.

California Spotted Owl and Northern Goshawk PACs

Desired Conditions:

- At least two tree canopy layers are present.
- Dominant and co-dominant trees average at least 24 inches dbh.
- Area within PAC has at least 60-70% canopy cover.
- Some very large snags are present (greater than 45 inches dbh).
- Levels of snags and down woody material are higher than average.

Management Intent:

- Maintain PACs so that they continue to provide habitat conditions that support successful reproduction of California spotted owls and northern goshawks. WUI defense zones have highest priority for treatment (along with threat zones).

Applicable Management Objectives:

- Avoid vegetation and fuels management activities within PACs to the greatest extent feasible.
- Reduce hazardous fuels in PACs in defense zones when they create an unacceptable fire threat to communities.
- Where PACs cannot be avoided in the strategic placement of treatments, ensure effective treatment of surface, ladder, and crown fuels within treated areas. If nesting or foraging habitat in PACs is mechanically treated, mitigate by adding acreage to the PAC equivalent to the treated acreage wherever possible. Add adjacent acres of comparable quality wherever possible.

HRCAs

Desired Conditions:

Within home ranges, HRCAs consist of large habitat blocks having:

- At least two tree canopy layers are present.
- Dominant and co-dominant trees average at least 24 inches dbh.
- Area at least 24 inches dbh in dominant and co-dominant trees.
- A number of very large (>45 inches dbh) old trees.
- At least 50-70% canopy cover.
- Some very large snags are present (greater than 45 inches dbh).
- Levels of snags and down woody material are higher than average.

Management Intent:

- Treat fuels using a landscape approach for strategically placing area treatments to modify fire behavior.
- Retain existing suitable habitat, recognizing that habitat within treated areas may be modified to meet fuels objectives.
- Accelerate development of currently unsuitable habitat (in non-habitat inclusions, such as plantations) into suitable condition.
- Arrange treatment patterns and design treatment prescriptions to avoid the highest quality habitat (CWHR types 5M, 5D, and 6) wherever possible.

Applicable Management Objectives:

- Establish and maintain a pattern of fuels treatments that is effective in modifying wildfire behavior.

- Design treatments in HRCAs to be economically efficient and to promote forest health where consistent with habitat objectives.

Federal Law

As a Federal agency, the Forest Service takes its direction from the United States Congress (Congress). Laws enacted by Congress that provide direction to the agency regarding the management of forest vegetation and the evaluation of environmental impacts include the National Forest Management Act (NFMA) of 1976 (16 United States Code (U.S.C.) 1600 et. seq) and the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et. seq.). Congress also instructs Federal agencies to promulgate regulations that provide specific instructions for implementing the legislation. In this case, National Forest Management Act regulations, also called the "Planning Rule," are found at 36 CFR 219, while the implementing regulations for the National Environmental Policy Act are found at both 40 CFR 1500 (Council on Environmental Quality) and 36 CFR 220 (Forest Service).

Other Guidance or Recommendations

The Healthy Forests Restoration Act (HFRA) provided communities with an opportunity to influence where and how federal agencies implement fuel reduction projects on federal lands. This is done through the development of a Community wildfire protection plan (CWPP).

National Fire Plan

The Federal Land Assistance, Management and Enhancement Act of 2009

The Federal Land Assistance, Management and Enhancement Act of 2009 (the FLAME Act) was signed by President Obama in November 2009. The Act states, in part, "Not later than one year after the date of the enactment, the Secretary of the Interior and Secretary of Agriculture shall submit to Congress a report that contains a cohesive wildfire management strategy." The FLAME Act directs that a cohesive strategy be developed addressing seven specific topic areas ranging from how best to allocate fire budgets at the Federal level to assessing risk to communities, and prioritizing hazardous fuels project funds. The FLAME Act is the catalyst for bringing fire leadership at all levels together and prompting a new approach to how wildland fire is managed. This new approach will guide the development of a national cohesive strategy that paves the way for developing a national wildland fire management policy.

National Cohesive Wildland Fire Management Strategy

In response to requirements of the Federal Land Assistance, Management, and Enhancement (FLAME) Act of 2009, the Wildland Fire Leadership Council (WFLC) directed the development of the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy). The Cohesive Strategy is a collaborative process with active involvement of all levels of government and non-governmental organizations, as well as the public, to seek national, all-lands solutions to wildland fire management issues. The

Cohesive Strategy will address the nation's wildfire problems by focusing on three key areas: Restore and Maintain Landscapes, Fire Adapted Communities and Response to Fire.

Three primary factors have been identified as presenting the greatest challenges and the greatest opportunities for making a positive difference in addressing the wildland fire problems to achieve this vision. They are:

- *Restoring and maintaining resilient landscapes.* The strategy must recognize the current lack of ecosystem health and variability of this issue from geographic area to geographic area. Because landscape conditions and needs vary depending on local climate and fuel conditions, among other elements, the strategy will address landscapes on a regional and sub-regional scale.
- *Creating fire-adapted communities***.** The strategy will offer options and opportunities to engage communities and work with them to become more resistant to wildfire threats.
- *Responding to Wildfires.* This element considers the full spectrum of fire management activities and recognizes the differences in missions among local, state, tribal and Federal agencies. The strategy offers collaboratively developed methodologies to move forward.

The cohesive strategy was designed to commit to this shared national vision for present and future wildland fire and land management activities in the United States. It will build on the foundation of other efforts to establish direction for wildland fire management in America — the 1995 Federal Wildland Fire Policy and Program Review; the documents that comprised the National Fire Plan; A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: A 10-Year Strategy; both editions of the Quadrennial Fire Review; Mutual Expectations for Preparedness and Suppression in the Interface; A Call to Action; and Wildland Fire Protection and Response in the United States, The Responsibilities, Authorities, and Roles of Federal, State, Local and Tribal Governments.

The Cohesive Strategy is being implemented in three phases, allowing stakeholders to systematically develop a dynamic approach to planning for, responding to, and recovering from wildland fire incidents. This phased approach is designed to promote dialogue between national, regional and local leadership.

Phase I involved the development of two documents: A National Cohesive Wildland Fire Management Strategy and the Federal Land Assistance, Management and Enhancement Act of 2009 Report to Congress. These documents provide the foundation of the Cohesive Strategy.

Phase II will involve utilizing the process outlined in Phase I, regions will identify values, conduct regional risk assessments and develop strategies to effectively meet local, regional and national goals.

During Phase III, the following steps will occur: Conduct the national analysis. Develop a draft national summary of the regional alternatives. The summary will include a description of the decision space available, a description of the activities and priorities associated with the regional alternatives, and a description of the tradeoffs associated among the alternatives. It will also:

- Share the results of the national results and summarization with stakeholders.
- Update and conclude the analysis based on feedback from the stakeholders.
- Establish a 5-year review cycle to provide updates to Congress.

Phases II and III have not yet occurred.

Cohesive Strategy Goals and Performance Measures

Wildfire crosses and affects all lands and resources regardless of jurisdiction and ownership. Each responding organization has a role in working together to protect lives, property and resources. Concise, mutually accepted goals and guiding principles are the foundation of a cohesive strategy. Clear accountability will ultimately promote transparency and aid oversight during the implementation phase. These overarching, broad goals and performance measures will be used as a foundation as regional tasks and actions and performance measures are developed in Phase II.

Restore and Maintain Landscapes

GOAL: Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.

Outcome-based Performance Measure:

- Risk to landscapes is diminished.

Fire-adapted Communities

GOAL: Human populations and infrastructure can withstand a wildfire without loss of life and property.

Outcome-based Performance Measure:

- Risk of wildfire impacts to communities is diminished.
- Individuals and communities accept and act upon their responsibility to prepare their properties for wildfire.
- Jurisdictions assess level of risk and establish roles and responsibilities for mitigating both the threat and the consequences of wildfire.
- Effectiveness of mitigation activities is monitored, collected and shared.

Wildfire Response

GOAL: All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.

Outcome-based Performance Measure:

- Injuries and loss of life to the public and firefighters are diminished.
- Response to shared-jurisdiction wildfire is efficient and effective.
- Pre-fire multi-jurisdictional planning occurs.

Effects Indicators

Quantitative indicators are used in this analysis to qualitatively evaluate treatment alternatives in terms of how well each alternative would achieve the project purpose and need. These indicators are identified and described in Table 3FF.1. Flame length and fuel models are indicators of potential fire behavior. Tree Mortality is a measure of potential resiliency.

Table 3FF.1 Resource Indicators and Measures

Resource Element	Resource Indicator	Measure (Quantify if possible)	Used to address: P/N, or key issue?	Source (LRMP S/G; law or policy, BMPs, etc.)?
Fire/fuels Management	Flame length in 90th percentile weather conditions	Flame length of treated areas	Yes	Scott & Burgan 2005 Rothermel 1983
Fire/fuels Management	Fuel models that reduce fire intensity and rate of spread	Projected Fuel model	Yes	Scott & Burgan 2005 Rothermel 1983
Fire/fuels Management	Tree mortality	% over time	Yes	Scott & Burgan 2005 Rothermel 1983

Methodology

During this analysis, information collected during field reconnaissance was utilized by interdisciplinary team specialists, forest databases and GIS databases. These data sources were utilized to establish the baseline vegetative data as described in the Power Fire Reforestation Silviculture Report. The data was utilized by the project silviculturist to project stands for modeling of existing condition and potential effects of the alternatives. Because the vegetative composition, structure and condition has a substantial impact on potential fire behavior, these same categories were utilized to the extent possible in this report.

The BEHAVE Plus 5 Fire Model

This modeling program for personal computers is a collection of mathematical models that describe fire and the fire environment. It can be used for a multitude of fire management applications including projecting the behavior of an ongoing fire, planning prescribed fire, and training. Primary modeling capabilities include surface fire spread and intensity, crown fire spread and intensity, safety zone size, size of point source fire,

fire containment, spotting distance, crown scorch height, tree mortality, wind adjustment factors, and probability of ignition. The user's guide describes operation of the program.

Fire behavior characteristics and hazard were derived for a sample of the proposed treatment areas by assigning nationally accepted fire fuel model groups that describe the potential fire behavior within defined weather variables and the fuel model groups were used as a measure to estimate changes in fuel profile by alternative. To be precise, fuel models are simulated fuel complex (or combination of vegetation types) for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified (Incise). These fuel models were utilized in the fire behavior modeling software package Behave +5. Given the uncertainty of any modeling exercise, the results are best used to compare the relative effects of the alternatives, rather than as an indicator of absolute effects. Interpretation, professional judgment, and local knowledge of fire behavior were used to evaluate the outputs from the models and adjustments made as necessary to refine the predictions.

Modeling was done utilizing both the “standard 13” and the “new” fuel models (such as TL6 and TL9 as described by Scott and Burgan 2005) as they allowed for more customization of predicted fire behavior as opposed to just using the standard 13 fuel models. The incorporation of the new fuel models allows for an increased ability to simulate changes in fire behavior as a result of fuel treatment by offering more fuel model choices (Scott and Burgan 2005), as well as tailoring fuel models to better represent conditions where fuel bed conditions are similar, but fuel loading is higher or lower than the original 13 fuel models.

Potential mortality to treated areas due to fire by alternative were modeled using the soils module of the First Order Fire Effects Model, Version 6 (FOFEM 6). Currently, FOFEM provides quantitative fire effects information for tree mortality, fuel consumption mineral soil exposure, smoke and soil heating. FOFEM is national in scope. It uses four geographical regions: Pacific West, Interior West, North East, and South East. Forest cover types provide an additional level of resolution within each region. Geographic regions and cover types are used both as part of the algorithm selection key, and also as a key to default input values.

Incomplete and Unavailable Information

Detailed information regarding the fuels for the project area does not exist. However the effects of vegetation regrowth following fire for the project area on expected fire behavior is well documented (see silviculture report).

Information Sources

Assumptions and Variables used in the Model: Weather parameters used in the models represent the 90th percentile weather conditions for the area. These values were derived from a weather station site located near the project area. Moderate conditions were utilized as well for predicting potential mortality under less severe conditions. Fire behavior outputs generated from modeling exercises only reflect static conditions and do not take into account changing weather conditions. Any change in these factors could drastically affect fire behavior. Given the uncertainty of any modeling exercise, the results are best used to compare the relative effects of the alternatives, rather than as an indicator of absolute effects. Interpretation, professional judgment, and local knowledge of fire behavior were used to evaluate the outputs from the models and adjustments made as necessary to refine the predictions.

Limitations of the Models

It should be noted a model is a simplification or approximation of reality and hence will not reflect all of reality (Stratton 2006). The use of models such as Behave Plus depends upon sample data, validity of the model itself, and assumptions made by the modeler. All three affect the results. The use of Behave plus in this analysis is to generally characterize and display existing conditions and the nature and magnitude of treatment effects to inform decisions to be made. The modeling results are not to be taken as reality.

Fire models are tools to help depict relative change in fire behavior and growth across the landscape. Although there are limitations to fire behavior modeling, the model outputs provide useful information for planning, assessing and prioritizing fuel treatments (Stratton 2004 and Stratton 2006). Interpretation, professional judgment and local knowledge of fire behavior were used to evaluate the outputs from the models.

Uncertainties in Predicting Fire Behavior

While we have a good general understanding of the factors that govern fire behavior, the interactions among these factors and the way in which fire behaves on the landscape are highly complex. As a result, fire behavior and severity can be understood and predicted in general terms, but exact predictions are not possible. Different models have been developed that are widely used and useful to assist in managing fires and developing fuel treatment plans. However, there are key uncertainties in how the simplifying assumptions of models affect their accuracy and as well as uncertainties that result from difficulties of providing adequate input data to operate the models. (Graham 2004).

Spatial and Temporal Context for Effects Analysis

Potential effects to fire and fuels are analyzed across National Forest System lands proposed for treatment within the proposed treatment area. The cumulative effects area was determined to be the project analysis boundary because collective activities within this area can modify fire behavior in such a way as to affect fuel loading and fire hazard. Although the activities outside this boundary could possibly influence fire spreading into the project area, they would not likely have a substantial effect on fire behavior within the project area. Because of this, the spatial magnitude (size) of this boundary was determined adequate from a fire management perspective.

Existing conditions are those present in year 2016. Mechanical treatments are modeled to occur in year 2018. (Actual project implementation might not start until 2018 and would likely continue for several years for herbicide treatment.)

Activities and events considered in this analysis include those that occurred within the past 15 years and those that are expected to occur within the next 15 years. Most long-term studies of forest vegetation condition indicate that time periods of this length are sufficient for evaluating the effect of silvicultural treatments (Hornbeck et al. 1993). Since the treatment of the overstory has a substantial impact on fire management, this is the time frame selected for the fuels analysis.

Affected Environment

Fire History and Occurrence

Both natural and human caused fires occur in the Power Fire Reforestation Project (PFRP) area. The abundance of human and natural ignition sources and the rapid growth of fuels in the area increase the likelihood of wildland fire. Fire has played a significant role in the historical development of the vegetation in the PFRP area. The project area is primarily within the upper- and mid-montane zones, which affect the area fire regime. Fire regimes are comprised of patterns of fire frequency, intensity, severity, seasonality, predictability, and spatial patterns over time across landscapes (Agee 1993). In the Sierra Nevada, fire regimes varied historically across the landscape with elevation, precipitation, aspect, topographic position, soil conditions or site productivity, and vegetation (Skinner and Chang 1996, Fites-Kaufman 1997). Historically, the majority of this area would have been timbered. Due to the Power Fire in 2004, much of the vegetation that has grown back into the area is early seral stage brush and grasses.. These fuels tend to burn hotter and spread faster than timber litter fuels.

Within the PFRP area, recent fires have been limited. Aggressive fire suppression action has kept most fires in the area small. Small fire occurrences (fires less than 10 acres) in the project area are largely attributed to lightening and supports the indication that lightening caused fires alone could have been responsible for a frequent fire return interval. Since 1971 the area has averaged about 2.2 of these small fires per year, with about 65% of those fires being lightning caused. Without suppression these fires could have burned through large areas of the project area over days, weeks or even months until they burned into non-fuel areas or received enough precipitation to extinguish the fire.

Prior to the Power fire, Eldorado National Forest records show that approximately 10,000 acres have burned in or adjacent to the project area since the early 1900’s. The largest fires occurred in 1917 and 1918, were 2,050 and 1,747 acres respectively. Four other large fires occurred in 1919 and 1927 south of Bear River Reservoir. The two fires in 1919 burned a total of 1,787 acres and the 1927 fires burned an approximate total of 1,560 acres.

Fire Weather

Historic weather data from local Remote Automated Weather Stations (RAWS) were obtained for fire behavior modeling. The 90th percentile weather was chosen because it is the normally accepted weather parameters used for fuels planning. Modeling at the most extreme end of atmospheric and fuel moisture conditions are not normally used for fuels planning. The 90th percentile is considered as the “average worst” conditions and therefore is used to represent conditions when fires have the potential to grow rapidly. The weather parameters used for modeling potential fire behavior and determining the associated fire hazard using weather parameters that represent the “average worst” conditions that can be expected on 90% of all the days that fires occur. More severe conditions would likely result in more severe fire behavior and fire effects to the site. This weather data was used to model potential fire behavior for the project area for both existing and post treatments vegetation and fuels.

The fuel moisture values generated from 90th percentile weather used were as follows:

1 hr time lag	4%
10 hr time lag	5%
100 hr time lag	7%
Slope	30%
20 ft wind speed	12 mph
Air temperature	85 ° F
Herbaceous moisture	40%
Woody moisture	70%

Fire Behavior

Fire resilience refers to the potential effects of a fire in the project area. An important factor in reducing the adverse effects of a fire is reducing the potential fire behavior. Fire behavior can be projected utilizing computer models. Fire behavior is the manner in which a fire reacts to available fuels, weather, and topography. A change in any of these components results in a change in fire behavior (DeBano et al.1998). Fire behavior is complex, with many contributing factors in the categories of topography (slope, aspect, elevation), weather (climate, air temperature, wind, relative humidity, atmospheric stability) and fuels (size, type, moisture content, total loading, arrangement) (Agee 1993). These three elements comprise the fire environment, surrounding conditions, influences, and modifying forces that determine fire behavior.

Topography and weather at a given location are beyond the ability of management to control. The fuel portion of fire behaviors the only controllable factor and is therefore the one factor that managers can use to manage fire hazard. Weather conditions such as drought, high temperature, low humidity, and high wind play a major role in the spread of wildfires and are influenced by topography and location of mountains as well as global influences such as La Niña and El Niño. Weather conditions are a major factor in the initiation and spread of all wildfires, but Omi and Martinson (2002) found that stands with prior fuel treatments experienced lower wildfire severity than untreated stands burning under the same weather and topographic conditions. Fuel management modifies fire behavior, ameliorates fire effects, and reduces fire suppression costs and danger (DeBano et al.1998). Manipulating fuels reduces fire intensity and severity, allowing firefighters and land managers more control of wildland fires by modifying fire behavior in the fire environment (Pollet and Omi 2000).

Fuel management can include reducing the loading of available fuels, lowering fuel flammability, or isolating or breaking up large continuous bodies of fuels (DeBano et al.1998). Fuels contribute to the rate of spread of a fire, intensity/flame length, fire residence time, and the size of the burned area (Rothermel 1983, Agee et al. 2000).

Flame length has significance for suppression strategy and tactics, and is a good visual indicator of fireline intensity at the head of the fire (DeBano et al. 1998). There are several ways of expressing fireline intensity. A visual indicator of fireline intensity is flame length (Rothermel 1983). Table 3FF.2 compares fireline intensity, flame length, and fire suppression difficulty interpretations.

Fire types (categorized by surface fire, passive crown fire, and active crown fire) are also widely used to determine general strategies and tactics to maximize the safety of both fire fighters and the public. Generally speaking flame lengths of less than 4 feet are often considered a benchmark for effective fire control operations because they can be attacked directly by hand crews (Rothermel 1983). Low intensity fires (those with 4-foot or less flame lengths) do not normally burn through the canopy or result in severe fire effects.

Table 3FF.2 Fireline Intensity Interpretations

Fireline Intensity	Flame Length	Interpretations
Low	< 4 feet	Direct attack at the head and flanks with hand crews; handlines should stop spread of fire
Moderate	4-8 feet	Fires are too intense for direct attack on the head by persons using handtools. Handline cannot be relied on to stop fire spread. Equipment such as dozers, engines, and retardant aircraft can be effective.
High	8-11 feet	Fires may present serious control problems-torching, crowning, and spotting. Control efforts at the fire head likely ineffective. This fire would require indirect attack methods
Very High	> 11 feet	Crowning, spotting, and major fire runs are probable; control efforts at the head are likely ineffective. This fire would require indirect attack methods

Table based on Rothermel (1983)

Higher intensity fires have greater potential to kill existing trees by scorching or burning into the tree crowns. Crown fires can be either passive (commonly called torching) or active. Both types can contribute significantly to spotting which increases spread rates and makes control efforts more difficult. During the Power fire, spotting was a significant factor in fire spread and containment difficulties, with spotting observed up to 1 mile from the main fire. Crown fires normally are highly destructive, difficult to control, and present the greatest safety hazard to firefighters and the public. Crown fires burn hotter and result in more severe effects than surface fires. Crown fires generally spread at least two to four times faster than surface fires (Rothermel 1983). Fires that spread quickly and at higher intensities can pose a greater risk to firefighters and the public when they occur. Agee (1996) states that crown fire potential can be managed through prevention of the conditions that initiate crown fires and allow crown fires to spread. Three main factors contributing to crown fire behavior can be addressed through fuels management: initial surface fire behavior, canopy base height, and canopy bulk density. Omi and Martinson (2002) note that that their study of fuel treatments provides strong evidence of fuel treatment efficacy, and that their results "appear quite similar to those provided by previous authors".

There is a large body of literature that makes the case for treating the various strata (surface, ladder, and canopy) of fuels. According to Graham et al.(2004) "Qualitative observations, limited empirical data, and modeling provide the scientific basis for identifying how forest structure can be modified to reduce fire hazard and modify fire behavior. Additionally, research shows that when activities reduce surface fuels (low vegetation, woody fuel, shrub layer), those activities decrease the chances that surface fires will be able to ignite ladder fuels and canopy fuels (Pollet and Omi 2002). The most effective strategy for reducing crown fire occurrence and severity is to (1) reduce surface fuels, (2) increase height to live crown, (3) reduce canopy bulk density, and (4) reduce continuity of the forest canopy (Van Wagner 1977, Agee 1996, Graham et. al 1999, Scott and Reinhardt 2001, Cruz et. al. 2002)."

Surface Fuels

Fire behavior is described by flame length, rate of spread, and fireline intensity (Rothermel 1983). Surface fuels are an important factor in determining how fast a surface fire will spread and how hot it will burn. Surface fuels consist of needles, leaves, grass, forbs, branches, logs, stumps, shrubs, and small trees. Surface fire factors are also important to the initiation and spread of crown fires.

Anderson (1982) identifies surface fuels that are up to 3 inches in diameter as those that are used in the Fire Behavior Model. Surface fuels greater than 3 inches contribute towards intensity, resistance to control and spotting but are not part of the fire behavior model. Fuel models as defined by Anderson (1982) were used to model general changes in fuel profiles by vegetative cover type. Fuel models were chosen after site visits in order to most accurately represent fuels for the project area.

Canopy Fuels

Crown fire and crown fire initiation is related to several conditions that must be met. First the intensity (flame length) of the surface fire must be high, the foliar moisture content of the live vegetation must be low, crown base heights must be low enough to interact with the surface fire and for active fire spread, and the crown bulk density must be high enough to sustain the fire once it gets into the crowns. Canopy base height (CBH) is the lowest height above the ground at which there is a sufficient amount of canopy fuel to propagate fire vertically into the canopy (Scott and Reinhardt 2001). CBH incorporates ladder fuels such as shrubs, brush and understory trees as well as the lower branches of mature trees. The lower the canopy base height, the easier it is for a given surface fire to initiate a crown fire. Low canopy base heights provide the “ladder” which allows a surface fire to become a crown fire. Figure 3FF.1 displays the CBH as it relates to critical flame length.

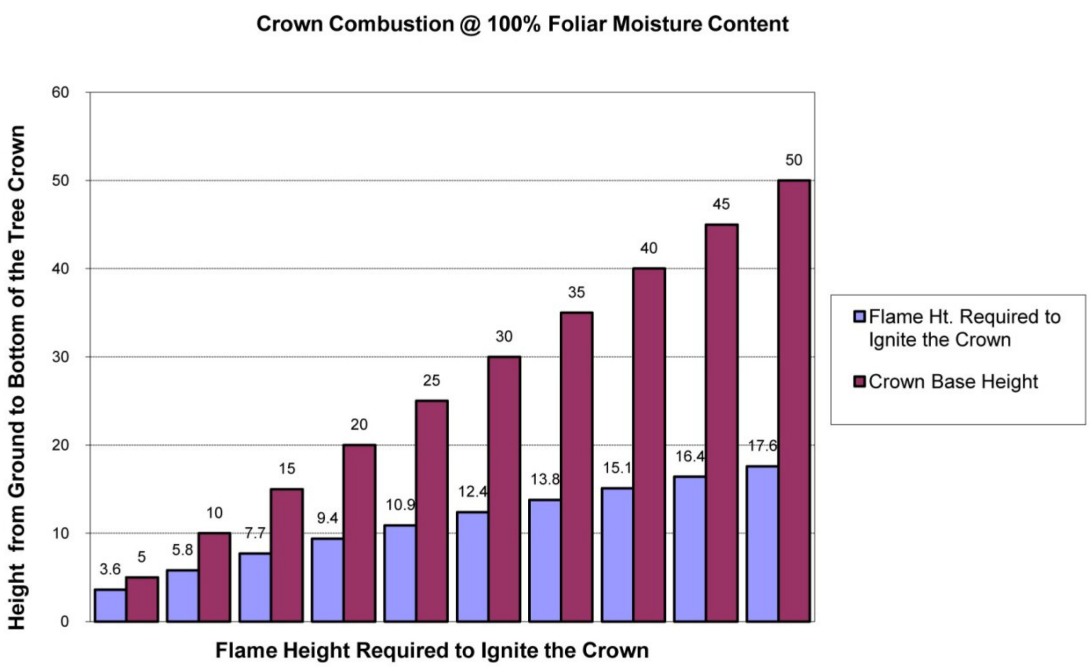

Figure 3FF.1 Canopy base height as it relates to critical flame length (feet)

In order for a crown fire to initiate, a surface fire must be intense enough, with long enough flame lengths, to ignite the lowest level of branches that will propagate fire to the upper levels of the canopy (Figure 1). When the height from the surface fuels to the bottom of the tree crown is low, for example only 5 feet, a relatively short flame length will ignite the crown. A greater height from the ground would require a larger flame length to ignite. At the same time, higher surface flame lengths will catch canopy fuels on fire even when they are higher up above the ground.

Once a fire begins burning in the crowns of the trees, whether that crown fire ignition is sustained or not is determined by surface fire rate of spread, and crown bulk density (Alexander 1988, Van Wagner 1977). Wind and slope are important factors in potential crown fire spread (Rothermel 1991), and species composition and structure control crown bulk density.

As shown above, in general, treated fuels result in less intense surface fires. Lower surface fire intensity means that fires are less likely to scorch or burn the canopy, resulting in decreased mortality to desired tree species. Given the anticipated weather conditions, the fuel model and the associated flame length for the areas proposed for treatment can be used to compare the likelihood that the treatments would result in areas that are more resistant and resilient to fires.

Managing Risk to Wildland-Urban Interface (WUI)

The PFRP area does have WUI areas. The wildland-urban interface refers to areas where wildland vegetation meets urban developments, or where forest fuels meet urban fuels such as houses or other man-made structures. Research by (Cohen and Butler 1998) has shown that structures with typical ignition characteristics (wood sided, wood framed, asphalt composition roof) are at risk of catching on fire from one of three sources. The first method is direct flame contact to the structure. Another method is aerial transport of burning materials to a structure from vegetation or other burning sources. The third is exposure to intense flames from a nearby source, which could be intensely burning vegetation or another structure. His research shows that the structures may be at risk if the flame front is less than approximately 100 feet away. Structures may also be ignited from less intense sources against or close to the side of the structure. This can occur if firewood or other flammable material next to the structure is ignited by a ground fire or firebrands. In addition, firebrands falling directly on roofs can ignite the structure if the roof is flammable, or if flammable debris is present.

There is some scientific controversy on treating forest fuels at distances more than 100 feet away from the structure itself, ongoing research by Cohen (2008) advocates that the home ignition zone primarily falls within private ownership, and therefore the responsibility for preventing home ignitions largely falls within the authority of the property owner. However he also states that during WUI disasters wildland fires are burning under conditions that are difficult to control. “The combination of vegetation, weather conditions, and topography produces fast-spreading, intensely burning fire behavior that overwhelms suppression efforts. If the extreme wildfire spreads close enough to residential development with its flames and firebrands (lofted burning embers), hundreds of ignitable homes can be simultaneously exposed. Although protection may be effective for some homes, an extreme wildfire’s high intensities and high rate of area growth (rapid spread and spot ignitions) ignites too many houses and threatens firefighters’ safety, preventing them from protecting all structures. With homeowners likely evacuated and firefighters unable to protect every house, initially small, easy-to-extinguish ignitions can result in total home destruction.”

Existing Fuels Conditions

The PFRP area consists primarily of historically forested vegetation that includes both deciduous and conifer trees. Much of the area following the fire is currently grass/shrub with mixed success of previous reforestation efforts. Vegetative cover averages over 80% and consists of a variety of grasses, forbs and woody brush. While grasses and forbs occur throughout the project area, averaging about 48% cover, woody brush has developed in a more distinctive pattern, reflective of the range in physical characteristics in the area, as well as different plant physiologies. Deerbrush, which resprouted from undamaged rootstock, is the major woody brush in the vicinity of East Panther Creek, on the western end of the fire area. Whitethorn and greenleaf manzanita, along with smaller amounts of bearclover, cherry, and gooseberry, occupy the higher elevations in the eastern sections of the fire area. Bearclover is the dominant woody brush species on southern slopes in the vicinity of the 8N29 Road, south of East Panther Creek, and along Spur 19 (8N16). Smaller amounts deerbrush, whitethorn and greenleaf manzanita occur along with bearclover. Cheatgrass (Bromus tectorum), a non-native grass, is widespread in the area, occurring in over 50% of survey plots. It averages about 25% cover

Field review of the proposed treatment areas shows that while some variety does exist, most of the areas have filled in with grass and shrubs. There are some small diameter trees within some of the units as a result of planting or natural regeneration. Modeling of potential fire behavior and existing tree mortality shows that current rates of spread and fire intensity ranges from moderate to high, with very high mortality to regenerating trees.

Environmental Consequences

Direct and Indirect Effects

Alternative 1

Alternative 1 proposes planting about 1,082 acres, the use of ground-based herbicide applications on about 3,508 acres, and controlling or eliminating noxious weeds using hand and herbicide methods. Discussion of effects is focused on these areas, which are used for comparison to Alternatives 2 and 3, as these are the areas that can be modeled given the best available information for the project.

The effects of treatment are described by resource indicator measures. The results were modeled incorporating the secondary treatments such as herbicide application listed within the proposed action to show the expected end result of all of the proposed activities. In general, treatments reduce the amount of surface fuels. Ladder fuels and canopy fuels increase in the short term due to planted trees, but over time the increased growth of the trees due to the reduction in competition increases the distance between the surface flame lengths and the ladder and canopy fuels. The effect on fire behavior from canopy and ladder fuels is discussed at length in the existing condition section of this report. The end result of the reduction in flame lengths and rate of spread means that fires are easier to contain at a smaller size.

Compared to the conditions with no treatment, most of the treated units would have reduced flame lengths and rate of spread. The reduction of these factors, when combined with the projected increase growth, results in lower potential mortality to the overstory as well. Table 3FF.3 below shows the predicted mortality to planted stands over time under both moderate and “average worst” (90^{th} percentile) conditions. Mortality for mixed Conifer/oak stands was not estimated because FOFEM does not model mortality for Oak, and there was not a significant enough growth difference when compared to conifer only stands to show a substantial change in mortality. For the purposes of analysis, it is assumed that under all alternatives, Oak species would experience very heavy mortality (greater than 80%) and conifers would be similar to that in mixed conifer stands.

Table 3FF.3 Predicted Mortality to Overstory Alternative 1

Alt 1	Mixed Conifer			
Age	DBH (in)	Height (ft)	Average Mortality Moderate Conditions	Average Mortality "average worst" Conditions
5 Years	0.4	4	100	100
10 Years	3.1	11.5	90	100
15 Years	5.7	22.3	97	100
20 Years	10	35	8	23
50 years	17.3	76	8	10

Post Treatment and Fire Behavior and Fuel Models

In proposed treatment areas the predicted fuel model and associated flame length, spread rate and likely fire size would drop substantially. This is due mostly to the reduction in surface fuels associated with herbicide treatments and the increased growth of overstory trees allowing them to shade out and compete against surface vegetation. While not modeled, the increased tree growth plays a significant role in reducing the likelihood of crown fires (torching) due to increasing the canopy base height. This would also reduce the spotting potential that can lead to significant fire control issues separate for the anticipated surface fire spread rates. Projected Fuel models are based upon input from local fire and vegetation managers experience (see silviculture report) as well as fuel model selection guides.

Table 3FF.4 displays the expected fire behavior and fuel model for the proposed treatment areas over time.

Table 3FF.4 Post Treatment Fuel Model and Fire Behavior*

	Fuel Model	Rate of Spread (ch/hr)	Flame Length (feet)	Fire Area After 1 hr. (acres)
10 years post treatment				
Alternative 1	GS2[1]	45	7	66
Alternative 2	SH7[2]	67	17	145
Alternative3	SH2[3]/SH7	36	17	42
20 years post treatment				
Alternative 1	GS2	32	6	39
Alternative 2	SH7	74	16.5	128
Alternative3	SH2/SH7	39	16	74
50 years post treatment				
Alternative 1	GS2	24	5	25
Alternative 2	SH7	50	15	112
Alternative3	SH2/SH7	24	14	25

*Reduced fire behavior over time while utilizing the same fuel model is due to the reduction of wind reaching the surface fuels due to increased canopy density and height.
[1]GS2: Shrubs are 1 to 3 feet high, moderate grass load. Spread rate high; flame length moderate.
[2]SH7: Very heavy shrub load, depth 4 to 6 feet. Spread rate high; flame length very high.
[3]SH2: Moderate fuel load, depth about 1 foot, no grass fuel present. Spread rate low; flame length low.

In the short term (less than 10 years), the lighter, flashier fuels such as grass and smaller shrubs would increase fire spread, but not flamelength with this alternative as compared to the no action alternative. Proposed treatments after 10 years however would decrease fire behavior and size over time in contrast to the no action alternative. Lower flame height means that the canopy base height would need to be lower in order for it to ignite. Due to the higher canopy and lower surface fuels spotting potential would be decreased. Raising the canopy base height as a result of increased growth requires a higher flame length needed to initiate crown fire activity including torching. This is often referred to as passive crown fire or torching. Torching and crown fire increase the amount and distance traveled of lofted embers that can land on area structures. These are often the source of home ignitions (Cohen 2008) and can significantly increase fire spread.

The effect of the treatment areas would be to reduce the potential for fires to escape initial attack, and would give firefighters areas of lower hazard from which to attack a larger fire. The projected flame length for treated areas would be moderate, allowing crews to be much more aggressive in their tactics to suppress them. The lighter fuels would allow crews to utilize areas for burning out and prepping fire control lines as well and would be an advantage in the Wildland Urban Interface. Increased canopy base height would shorten the timeframe to reintroduce prescribed fire to the landscape without incurring substantial tree mortality.

Alternative 2

Direct and Indirect Effects

Fuels will continue to accumulate over time, and in most cases the associated fuel model will continue to increase flame length. This would result in low resiliency and higher potential for mortality to desirable tree species. The vegetation in the project area is anticipated to continue to be susceptible to high fire intensity with the potential for torching and crown fire under 90th percentile weather conditions. Under these conditions, direct attack of fires would not be effective.

Surface, ladder, and crown fuels would accumulate in the absence of fire or treatment, although there will likely be much less in terms of overstory trees. With no modification of forest structure and fuels, fire behavior would persist and in most instances increase over the long term as compared to the action alternatives. Fires burning under the modeled conditions would have surface fire flame lengths classified as very high and would require indirect attack as per Table 2 above. As a result fires would have greater potential to escape control. Fires that escape initial attack are likely to become large and have adverse effects. In addition, large fires are more likely to impact Wildland Urban Interface areas in the fire vicinity.

In the absence of any kind of human-caused or natural disturbance, unwanted effects would occur from the natural progression of forest growth and change. The result would be increasing surface and ladder fuels that affect fuel models, flame length, rate of spread and potential mortality. No progress would be made towards reducing flame lengths, Rate of spread or modifying fuel models See table 3FF.4 in discussion of Alternative 1, above. In addition, no progress would be made toward reducing the potential mortality to the forested stand as displayed in Table 3FF.5 below.

Table 3FF.5 Predicted Mortality to Overstory Alternative 2

Alt 2	Mixed Conifer			
Age	**DBH (in)**	**Height (ft)**	**Average Mortality Moderate Conditions**	**Average Mortality "average worst"Conditions**
5 Years	0.1	3.1	100	100
10 Years	1.3	6.8	100	100
15 Years	2.8	11	100	100

Alt 2	Mixed Conifer			
Age	DBH (in)	Height (ft)	Average Mortality Moderate Conditions	Average Mortality "average worst"Conditions
20 Years	10	36	91	90
50 years	14.4	55	90	90

The no action alternative would not contribute to the desired condition, purpose and need, or respond to the National Fire Plan goals of reducing hazardous fuels to modify current fire behavior that would improve suppression operations. The ability of firefighters to safely and effectively suppress wildland fire would become more difficult as fire behavior characteristics remain very high.

Cumulative Effects

The No Action Alternative would result in no cumulative effects of past, present, and reasonably foreseeable future actions with respect to forest vegetation and fuels within the Project area.

Alternative 3

Alternative 3 would differ from the Proposed Action primarily in planting arrangements, planting density (trees per acre), and type and methods of release. The result over time is that some aspects of fire behavior would be less, but overall expected mortality would be mostly unchanged as compared to no action.

Table 3FF.6 below shows the predicted mortality over time under this alternative. This is largely due to only slightly reduced surface fire flame lengths. Overall rate of spread and fire size (see table 3FF.3 under Alternative 1 discussion) is reduced over no action, but direct attack on the treated areas would not be possible under this alternative, further increasing potential fire size.

Table 3FF.6 Predicted Mortality to Overstory Alternative 3

Alt 3	Mixed Conifer			
Age	DBH (in)	Height (ft)	Average Mortality Moderate Conditions	Average Mortality "average worst" Conditions
5 Years	0.5	3.6	100	100
10 Years	2.4	9.3	100	100
15 Years	4.2	14.8	100	100
20 Years	10	38	90	90
50 years	15.4	60	88	90

Cumulative Effects: Alternatives 1 and 3

Existing conditions, which serve as a proxy for the effects of past actions, are discussed above in the Existing Condition section. In general, past treatments probably increased suppression ability and reduced fire hazard in residual stands (by reducing density and fuels) and led to some regeneration, depending on the treatment and intensity of that treatment. Given the size and intensity of the Power fire within the analysis area, past treatments play a small role in shaping the existing vegetation condition and influencing proposed treatments. Cumulative effects of past, present, and reasonably foreseeable future actions are minor with respect to forest vegetation and fuels within the Project area.

Forest Vegetation

Relevant Laws, Regulations, and Policy

Management Direction

Management Direction is contained in the ENF Land and Resource Management Plan as amended by the Sierra Nevada Forest Plan Amendment (SNFPA) Standards and Guidelines. Following are the standards and guidelines applicable to this proposal:

- In Plantations, apply the necessary silvicultural and fuels reduction treatments to: 1) accelerate development of old forest characteristics, 2) increase stand heterogeneity, 3) promote hardwoods, and 4) reduce risk of loss to wildland fire (SNFPA ROD, Appendix A-25).
- Plantations size (0x-2x):
    - 3 inches and smaller surface fuel load: less than 5 tons per acre, less than 0.5 foot fuel bed depth
    - stocking levels that provide well-spaced tree crowns (for example, approximately 200 trees per acre in 4 inch dbh trees),
    - less than 50% surface area with live fuels (brush), and
    - tree mortality less than 50% of the existing stocking under 90th percentile fire weather conditions (2x type only)
- Encourage hardwoods in plantations. Promote hardwoods after stand-replacing events. Retain buffers around existing hardwood trees by not planting conifers within 20 feet of the edge of hardwood tree crowns. (SNFPA ROD, Appendix A-27).
- Promote shade intolerant pine species (sugar pine and ponderosa pine) and hardwoods in Westside forest types. (SNFPA ROD, Appendix A-28).
- Ensure that all projects involving revegetation adhere to regional native plant policies. (SNFPA ROD, Appendix A-30).
- Specific Forest-wide Standards and Guidelines pertinent to this alternative are Management Practice 73 - Artificial Stand Establishment in which the Standard and Guideline states:

"...reduce competing vegetation to insure stand reestablishment of conifers, but accept some competing brush and oaks. Reduce surface ground cover to permit successful artificial regeneration while meeting soil protection standards. Apply hand, mechanical and chemical treatments"

- Specific Standards and Guidelines pertinent to this alternative for Management Area 20 includes Management Practice 77 - Release and Weeding, which states as an objective to:

  "Manage conifer stocking and control competing vegetation. Maintain conifer height and diameter growth commensurate with site, as per appropriate yield tables. Use all available release and weeding methods."

- Specific Standards and Guidelines pertinent to this alternative for Management Areas 21, 23 and 24 include Management Practice 77 - Release and Weeding, which states as an objective to:

  "...manage competing vegetation in juvenile stands to maintain growth approximately at site potential. Base the method, and intensity of treatment upon interdisciplinary study of effective alternatives. Select treatment method that meets resource management objectives in the most cost effective way. Apply release treatment to new stands as soon as conifer growth reduction is foreseen, when cost and environmental impacts are least, and effectiveness is greatest..."

The Pacific Southwest Region (R-5) of the Forest Service has developed specific stocking standards for successful reforestation (USDA, FS, R-5 FSH. 2409.26b, 1991). These standards describe the specified minimum and recommended numbers of trees per acre needed to establish a growing forest. For the mixed conifer forest type, the minimum stocking is 50% of a given area having at least 150 trees per acre. The recommended stocking is 50% of a given area having at least 200 trees per acre. These standards reflect the knowledge that not every seedling has the genetic potential to thrive on the micro-site they were planted in. It also requires that the seedlings be well-distributed and growing under conditions that will allow them to "persist into the future".

A certified silviculturist can approve lower stocking levels than the Regional recommendations, if the change meets the test that the levels will "persist into the future" (FSH 2409.26b, Sec. 4.11a). The conclusion of the Power Fire project silviculturist was that stocking standards could be set at a minimum of 100 trees per acre and "persist into the future".

Methodology

Unit data were obtained from the stand records, fixed plot plantation surveys, and walk through exams in 2013 through 2015. Foliar cover of competing vegetation was based on ocular estimation taken from fixed plot or walk thru exams. Data on other vegetative characteristics, including live larger softwoods and hardwoods, and natural conifer regeneration were also collected. Other data were obtained from district and forest records.

Spatial and Temporal Context for Effects Analysis

Direct, indirect and cumulative effects for conifers, hardwoods and competing vegetation consider the impacts of the alternatives when combined with the following past, present, and foreseeable future actions and events: Vegetative changes resulting from the fire and effect of future management actions. The actions contributing to cumulative effects were selected because they have caused or have the potential to cause changes in seedling survival and growth, species present, and stocking levels. The geographic scope of the cumulative effects analysis was selected because impacts to these factors are limited to a given location on the ground, irrespective of actions in surrounding areas. The temporal scope was selected because the impacts to seedling survival and growth, stocking and species at a given location can accumulate over time from different activities or events.

Affected Environment

The Power Fire Reforestation Project consists of 160 units covering about 4,094 acres of the project area. No project activities are proposed on the other acres within the fire perimeter at this time.

Since the fire about 2,430 acres have been planted with conifer seedlings. Subsequently, competing vegetation has been manually grubbed or manually cut in many cases, numerous times. Planted trees encounter many barriers to establishment early in their life and cannot be considered established upon planting. According to plantation survey data, approximately 60% of the planted trees have survived in the successful planting areas. This number represents seedling mortality that has occurred over 7-8 yrs. In these areas that had adequate survival and stocking, pre-commercial thinning has occurred on approximately 1,500 acres. However high levels of woody brush cover continue to impede tree growth and pose a fire risk. On an additional 400 acres, although seedling survival appears adequate, slow growth has prevented evaluation for pre-commercial thinning.

In other planted areas, seedlings have not been established and seedling mortality is high, the result of lack of adequate moisture. Approximately 500 acres are in a failed condition with high levels of grass and woody brush species that make seedling establishment extremely difficult.

There is approximately 1,100 acres considered in this project that has not been planted since the fire. These areas are made up of areas that were not salvage logged after the fire and areas where established vegetation was prohibitive of planting.

Vegetative cover averages over 80% and consists of a variety of grasses, forbs and woody brush. While grasses and forbs occur throughout the project area, averaging about 48% cover, woody brush has developed in a more distinctive pattern, reflective of the range in physical characteristics in the area, as well as different plant physiologies. Deerbrush, which resprouted from undamaged rootstock, is the major woody brush species in the vicinity of East Panther Creek, on the western end of the fire area.

Whitethorn and greenleaf manzanita, along with smaller amounts of bearclover, cherry, and gooseberry, occupy the higher elevations in the eastern sections of the fire area. Bearclover is the dominant woody brush species on southern slopes in the vicinity of the 8N29 Road, south of East Panther Creek, and along Spur 19 (8N16). Smaller amounts deerbrush, whitethorn and greenleaf manzanita occur along with bearclover. Cheatgrass (*Bromus tectorum*), a non-native grass, is widespread in the area, occurring in over 50% of survey plots. It averages about 25% cover.

Mortality from pocket gophers is low, and gopher activity is generally low, although small pockets of heavy gopher activity are present in the area. Insect and disease damage are few, with nothing of note.

The Forest Service in Region 5 has extensive experience, a large body of research and numerous long-term studies (ranging from 10-31 years) that clearly establish the efficacy of herbicide release to improve conifer survival, growth and stand development. According to the findings of the National Administrative Study: Alternatives Methods of release, herbicides far more cost-effective than hand grubbing or hand cutting, and yield the longest-lasting results on established shrubs (McDonald and Fiddler, 2010, Abstracts of presentations, 26th Forest Vegetation Management Conference, 2005, USDA). Based on research findings and local conditions on the Eldorado National Forest, in 1991, a methodology was developed on the Eldorado National Forest by a group of certified silviculturists and culturists to evaluate plantations or areas proposed for reforestation as to the need for herbicides as a release tool and to prioritize the need for release. The evaluation as to the need for herbicides in a given area is based upon factors such as competing species, stocking of conifer seedlings, relationship between conifer condition and competing vegetation condition, and the presence or absence of pocket gophers.

Seven situations are described in the evaluation process, which are considered herbicide-dependent.

These seven situations are briefly described as:

1. Bearclover/grass - These are areas primarily in the lower elevations that are competing with bearclover (*Chamaebatia foliolosa*) and/or annual or perennial grasses. Both types of vegetation are very competitive with conifers for water and nutrients. Both types are difficult to control, often with very poor results in terms of conifer release. Bearclover is not a fast invader, but grasses are, therefore when bearclover is eliminated, grasses generally reinvade. The pine reproduction weevil can often be found in plantation trees in this situation, due to the high levels of competition and generally drier, warmer sites this situation is found on. This weevil can kill seedlings and saplings through girdling and disrupting water uptake.

2. Lupine, grasses, forbs, thistle and/or bracken fern in association with pocket gophers - These plantations are generally in the middle to high elevations. The challenges facing conifers in this situation are twofold. As the plant population increases, the pocket gopher population also increases. Gophers feed on conifer roots and stems. Conifer survival drops off quickly due to both physical damage and moisture stress. These competing plants are difficult to control also, often with poor results in terms of conifer release. Gopher control can be done in three ways: direct, using poison baits; indirect, using vegetation manipulation (eliminating the food base); or a combination of the two. The indirect method can achieve results if it is begun shortly after land clearing.

3. Chinquapin and/or greenleaf manzanita - These are plantations primarily in the mid to high elevations that are competing with chinquapin or greenleaf manzanita. Both species are difficult to control, especially once established on a site. Manzanita is a fast invader, chinquapin is not.

4. Low conifer stocking with competition - In plantations with stocking below recommended regional standards (otherwise known as marginal stocking), competition is especially critical because of the chance of plantation failure with continued mortality. There is also a need for effective site preparation for the interplanting (or replanting) effort.

5. High volume of woody brush - Even though the individual species of competing vegetation may not be considered highly competitive, the sheer number and volume of competing vegetation presents a difficult control situation and a potentially lethal combination to the conifer. Some species are difficult to control (such as chinquapin), others are difficult to adequately treat using hand methods of control when found in dense stands (such as whitethorn). Both pocket gophers and weevils can be found in this situation, although in relatively fewer sites than in the first two situations described.

6. High levels of herbaceous vegetation - This situation is similar to that described in #2, except that the amount of vegetation is higher to qualify for this situation and gophers need not be present. This vegetation is often difficult to control for any length of time due to its ability to rapidly reinvade.

7. Wildfire Risk-Vegetative structure and levels of woody brush species in plantation results in a fuel model which predicts a tree mortality of greater than 25% in the event of wildfire.

Any plantation that doesn’t fit into one of the above categories is considered currently feasible for mechanical or hand treatments (such as hand cutting or grubbing treatments), although herbicides might still be prescribed due to the potential for these units to become classified under one of the described scenarios, even after mechanical or hand treatments.

Most of the units contain elements of many of the above release need situations, either scattered over an entire unit or as inclusions within a unit. Units were classified in primary release need situation that occurred over the majority of the unit. Secondary release need situations were also noted.

Of the primary competitive species, bearclover, the grasses, lupine, chinquapin, and bracken fern are very difficult to control at any age, whereas deerbrush, bitter cherry, and manzanita present control problem once they become established (based on regional and local experience). Bearclover, grasses, and manzanita are considered plants able to compete very successfully against conifers and dominate a site. The ceanothus species and bitter cherry are considered less of a competitor then those previously mentioned, however in large numbers, these species can also dominate a site (refer to Appendix B, of the FEIS for Vegetation Management for Reforestation, USDA 1989).

Environmental Consequences

Alternative 1

Direct Effects

Vegetative Competition

Initial site preparation treatments would use glyphosate and or aminopyralid. Release treatments would use glyphosate/aminopyralid or triclopyr. Competing vegetation in areas treated would experience a dramatic reduction in percent cover, to below 20% cover. Since glyphosate has no pre-emergent effect, competing vegetation would begin to re-establish the year following treatment. Over time, the woody brush component would gradually re-establish itself, and grow. The plants would develop from seed in the soil and/or recovery of plants surviving initial treatments.

Follow-up treatment would occur, if needed, in 1 to 3 years, based on monitoring. Follow-up herbicide treatments (3,508 acres) would be based on competing vegetation type. Initial follow-up treatments in the bearclover/grass and deerbrush types would again reduce competing vegetation levels below 20%, meeting the project objective. Subsequent follow-up treatments in the bearclover/grass type would reduce competing vegetation levels below 20%, meeting the project objective. Follow-up treatments in the whitethorn/manzanita type and in the deerbrush type (after the first follow-up treatment) would be a radial eight foot treatment. These treatments would reduce competing vegetation to about 30%, marginally meeting the project objective.

This alternative would meet the short-term silvicultural goal to keep competing vegetation levels below 20% (total live ground cover) for a period of two to three years after planting.

Direct effects to culturally important plants that exist within treatment units could occur through death of plants or through non-lethal exposure to herbicides which may render them unusable or unacceptable by gatherers. Herbicide treatments could result in plants being dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term. Throughout the treatment units some plants would survive herbicide treatment by either being located in excluded areas (untreated buffer strips, sensitive plant areas) or through skips during application, receiving a less than lethal dose, or not being targeted during application. Individual plants killed during herbicide treatments would be eliminated from the site and not available to gatherers. Signs, posted at likely access points for each treatment unit, would alert the public of the specific herbicide and date the unit was treated and would reduce potential for exposure to herbicides.

Hardwoods

Direct effects to hardwoods would be minor, as they would be protected during reforestation activities. Where oak densities, including resprouting oaks, preclude planting of conifers (conifers would not be planted within 20 feet of the crown dripline of mature live, or sprouting, hardwoods), these stands would develop as oak stands. Where more scattered, planting of conifer would result in mixed conifer/oak stands. Scattered oaks would also be present in some conifer dominated stands.

Oaks would not be intentionally sprayed, including seedlings, sprouts, and larger trees, during herbicide treatments and would remain a part of the stand’s species composition. With the protection measures implemented as described, very few oaks/oak clumps will die.

Conifer survival/species composition

In the areas where adequate survival and stocking currently exist, survival will not significantly drop. Given that the known survival rate on successful planting sites in the Power Fire was 60% without the use of herbicide, survival rates should improve to between 70 and 80% on newly site prepped and planted areas. By meeting competing vegetation levels objectives, and by interplanting, conifer survival levels would be sufficient to meet minimal stocking requirement of 100 established seedlings per acre by age five to ten years. While some additional mortality may occur, it is expected that the prescribed treatments would maintain survival near this level. Interplanting or replanting would be possible and would be prescribed, based on minimum 100 TPA survival and 60% stocking criteria in the proposed action.

Effective vegetation control is particularly critical for the establishment of non ponderosa/Jeffrey pine conifers, such as red fir, white fir, Douglas fir, sugar pine, and incense cedar. These species typically have much lower early survival success than ponderosa/Jeffrey pine. Treatments under this alternative would be reflected in greater survival percentages of all of the mixed conifers species in the project area, resulting in the establishment of a mixed conifer forest.

Aquatic Features

Within the buffered areas (non-herbicide) adjacent aquatic features throughout the project area, varying widths of herbicide release/hand release/no release zones are proposed. Where hand release is proposed the effects on conifer survival and growth would be similar to Alternative 3, although the availability of water to conifers proximate to these drainages may increase conifer survival. Where no release is proposed, the effects on conifers would be similar to the no action alternative. The streamside zones, over time, would become zones of dense woody vegetation with slowly growing conifers.

There would be little to no effect to riparian species, as these species would be protected by no herbicide spray zones along stream courses. Sprouting plants, such as alders, dogwoods, maples, or willows, would be the dominate species in riparian areas. These species primarily grow adjacent to streams, springs, seeps, or other areas with water. The scattered individuals of these species that may be growing beyond the no herbicide spray zones could be killed, but this would constitute few individuals. Riparian species within hand release zones could be cut, but there would be little mortality, as they would resprout and grow.

Growth

Conifer growth is affected under this alternative by the herbicide control of competing vegetation. Competing vegetation greatly affects tree growth rates. Control of competing vegetation would increase conifer growth rates. Increased growth would accelerate the development of key habitat and old forest characteristics and reduce the risk of loss to wildland fire (SNFPA ROD, page 49). Controlling competing vegetation is critical during at least the first three years after planting.

As previously stated, the Forest Service in Region 5 has extensive experience, a large body of research and numerous long-term studies (ranging from 10-31 years) that clearly establish the efficacy of herbicide release to improve conifer survival, growth and development. Results of a long-term study, measurements in the local area, and the results from modeling done on a similar site on the Eldorado NF were used to estimate future growth in the project area.

In a study near Mt. Shasta (McDonald et al, 1997), foliar cover of grasses corresponded well to the trend in shrub density. The paper looked at four different shrub density regimes, no, light, medium, and heavy shrubs. The Mt. Shasta study measured the growth of planted trees during the 31 year study and found statistically different height and diameter values for each of the four shrub density regimes. The no shrub or light shrub categories in the study most closely resembles what the Proposed Action Alternative would be in terms of competing vegetation. The average tree height after 31 years in the no shrub category was almost 3.4 times that of the “heavy shrub” average tree height, while the average tree height in the light shrub category was about 2 ½ times that of the “heavy shrub” average tree height. Similarly, the no shrub average tree diameter was almost 3.7 times that of the “heavy shrub” environment, and the light shrub average tree diameter was about 2.8 times that of the “heavy shrub” environment. The study concluded that after 31 years, the differences in tree height were still widening.

Table 3.FV1. Results Taken from Mt. Shasta Study

Shrub density	None	Light	Medium	Heavy
1979 DBH*	5.08	3.89	2.91	1.35
1992 DBH*	7.85	6.11	4.56	2.14
Difference	2.77	2.22	1.65	0.79
years	13	13	13	13
Growth per year (in)	0.21	0.17	0.13	0.06
inches to reach 6 in.	-1.85	-0.11	1.44	3.86
Years at 13 year rate	-9	-1	11	64
	31	31	31	31
Total	**22**	**30**	**42**	**95**
inches to reach 10 in.	2.15	3.89	5.44	7.86
Years at 13 year rate	10	23	43	129
	31	31	31	31
Total	**41**	**54**	**74**	**160**
inches to reach 24 in.	16.15	17.89	19.44	21.86
Years at 13 year rate	76	105	153	360
	31	31	31	31
Total	**107**	**136**	**184**	**391**

*From Table 9 (McDonald/Abbott: PSW Research Paper 231, 1997)

Height and diameter were measured locally on trees planted and herbicide released after the Cleveland Fire which is located North of Hwy 50 on the ENF. On a good site off of the Raincoat Road, ponderosa pine averaged about 34 feet in height (range 26-44) and 9.6 inches DBH (range 6.6-12.1) at 16 years old (Figure 3FV.1). Other vegetation on the site consisted of grasses, forbs, and small brush (deerbrush and manzanita) forming close to 100 % ground cover. On good sites in the Power Fire similar diameter and height growth could be expected.

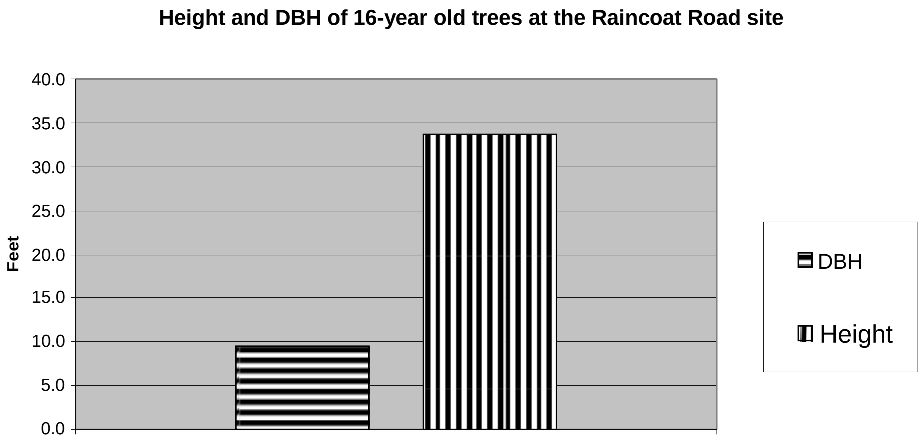

Figure 3FV.1 Tree Characteristics at year 16 at Raincoat Road Site

Trees were measured on a 22-year old local field demonstration plot (Windmiller) in the Cleveland Fire. (Figure 3FV.2). This site was of lower site quality than the Raincoat site. Trees in the demonstration plot, representing herbicide, hand release, and control plots, were measured. Both herbicide and hand release plots received two release treatments. Here, at 22 years old, herbicide released Jeffrey pine trees averaged about 30 feet in height and 12.6 inches DBH. Hand released Jeffrey pine trees averaged about 14 feet in height and 6.2 inches DBH. The Jeffrey pine in the control plot averaged about 13 feet in height and 5.6 inches DBH. Heights and DBH averages for all species combined were lower. The hand release plot totaled 44 trees per acre while the control plot totaled 56 trees per acre. The trees in the herbicide plot had been precommercially thinned. As on the Raincoat road site, grasses, forbs and small brush occupied the herbicide treated plots, while brush 5-10 feet tall (whitethorn, greenleaf manzanita, deerbrush) dominated the hand release and control plots (Figures 3FV.3 and 3FV.4).

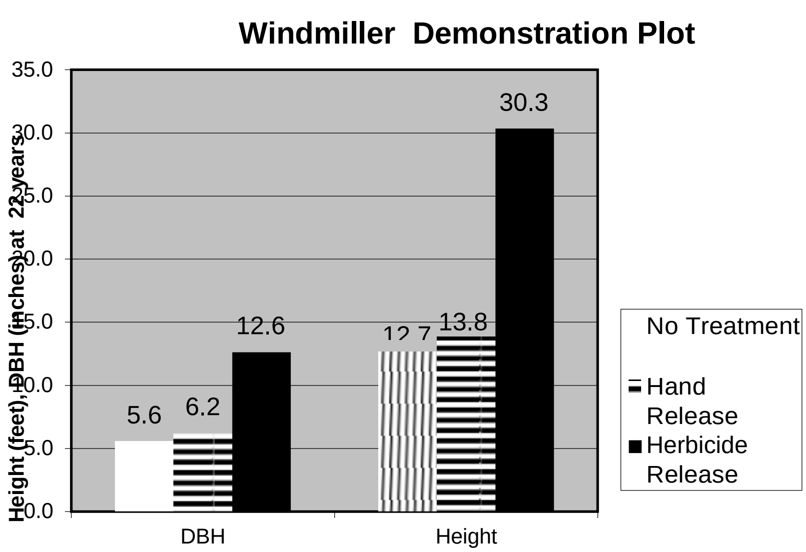

Figure 3FV.2. Tree Height and Diameter from Two Treatments and Control at Windmiller Site.

Figure 3FV.3 – Windmiller Demonstration Plot (hand release plot at 16 years).

Figure 3FV.4 – Windmiller Demonstration Plot (herbicide release plot at 16 years).

SYSTUM-1 small tree growth simulator (Richie and Powers 1993) was used to predict future growth and development of trees, forest attributes, and competing vegetation on a similar site to the Power Fire located on the Eldorado NF. SYSTUM-1 is more applicable to this area, meaning that the data collected and vegetation types coincide better with the vegetation types in the Power Fire, than a newer model (Conifers) whose applicability is primarily in the North coast of California and into Oregon (Richie, M. personal communication, 2008). SYSTUM-1 was originally intended for stands between the ages of 3 and 20, although there are no specific age constraints in the simulator (Richie and Powers, 1993).

SYSTUM-1 scenarios completed for the alternatives were mixed conifer types and mixed conifer/oak types. Trees per acre would be higher for the proposed action in the Power Fire than modeled here resulting in slightly more crown closure at any given age. Results are shown in Tables 3FV.2 and 3FV.3.

Table 3FV.2

Alt 1	Mixed Conifer			
Age	**DBH (in)**	**Height (ft)**	**Trees per acre**	**Crown closure (%)**
5 Years	0.4	4	88	1
10 Years	3.1	11.5	88	5
15 Years	5.7	22.3	88	8
20 Years	10	35	88	18
50 years	17.3	76	88	37

Table 3FV.3

Alt 1	Mixed Conifer/oak (50% Conifer, 50% oak)			
Category	**DBH (in)**	**Height (ft)**	**Trees per acre**	**Crown closure (%)**
5 Years	0.6	5	100	1.2
10 Years	3.3	13.1	100	5.2
15 Years	6.1	21.9	100	10
27 Years	10	39	100	16
50 years	16.9	72	94	28.9

Projections into the future were made using growth models. The primary question in projecting future growth is, "How long do the effects of brush suppression influence growth rates?" Growth was still being influenced by shrubs at age 31 in the Mt. Shasta study. Powers et al.(2004), on a site near Georgetown, found the influence of shrubs on growth lasted much longer on poorer sites than on more productive sites. By age 37, 28 years after treatments, growth rates on a poorer Mariposa soil increased following brush removal and continued to separate from the control. By contrast, on a more productive Cohasset soil, differences were less striking and plateaued about a decade after release. Following that, growth patterns for treated and untreated plots were essentially parallel. However, even in treated plots on better sites, stands remain at high risk to ground fire as a persistent fuel ladder connects the ground to the canopy.

Zhang et al.(2006), in a study of shrub competition and stand density on three different site quality sites found, in general, stand volume increased by controlling competing shrubs. Differences in stand volumes between no shrub and shrub plots were still widening on poorer sites after 26 years. On a highly productive site, periodic increments were essentially equal on shrub and no shrub plots after 36 years (Zhang et al., 2006), figure 1, 331 TPH (150 TPA)). As in the Powers paper, the authors in Zhang et al. describe reducing hazardous fuels can be a major advantage of controlling shrubs. When shrubs are controlled, trees can be planted at a wide spacing (such as on this project) to maximize tree size and accelerate stand development.

Whether growth suppression effects on poorer sites will continue, and for how long, is unknown. But at some point the suppression effects on individual trees must cease (Fiske, 1981). As suppression effects were still evident and widening on the Mt. Shasta study, and poorer sites in the Powers and Zhang studies, it is likely they would continue for a period of time. Therefore growth was not suppressed for any alternative beyond 50 years, assuming the growth suppression effects of shrubs will have ceased by then. If suppression effects actually continue beyond 50 years, using default values in the projection would result in an overestimation of growth in Alternative 2 and 3 for a number of years, until growth suppression ceases.

Projections beyond age 50 were made using the Forest Vegetation Simulator (FVS) (Western Sierra Nevada Variant) to estimate the age where average stand diameters reached 12 and 24 inches, and the age where canopy closure reached 40 and 60 percent. Results are shown in Table 3FV.4. Input was taken from the 50 year averages for diameter and height from the Raincoat road site, Windmiller site, Mt. Shasta study, and SYSTUM-1. Site index was set at Forest Survey Site Class 3 – 120-164 cubic feet per acre per year at culmination of mean annual increment, an average site for the project area.

Table 3FV.4. Age to meet stand parameters - FVS

	Alt 1	Alt 2 (planted)	Alt 3 (planted)
>12 inches (WHR4)	< 50	57	54
>24 inches (WHR5)	80	112	115
>40% CC (WHR M)	<50	150	110
>60% CC (WHR D)	60	>150	>150

Summary of the above information is displayed below (Table 3FV.5). The averages for 15 and 50 years coincide closely with the Windmiller site and the SYSTUM-1 model. The Raincoat Road Site and the Mt Shasta Study results display the range of what could be expected on higher and lower sites.

Table 3FV.5. Summary of Modeling and Actual Data Collection.

Alternative 1	15 years		50 years		Age for
Range of Data	DBH	Height	DBH	Height	24 inch trees
Raincoat Rd Site	9.0	31.6	30.0	105.3	
Windmiller	6.2	19.8	20.6	66.3	
SYSTUM-1	6	21.4	17.2	76.0	
FVS					80
Mt. Shasta	4.2	14.7	12.7	49.0	107
Average	6.4	21.9	20.1	74.2	

At the end of 15 years conifers would average about 22 feet in height (range 15 to 32) and have a diameter breast height (DBH) of about 7 inches (range 4-9). This estimate is based on the above data. Average oak height would be somewhat taller than conifers because they sprouted from established root systems, although on good sites conifers are likely to be as tall as oaks. Their average diameter would be smaller than conifers due to the large stem numbers in a clump.

At the end of 50 years conifers would average about 74 feet in height (range 49 to 105) and have a diameter breast height (DBH) of about 20 inches (range 13 to 30). This estimate is based projections from the above data.

Indirect Effects

Over the short-term, plant abundance may be affected by herbicide treatments, but no plant species would be eliminated from treatments units. Plants that survive herbicide treatment would recover and grow. Plants outside the treatment units would serve as seed sources for recruiting into treatment units. The existing seed banks within treatment units would also be sources for recruitment within the units. Proposed herbicides (glyphosate and triclopyr) would not affect seeds in the ground, which could germinate and grow following application. Clopyralid has a short residual effect on seeds, which would prevent germination of seed for the growing season. It is, however, selective and its effects would only be seen on several members of the sunflower family (*Asteraceae)*, legume family (*Fabaceae*), nightshade family (*Solanaceae*), and some species in the knotweed and carrot families.

DiTomaso et al. (1997) in northern California found no long-term detrimental effect on vegetative cover or species evenness with herbicide use. They also found that in areas without herbicide treatment, biodiversity and to a lesser extent species evenness had not recovered after 14 years, in contrast with herbicide treated areas.

Over the longer-term, culturally important plants that favor early seral, open conditions would be enhanced by the proposed action as its activities would maintain units in this condition for a longer period of time as compared to the other two alternatives.

Species and structural diversity within stands would be conserved as heritage resource and sensitive plant areas, areas that burned with low intensity in the Power Fire, and snag patches left untreated in the Power Fire Restoration EIS would not be reforested or released. Areas with a high concentration of surviving or sprouting oaks would maintain a large abundance of oaks. Natural variations such as surviving conifers, rock outcrops, and riparian areas contribute to diversity. In addition, there would be no herbicide treatment zones for varying widths along streamcourses. Species in the outer part of these zones, especially ephemeral and seasonal streams, resemble those of the rest of the unit and would contribute to structural diversity. In the inner portion of these zones, adjacent to live streams, species with high moisture requirements, such as alder, dogwood and willow, would not be treated, contributing to species diversity.

To analyze age class and structural diversity requires a logical discussion of the future. The planted trees in the Mt. Shasta study in the "no shrub" environment would take approximately 105 years to develop into large trees (≥24 inches DBH) assuming a consistent rate of growth beyond the life of the study. It is estimated that the trees under Alternative 1 would take 80-90 years to develop into large trees (WHR size class 5 (≥24 inches DBH)) due to more productive site conditions in the project area. Under the modeling program, FVS, large trees would develop in about 80 years.

Canopy closure is expected to reach 40% at year 50 and 60% in 60 years, based on FVS modeling. From the time the stand canopy closes, individual trees would continue to differentiate into size classes based on the resources available to each individual tree and the genetic make-up of each tree. A portion of the trees would maintain their height advantage over their shorter neighbors, resulting in a range of tree heights and diameters. After the tree crowns touch, there would be an opportunity to manage the stands to provide a variety of canopy densities, including openings. A variety of individual tree growth rates, and therefore sizes, would result in an increased vertical structural diversity. The exact structure goals would depend on direction from the management plans at that future date.

Risk of Loss to Wildland Fire

Small trees by nature are susceptible to the low intensity fires. As trees increase in height and diameter the probability of fire-induced mortality declines. As trees grow, bark thickness increases which provides protection for living tissue (cambium) from heat. As trees grow in height, there is a lower probability that the entire crown will be consumed by a fire. In other words, in the event of a fire the lower branches may be scorched, but if the tree is tall enough there will be sufficient live crown remaining to keep the tree alive. By promoting tree growth through effective control of competing vegetation the proposed action will lead to a decrease in tree mortality in wildfire situation. Faster growing trees also provide the opportunity for earlier use of prescribed fire with lower potential for tree mortality. In addition keeping brush levels below 50% cover will meet the fire and fuels objective of limiting live fuel loading and increasing effective fire suppression.

Cumulative Effects

This alternative would contribute about 4,094 acres (3,508 acres of conifer release and 586 acres of oak stand improvement treatments outside of existing of conifer release) with sufficient oak and mixed conifer stocking and growth to allow eventual attainment of the desired future conditions as defined by the Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement and Record of Decision (USDA 2004). The treatments proposed under this alternative will result in a forested landscape of 80-100 trees per acre with average diameters of 24 inches and canopy closure between 40 and 60% after about 80-90 years. The project area landscape is a combination of private timberlands and public lands. The private timberlands are managed for timber production and therefore will likely develop these levels in less than 80-90 years. There are no effects on the development of forest structure on ENF lands as a result of private land activities.

The loss of individual culturally important plants or their undesirability for gathering and use on about 3,508 acres proposed for herbicide treatment on this project could result in short-term cumulative effects. These effects would be temporary, lasting until herbicide residues were eliminated from plants and surviving plants recover or seed in from surrounding areas or untreated portions of treatment units.

Alternative 2

Direct and Indirect Effects

There would be no direct effects from this alternative as no activities would take place. This alternative would have no direct effects on culturally important plants from herbicides as plants would not be exposed to herbicides.

Vegetative Competition

In the absence of any further activities, the area would continue to be occupied by competing vegetation, and densities would quickly approach 100% cover. Woody brush, would begin to dominate, often overtopping any planted conifer seedlings. A continuous horizontal woody brush layer would develop in units, limited only by environmental factors. The woody brush layer would also expand vertically up to its potential, resulting in brush heights of two feet (bearclover) to 10 feet and higher (deerbrush, bitter cherry). This alternative would not meet the short-term silvicultural goal to keep competing vegetation levels below 20% (total live ground cover) for a period of two to three years after planting.

Hardwoods

Oaks, which were top-killed in the Power fire, have resprouted from rootstock and exist in clumps. Established rootstocks have provided resources which allowed stems to grow in height quickly. Oak clumps would continue to grow in full sun and become locally dominant over competing vegetation. This dominance will continue into the future, and oaks will survive, and become part of the stand overstory. Any conifer component of these stands would slowly develop from scattered natural regeneration.

Conifer Survival/species Composition

In the area where adequate survival and stocking currently exist, survival will not significantly drop**.** On approximately 1,081 acres both planted trees, and natural regeneration currently averaging below minimum acceptable stocking, would continue to die from moisture stress from competing vegetation on these harsh, south–facing slopes. Conifer survival rates would continue to decline, and the resultant stand would contain fewer trees and a sparser canopy cover than the proposed action or Alternative 3. Competing vegetation would be able to survive and grow under this relatively sparse canopy cover.

Where trees have not been planted this alternative would rely on natural regeneration for conifer stocking. Some conifers have seeded in and would continue to seed in from scattered trees that survived the Power fire. Seed germinating from these sources would encounter greater competition for moisture than current conditions as the temporary reduction in competing vegetation as a result of the fire have dissipated. Conifer survival would be low due to moisture competition and a vegetative overstory of grasses and shrubs, resulting in a sparse conifer component within a 100% cover of shrubs. Shade tolerant conifer species (incense cedar, Douglas fir, and white fir) would be more likely to eventually be established under a brush understory, however overall tree cover would be low due to lack of nearby seed sources and vigorous competition. Shade intolerant conifers (ponderosa pine and sugar pine) would be less likely to establish under a brush overstory and would not be released.

Growth

See discussion under Alternative 1.

SYSTUM-1 Scenarios completed for this alternative were planted and not planted mixed conifer types and oak types. For the planted scenario, this would be representative of areas in the Power Fire that were unsuccessful in maintaining survival and stocking. Results are shown in tables 3FV.6, 3FV.7 and 3FV.8.

Table 3FV.6

Alt 2	Planted			
Age	**DBH (in)**	**Height (ft)**	**Trees per acre**	**Crown closure (%)**
5 years	0.1	3.1	72	
10 years	1.3	6.8	43	0.4
15 years	2.8	11	37	1.7
36 Years	10	36	37	7
50 Years	14.4	55	37	13.5

Table 3FV.7

Alt 2	Not Planted			
Age	**DBH (in)**	**Height (ft)**	**Trees per acre**	**Crown closure (%)**
5 years	0	2.3	20	0
10 years	1	5.3	19	0
15 years	2.4	8.8	19	0
41 years	10	33	19	2
50 Years	12.9	41	19	4.2

Table 3FV.8

Alt 2	Oak			
Age	**DBH (in)**	**Height (ft)**	**Trees per acre**	**Crown closure (%)**
5 years	0.6	7.5	50	1
10 years	2.9	12.8	50	0.3
15 years	5	19.5	50	2.5
30 years	10	38	50	12
50 Years	15.8	62	50	22

Estimates of growth were determined using data from FVS, SYSTUM-1, Windmiller demonstration plot, and the Mt. Shasta Study and are displayed below (Table 3FV.9):

Table 3FV.9 Summary of modeling and actual data collection.

Alternative *2*	15 years		50 years		Age for
Range of Data	**DBH**	**Height**	**DBH**	**Height**	**24 inch trees**
Windmiller	3.1	11.1	10.3	35.0	
SYSTUM-1	3.9	14.5	14.4	55.0	
FVS					112
Mt. Shasta	1.1	4.4	3.5	14.5	391
Average	2.7	10.0	9.4	34.8	

Height and diameter growth rates would be slow. At the end of 15 years conifers would average about 10 feet in height (range 4 to 15) and have a diameter breast height (DBH) of about 3 inches (range 1 to 4). This estimate is based on the above data. Average oak height would be taller than conifers, as a result of early growth from sprouting from established root systems. Their average diameter would about the same as the conifers due to the large stem numbers in a clump.

At the end of 50 years conifers would average about 35 feet in height (range 15 to 55) and have a diameter breast height (DBH) of about 9 inches (range 4 to 15) based on projections from the above data.

Areas with a high concentration of surviving or sprouting oaks would maintain a large abundance of oaks. This alternative would not maintain the early seral open conditions that some plants favor for as long a time period, as compared to the proposed action alternative. Those plants would likely become less abundant under this alternative, existing primarily in naturally occurring open areas such as low sites, and rock outcrops.

Early stand development (50 years and less) would be considerably slower, and would be less dense than the proposed action. There is considerable variability in projections of diameter beyond 50 years because of the assumptions used. Projections from the Mt. Shasta study assume growth rates would continue as in the final 13 years of the study, with growth suppression effects of competing vegetation still widening. The FVS projections use the default growth rates, which assume effects of growth suppression beyond 50 years are no longer evident. Thus, these projections frame the range of growth beyond 50 years.

The planted trees in the Mt. Shasta study in the "heavy shrub" environment experienced high mortality in the first 15 years of the study due to insect damage on stressed trees. In the absence of additional mortality, the planted trees in this study would take approximately 390 years to develop into large trees (≥24 inches DBH) assuming a consistent rate of growth beyond the life of the study. It is estimated that the trees under Alternative 2 would take 200-250 years to develop into large trees (≥24 inches DBH) due to higher site conditions in the project area.

Under the FVS modeling programs, large trees would develop in about 110-115 years. A 40% canopy closure would be achieved in about 150 years. A 60% canopy level would be unlikely from the planted trees, due to the sparse tree cover. Unplanted areas would depend on natural regeneration and would take longer to become established and develop because of a brush overstory.

These projections assume wildfire can be excluded during each of the time periods, which is an unlikely scenario. Wildfire within the project area would "reset" the vegetative conditions back to shrubs over large portions of the project area.

Over the short-term, plant abundance would be unaffected. Over the longer-term, culturally important plants that favor early seral, open conditions could be negatively affected by the continuous horizontal woody brush layer that develops under this alternative.

Risk of Loss to Wildland Fire

Small trees are susceptible to mortality from low intensity fires. This alternative would result in the shortest, smallest diameter trees of any alternative, with trees reaching an estimated 10 inches DBH in an estimated 35-40 years. None of the areas will be brought below 50% brush cover.

Cumulative Effects

The project area landscape is a combination of private timberlands and public lands. The private timberlands are managed for timber production and therefore will likely develop a mature forest in less than 80-90 years. There are no effects on the development of forest structure on ENF lands as a result of private land activities. A stand replacing wildfire within the project area could "reset" the vegetative conditions back to early seral conditions, dominated by shrubs (refer to Fire and Fuels Report), potentially affecting the project area. The combined effect of these approaches on the landscape will result in a varying pattern of forest structure over the long term. Widespread cumulative effects to culturally important plants are not expected due to the abundance and region-wide distribution of these species (although, see botany section for sensitive plants).

Alternative 3

Direct Effects

Vegetative Competition

Treatments for bearclover and grasses would be the same as the proposed action. For site prep all treatments would be the same as the proposed action with the exception that prior to chemical application, brush would be cut on about 105 acres where deerbrush is the primary competing vegetation type. For whitethorn, manzanita, and deerbrush, radial ground application of herbicide for release would occur within 5 feet of a seedling. Within this radius competing vegetation would initially drop to below 20% cover. Because herbicide has the ability to kill individual plants, radial release with herbicide is likely to be more effective than manual grubbing alone, but establishment of conifer forest is still expected to be reduced compared to Alternative 1. With radial-only herbicide treatments, shrub levels throughout the remainder of stands are likely to be similar to the no action. In site prepped and planted areas, shrub competition in the stands are likely to exceed 30% within two to three years and to continue to cause increased moisture stress resulting in reduced growth for conifer seedlings (McDonald & Fiddler, 2010). Even small amounts of shrub cover have been shown to markedly restrict tree growth and health (Oliver, 1984). Shainsky and Radosevich (1986) found that even with a reduction of 75% of the existing greenleaf manzanita, rapid regrowth by the remaining 25% quickly equaled the competitive effect of the 75% removed. Even through repeated radius treatments, the non-treated areas will continue to re-grow with brush eventually surpassing 50% brush cover. As discussed below, there will not be enough area treated to keep overall brush cover below the critical threshold of 30%.

In areas where trees have previously been established, the shrub cover already exceeds 30% in many areas and in some places is approaching 100%. In these areas, with radial treatment only, stand level shrub cover will not be brought below 30%. See Table

3FV.10. The table shows different planting arrangements along with different release methods resulting in different shrub cover amounts. Based on the geometry of the tree spacing and how many actual trees will exist on a given acre, it becomes impossible to get shrub cover below 30% assuming all non-treated areas are already at 100%. As shown for the Prescription “Alternative 3 PCT/Release” the trees are currently at approximately 18 foot spacing (post pre-commercial thinning). With treating only a 5 foot radius, the actual area treated is only approximately 10,600 sq. ft. or approximately 24% of an acre which is 43,560 sq.ft.

Table 3FV.10. Estimated brush cover by treatment prescription.

	Geometry	Average TPA	Radius	MAX.area treated	MIN. woody brush cover (end of project)
Alt 1 Plant Rx A	3@6' x 21'	300	Area	Up to 100%	<30%
Alt 1 Plant Rx B	12' x 12'	300	Area	Up to 100%	<30%
Alt 1 Plant Rx C (+PCT/Release = same Rx)	18' x 18'	135	Area	Up to 100%	<30%
Alt 1 WORST Case Veg. (Post-PCT w/ radial followups)	18' x 18'	135	8	62%	<50%
Alt 3 Plant Rx A	5@10' x 60'	60	5	11%	89%
Alt 3 Plant Rx B	5@10' x 43'	120	5	22%	78%
Alt 3 Plant Rx C	5@10' x 36'	170	5	31%	69%
Alt 3 Plant Rx D	5@10' x 33'	200	5	36%	64%
Alt 3 Plant Rx E	5@10' x 25'	350	5	63%	37%
Alt 3 PCT/Release	18' x 18'	135	5	24%	76%
Alt 3 BEST Case Veg. (W/ NO future stocking reduction)	60-350 TPA	145	5	26%	74%

This alternative would not meet the short-term silvicultural goal to keep competing vegetation levels below 30% (total live groundcover) in all non-bear clover/grass vegetation types. Shrub competition greater than 20 to 30% has been shown to reduce pine growth by 30 to 85 percent; however, larger plots grubbed more often yield an advantage for conifer growth compared to no treatment (McDonald & Oliver, 1984; McDonald & Fiddler, 2010).

Follow-up treatment would occur, if needed, up to 3 additional times, based on monitoring.

Conifer Survival/Species Composition

Conifer survival is of primary concern in the areas that are planned for site prep and planting. Survival under Alternative 3 for newly planted seedlings should increase beyond 60% but would likely be less than the proposed action over time. Areas under planting arrangement 3.A would fail to meet the minimum stocking requirement at time of planting. Even with an 80% initial survival rate it will fall well below the minimum the first year following planting. Over time (5-10 yrs.) additional mortality will occur and a more reasonable overall survival rate would likely be 70%. Assuming 120 TPA on average will be planted with arrangement 3.B, it also would likely suffer enough conifer mortality to fall below the 100 TPA stocking requirement. Under planting arrangements 3.C, 3.D and 3.E conifer survival levels would be sufficient to meet minimal stocking requirement.

Because of the density of vegetation outside of the release circles there would be little to no opportunity to interplant or replant. Within the release circles interplanting or replanting could occur. Moving between release circles for release, planting, or survival surveys would be physically difficult where deerbrush, whitethorn, manzanita, and bittercherry are dominant, increasing costs. Conifer survival on subsequent initial planting and interplanting acres would likely be lower than previously planted acres as live ground cover of competing vegetation has increased since the fire. Trees planted into the current levels of vegetation in the project area would face immediate competition from high levels of vegetation, with survival at age three estimated to be below the previous survival rate of 60 percent.

While effective vegetation control is critical for the seedling establishment, it is particularly critical for the establishment of non ponderosa/Jeffrey pine conifers, such as red fir, white fir, Douglas fir, and sugar pine. These species typically have much lower early survival success than ponderosa/Jeffrey pine. The release treatments under this alternative would favor the establishment of ponderosa and Jeffrey pine, and the resultant stands would contain high percentages of these pines, with low percentages of the other species over the project area.

Hardwoods

Direct effects on hardwoods would be minor, as they would be protected during reforestation. Where oak densities, including resprouting oaks, preclude planting of conifers (conifers would not be planted within 20 feet of the crown dripline of mature live, or sprouting, hardwoods), areas would develop as oak stands. Planting of conifers where oak is more scattered would result in mixed conifer/oak stands.

Aquatic Features

Within the buffered areas of streamside zones throughout the project area, varying widths of planting/hand release/no release zones are proposed. Where planting and hand release are proposed the effects on conifer survival would be similar to upland areas, although the availability of water to conifers proximate to these drainages may increase conifer survival. Where no release is proposed, the effects on conifers would be similar to the no action alternative. The streamside zones, over time, would become zones of dense woody vegetation with slower growing conifers.

There would be little to no effect to riparian species, as these species would be protected by no hand release zones along stream courses. Sprouting species such as alders, dogwoods, maples, or willows would continue to recover in riparian areas. These species primarily grow adjacent to streams, springs, seeps, or other areas with water. Riparian species within hand release zones could be cut, but there would be little effect as they would resprout and grow.

Growth - *(See discussion under Alternative 1).*

SYSTUM-1 Scenarios completed for this alternative were planted mixed conifer types and mixed conifer/oak types. Results are shown in Tables 3FV.11 and 3FV.12. Non-planted areas would be the same as Alternative 2.

Table 3FV.11

Alt 3	Mixed Conifer			
Age	**DBH (in)**	**Height (ft)**	**Trees per acre**	**Crown closure (%)**
5 years	0.5	3.6	80	1
10 years	2.4	9.3	62	2.3
15 years	4.2	14.8	48	3.1
33 years	10	38	48	12
50 Years	15.4	60	48	18

Table 3FV.12

Alt 3	Mixed Conifer/oak (50% Conifer, 50% oak)			
Age	**DBH (in)**	**Height (ft)**	**Trees per acre**	**Crown closure (%)**
5 years	0.6	5	100	1.2
10 years	2.9	12.3	100	4.6
15 years	5.1	19.1	100	7
29 years	10	40	100	18
50 Years	15.3	65	94	26.5

Estimates of growth were determined using data from SYSTUM -1, Windmiller demonstration plot, and the Mt. Shasta Study and are displayed below (Table 3FV.13). Alternative 3 would be similar to the medium shrub category in the Mt. Shasta research paper.

Table 3.FV13. Summary of modeling and actual data collection

Alternative 3	15 years		50 years		Age for
Range of Data	**DBH**	**Height**	**DBH**	**Height**	**24 inch trees**
Windmiller	2.9	10.2	9.7	34	
SYSTUM-1	4.1	14.8	15.4	60	
FVS					115
Mt. Shasta	2.4	7.8	7.4	24.5	184
Average	3.1	10.9	10.8	39.5	

At the end of 15 years conifers would average about 11 feet in height (range 8 to 15) and have a diameter breast height (DBH) of about 3 inches (range 2 to 4). This estimate is based on the above data. Average oak height would be taller than conifers, result of early growth from sprouting from established root systems. Their average diameter would about the same as the conifers due to the large stem numbers in a clump. At the end of 50 years conifers would average about 40 feet in height (range 25 to 60) and have a diameter breast height (DBH) of about 11 inches (range 7 to 15) based on projections from the above data.

Early stand development (50 years and less) would be considerably slower, and would be less dense than the proposed action. Height and diameter growth would not be substantially different from Alternative 2, although stocking would be higher than Alternative 2. As discussed under Alternative 2, there is considerable variability in projections beyond 50 years. The planted trees in the Mt. Shasta study would take approximately 185 years to develop into large trees ($\geq$ 24 inches DBH) assuming a consistent rate of growth beyond the life of the study. It is estimated that the trees under Alternative 3 would take 140-160 years to develop into large trees ($\geq$ 24 inches DBH) due to higher site conditions in the project area.

Under the FVS modeling program, large trees would develop in about 115 years. In planted areas canopy closure is expected to 40% in about 110 years. A 60% canopy level would take slightly longer than 150 years, due to the sparse tree cover. Unplanted areas would be the same as described for the no action alternative.

These projections assume wildfire can be excluded during each of the time periods, which is an unlikely scenario. Wildfire within the project area would "reset" the vegetative conditions back to shrubs.

Indirect Effects

No vegetation species will be eliminated from the project area. Within treatment units, all species will persist. Within release circles the balance will be shifted toward a greater representation of grasses and forbs in the short-term, followed by an increase of woody shrubs encroaching into the circles. Eventually, conifers will develop and express dominance over the site. Outside of the release circles, woody species such as deerbrush, whitethorn, greenleaf manzanita, or bearclover would form a dense closed canopy, dominated by a single species, or a few species. Opportunities for regeneration of other species under this canopy is limited.

Species and structural diversity within stands would be conserved as heritage resource and sensitive plant areas would not be reforested or released. Areas with a high concentration of surviving or sprouting oaks would maintain a large abundance of oaks. Natural variations such as surviving conifers, rock outcrops, and riparian areas contribute to diversity. In addition, there would be no hand release zones for varying widths along streamcourses. Species in the outer part of these zones, especially ephemeral and seasonal streams, resemble those of the rest of the unit and would contribute to structural diversity. In the inner portion of these zones, adjacent to live streams, species with high moisture requirements, such as alder, dogwood and willow, would not be treated, contributing to species diversity.

Risk of Loss to Wildland Fire

Small trees are susceptible t to mortality from even the lowest intensity fires. This alternative would result in trees reaching an estimated 10 inches DBH in an estimated 29-33 years. All of the areas planned for site prep and planting with the exception of the 53 acres under planting arrangement 3.E would fail to maintain brush levels below 50% cover. None of areas that currently have trees well established would have brush levels brought below 50% cover.

Alternative 3

Cumulative Effects

The project area landscape is a combination of private timberlands and public lands. The private timberlands are managed for timber production and therefore will likely develop a mature forest in less than 80-90 years. There are no effects on the development of forest structure on ENF lands as a result of private land activities. As in Alternative 2 a stand replacing wildfire within the project area could "reset" the vegetative conditions back to early seral conditions, dominated by shrubs (refer to Fire and Fuels report), potentially affecting the project area. The combined effect of these approaches on the landscape will result in a varying pattern of forest structure over the long term. Widespread cumulative effects to culturally important plants are not expected due to the abundance and region-wide distribution of these species (Although, see botany section for sensitive plants).

Human Health

Relevant Laws, Regulations, and Policy

Forest Service Manual (FSM) 2150 2150 and Forest Service Handbook (FSH) 2109.14 provide direction to provide for pesticide use safety for public and employees from unsafe work conditions when pesticides are involved. Existing risk assessment documents and worksheets for a number of priority pesticides have been developed for the Forest Service. These are available online at the Forest Service, State and Private Forestry, Forest Health Protection website. Existing risk assessments may be used instead of developing a project-specific risk assessment (FSH 2109.14, Chapter 20). A pesticide risk assessment does not, in itself, ensure safety in pesticide use. The analysis must be tied to an action plan which provides mitigation measures (design criteria) to avoid potential risks identified by the risk assessment.

The following risk assessments for proposed pesticides along with chemical specific Excel Workbooks constitute the pesticide risk assessment for this project. However a summary of these documents is provided below in the Environmental Consequences section. Both the risk assessment documents and the Excel workbooks can be found in the project record.

Syracuse Environmental Research Associates Inc. (SERA). 1997b. Use and assessment of Marker Dyes used with Herbicides. December 21, 1997. SERA TR 96-21-07-03b. Fayetteville, New York. 47 pp.

SERA. 2011. Glyphosate Human Health and Ecological Risk Assessment – Final Report. March 25, 2011. SERA TR-052-22-03b. Manlius, New York. 336 pages.

SERA. 2004b. Clopyralid - Human Health and Ecological Risk Assessment – Final Report. December 5, 2004. SERA TR 04-43-17-03c. Fayetteville, New York. 154 pages.

SERA. 2007b. Aminopyralid - Human Health and Ecological Risk Assessment – Final Report. June 28, 2007. SERA TR 052-04-04a. Fayetteville, New York. 231 pages.

SERA. 2011b. Triclopyr – Human Health and Ecological Risk Assessment – Final Report. May 24, 2011. SERA TR 052-25-03a. Fayetteville, New York. 251 pages.

USDA Forest Service. 2000. Consideration of Cancer Risk with Colorfast Purple Dye Unpublished report written by David Bakke, Pacific Southwest Regional Pesticide-Use Specialist. 1pp.

USDA Forest Service. 2003a. Human and ecological risk assessment of nonylphenol polyethoxylate-based (NPE) surfactants in Forest Service herbicide applications. Unpublished report, written by David Bakke, Pacific Southwest Regional Pesticide-Use Specialist. May 2003. 182 pages.

USDA Forest Service. 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 pages.

Effects Indicators

This pesticide risk assessment consists of comparing doses that people may get from applying the pesticide (worker doses) or from being near an application site (public doses) with the US Environmental Protection Agency's (US EPA) established Reference Doses (RfD), a level of exposure that result in no adverse effect over a lifetime or chronic exposures. 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 forest users or 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 food items or other plant materials, such as berries or shoots, growing in or near the forest; by eating game or fish containing herbicide residues; or by drinking water that contains such residues. 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 consider acute exposures. This aspect is discussed below in the evaluation of possible effects. The computation of HQ is independent of the amount of acres proposed for treatment in this project. The assessment uses the standard of one chance in one million for cancer risk and the RfD for non-carcinogen exposures. In evaluating the doses received under each scenario, the doses are evaluated against the RfDs as previously discussed. If all the exposures are below the RfD (a HQ less than or equal to one) the assumption is that the herbicide presents little risk of use to either the public or workers. If any exposure exceeds the RfD, a closer examination of various studies and exposure scenarios must be made to determine whether a toxic response is expected from the exposure. A summary of HQs calculated specifically for the chemicals and application rates for this project are given at the end of the summary description for all chemicals (Tables A-3 and A-4). These HQs are based on the central or "typical" exposure values.

Even in the cases where HQs are extremely low and there is no reasonable belief adverse effects will result, 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 is fraught with uncertainty. Prudence dictates that normal and reasonable care should be taken in the handling of any pesticide.

Affected Environment

As described above under Effects Indicators, the affected environment is the human body, specifically the potential exposure to workers and the public from application of herbicides. The forest environment where potential exposure could occur is the portion of the project area where herbicides are applied as described in the Alternatives section of Chapter 2 and in the Forest Vegetation section above in Chapter 3.

Environmental Consequences

Alternative 1 and 3

Direct and Indirect Effects

Glyphosate

Given the low HQs for both general occupational as well as accidental exposures, the risk characterization for workers is unambiguous. All worker occupational exposures result in a HQ of less than one. None of the exposure scenarios exceed a level of concern. Given the low HQs for both general occupational exposures as well as accidental exposures, the results imply that long-term employment applying this herbicide can be accomplished without toxic effects. However, there is some suggested information that occupational exposures to glyphosate may be associated with overt signs of toxicity (SERA, 2011), which indicates the continued importance for use of safe handling procedures and personal protective equipment.

Under normal conditions, members of the general public would not be exposed to substantial levels of glyphosate. Members of the public would generally not be in the areas during herbicide application. In addition, posting signs around treatment areas would provide warning to the public that an area is being or recently has been treated. The proposed units are within or near parts of the Eldorado National Forest used for dispersed recreation, which might include activities such as woodcutting, hunting, camping, trail use, or gathering of plant materials. The public may pass through or near some of these areas while participating in these and other activities. This dispersed use is estimated to be less than 10 people a year in any given unit.

For the acute/accidental scenarios, the exposure resulting from the consumption of contaminated vegetation is the scenario with the highest HQ (HQ = 3) at the upper level. At typical and lower levels of exposure, this scenario yields HQs 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 HQs would drop substantially. The upper range of exposure scenario involves a dose of 6.48 mg/kg bw. While this is an unacceptable level of exposure, it is far below doses that would likely result in overt signs of toxicity, and is over 50 times lower than doses where mild signs of toxicity were apparent (427 mg/kg). Signing and the presence of dye on vegetation would reduce the potential of freshly sprayed material to be consumed.

For the other acute/accidental scenarios, the exposure resulting from the consumption of contaminated water by a child, at the highest application rates, approaches but does not reach the level of concern (HQ=0.8). 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 HQ. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of glyphosate, all of the HQs 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. 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 glyphosate, such scenarios involve oral (contaminated water) rather than dermal (spills or accidental spray) exposure. None of the other acute/accidental exposure scenarios approach a level of concern.

Carcinogenicity- Recently, the International Agency for Research on Cancer ((IARC) Monograph Working Group determined that glyphosate should be classified as "probably carcinogenic to humans" (Guyton et al.2015). This recent decision was based on a review of existing studies and not on new research. The issue is a particular group of cancers called non-Hodgkin's lymphomas.

In 1991, US EPA concluded that glyphosate should be classified as a Group E (evidence of non-carcinogenicity for humans) based on a lack of convincing carcinogenicity evidence and considering the criteria in EPA Guidelines for classifying a carcinogen.

The USFS human health and ecological risk assessment for glyphosate (SERA 2011), includes a lengthy discussion of the mutagenic and carcinogenic potential of glyphosate including non-Hodgkin's lymphoma (Section 3.1.10). Many of the key references used in Guyton (2015) and another recent, but more in-depth review (Schinasi and Leon, 2014) are discussed in the glyphosate risk assessment. The USFS risk assessment concludes (page 70):

The nature of the available epidemiology data on glyphosate is addressed in the U.S. EPA/OPP (2002) assessment:

This type of epidemiologic evaluation does not establish a definitive link to cancer. Furthermore, this information has limitations because it is based solely on unverified recollection of exposure to glyphosate-based herbicides.

Based on an evaluation of the available animal studies as well as epidemiology studies, U.S. EPA/OPP (2002, p. 60943) classifies the carcinogenic potential of glyphosate as Group E, No Evidence of Carcinogenicity. Given the marginal mutagenic activity of glyphosate (Section 3.1.10.1), the failure of several chronic feeding studies to demonstrate a dose-response relationship for carcinogenicity, and the limitations in the *available epidemiology studies on glyphosate, the Group E classification in U.S. EPA/OPP (1993a, 2002) appears to be reasonable.*

It has been USFS practice to defer to US EPA unless there is a compelling reason to do otherwise. At this point, there is not yet a compelling reason to adopt the IARC's classification since all the technical details are not yet available from IARC and since US EPA's and our analyses would indicate a different conclusion. As stated, a new risk assessment from US EPA is expected later this year which will undoubtedly consider the IARC's classification. If the US EPA accepts the IARC recommendation, then the USFS would consider an update to the glyphosate RA and for purposes of existing NEPA documents, such a reclassification would be considered 'new information.'

Clopyralid

The risk characterization f for potential human health effects associated with the use of clopyralid in Forest Service programs is relatively unambiguous. Based on the estimated levels of exposure and the criteria for acute and chronic exposure developed by the U.S. EPA, there is no evidence that typical or accidental exposures will lead to dose levels that exceed the level of concern for workers. In other words, all of the anticipated exposures for workers are below the acute RfD for acute exposures and below the chronic RfD for chronic exposures.

For members of the general public, none of the longer-term exposure scenarios approach a level of concern and none of the acute/accidental scenarios exceed a level of concern, based on central estimates of exposure, although the upper limit of the HQ for the consumption of contaminated vegetation by a female slightly exceeds the level of concern **–** i.e., a HQ of 1.2.

Irritation and damage to the skin and eyes can result from exposure to relatively high levels of clopyralid (i.e., placement of clopyralid directly onto the eye or skin). From a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling clopyralid. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of clopyralid.

The contamination of clopyralid with hexachlorobenzene and pentachlorobenzene does not appear to present any substantial cancer risk. Administratively, the Forest Service has adopted a cancer risk level of one in one-million (1÷1,000,000) as a trigger that would require special steps to mitigate exposure or restrict and possibly eliminate use. Based on relatively conservative exposure assumptions, the risk levels estimated for members of the general public are below this trigger level. The highest risk level is estimated at about 3 in 100 million, a factor of 33 below the level of concern. The exposure scenario associated with this risk level involves the consumption of contaminated fish by subsistence populations (i.e., groups that consume relatively large amounts of contaminated fish). The consumption of fish contaminated with hexachlorobenzene is a primary exposure scenario of concern because of the tendency of hexachlorobenzene to bioconcentrate from water into fish. This is also consistent with the general observation that exposure to hexachlorobenzene occurs primarily through the consumption of contaminated food.

Aminopyralid

The risk characterization for both workers and members of the general public is reasonably simple and unambiguous: based on a generally conservative and protective set of assumptions regarding both the toxicity of aminopyralid and potential exposures to aminopyralid, there is no basis for suggesting that adverse effects are likely in either workers or members of the general public even at the maximum application rate that might be used in Forest Service or NPS programs.

For workers, no exposure scenarios, acute or chronic, exceeds the RfD at the upper bound of the estimated dose associated with the highest application rate of 0.11 lb a.e./acre. The HQs are below the level of concern by factors of 33 to 200 over the range of application rates considered in this risk assessment.

For members of the general public, upper bounds of HQs at the highest application rate are below a level of concern by factors of 100 to 125,000 for longer term exposures. The upper bounds of acute exposure scenarios for contaminated vegetation or fruit are below the level of concern by factors of 10 to 50. Acute non-accidental exposure scenarios for members of the general public that involve contaminated water are below the level of concern by factors of about 140 to 14,000.

The risk characterization given in this risk assessment is qualitatively similar to that given by the U.S. EPA: no risks to workers or members of the general public are anticipated. The current risk assessment derives somewhat higher HQs than those in the U.S. EPA human health risk assessment because the current risk assessment uses a number of extreme exposure scenarios that are not used by the U.S. EPA.

Triclopyr

Some workers applying triclopyr BEE at the application rate of 3 lb a.e./acre will be subject to exposures that exceed the chronic RfD by a substantial margin. The central estimate of the HQ for workers under the acute accidental exposure scenario is 1.9 which is slightly above the level of concern. The upper estimate for acute accidental exposure reaches a HQ of 4. At the upper bounds of the estimated general exposures, the HQ for triclopyr BEE formulations is 19, based on the chronic RfD.

Overt toxic effects in workers do not appear to be likely. There are no epidemiology studies or case reports which suggest that systemic toxic effects are associated with occupational or even accidental exposures to any form of triclopyr; furthermore, no poisoning reports involving any form of triclopyr are documented in the reasonably comprehensive summary of human case reports on pesticide exposures.

Some triclopyr BEE formulations are moderate eye irritants. From a practical perspective, eye irritation is probably the mostly likely effect that workers will experience during the application of triclopyr formulations; furthermore, eye irritation is the only adverse effect associated with triclopyr exposure in humans.

For the general public only scenarios involving consumption of contaminated fruit or vegetation exceed a level of concern. Only one of these occurs at the central estimate of exposure which involves a young woman consuming contaminated vegetation or fruit has (HQ=10). For a young woman consuming contaminated vegetation, the upper bound HQ is 81 for acute exposures and 19 for longer-term exposures.

The upper bound HQs are based on very conservative exposure assumptions including the upper bound estimates of food consumption and upper bound estimates of residue rates. For 3,5,6-trichloro-2-pyridinol (TCP), the conservative nature of the upper bound estimates is compounded by the use of upper bound half-lives. The use of several *worst-case* or at least very conservative assumptions in multiplicative models leads to assessments in which risks may be unrealistically magnified. As discussed in Section 3.2.3.1.1(SERA, 2011b) (Likelihood and Magnitude of Exposure), the conservative nature of the upper bound assessments is intentional and intended to encompass risks to the *Most Exposed Individual*.

Forest Service risk assessments use an Extreme Value approach which also estimates the central estimates and lower bounds of exposure and risk. The central estimates of HQs are intended to reflect exposures that are expected using typical values for consumption rates and other inputs.

Finally, lower bounds of exposures are used as *best case* estimates and are generally intended to represent the feasibility of risk mitigation. At an application rate of 3 lb a.e./acre, the lower bound of the HQ for the exposure scenario involving a young woman consuming vegetation contaminated with triclopyr is 0.7, below a level of concern.

Because triclopyr has been shown to cause adverse developmental effects in mammals, the high HQs associated with terrestrial applications are of particular concern in terms of the potential for adverse reproductive outcomes in humans. Adverse developmental effects in experimental mammals have been observed, however, only at doses that cause frank signs of maternal toxicity. The available toxicity studies suggest that overt and severe toxicity would not be associated with any of the upper bound HQs and this diminishes concern for reproductive effects in humans.

Adjuvants

Nonylphenol Polyethoxylate

The primary active ingredient in many of the non-ionic surfactants used by the Forest Service (such as R-11®) is a component known as nonylphenol polyethoxylate (NPE). NPE is found in commercial surfactants at rates varying from 20-80%. NPE is formed through the combination of ethylene oxide with nonylphenol, and may contain small amounts of un-reacted nonylphenol. Nonylphenol (NP) is a material recognized as hazardous by the U.S. EPA (currently on U.S. EPA's inerts list 2). Both NP and NPE exhibit estrogen-like properties, although they are much weaker than the natural estrogen estradiol. Because of the potential for exposure to nonylphenol, as well as the demonstrated estrogenicity of these compounds, a comprehensive consideration of NPE is warranted.

Given the low HQs for accidental exposure, the risk characterization is reasonably unambiguous. None of the accidental exposure scenarios exceed a level of concern. While the accidental exposure scenarios are not the most severe one might imagine (e.g., complete immersion of the worker or contamination of the entire body surface for a prolonged period of time) they are representative of reasonable accidental exposures. Confidence in this assessment is diminished by the lack of information regarding the dermal absorption kinetics of NP9E in humans. Nonetheless, the statistical uncertainties in the estimated dermal absorption rates, both zero-order and first-order, are incorporated into the exposure assessment and risk characterization.

The upper limit of general worker exposure scenarios approach, but don't exceed, a level of concern (HQ = 0.8). The simple verbal interpretation of this quantitative characterization of risk is that under the most conservative set of exposure assumptions, workers should not be exposed to levels of NP9E that are regarded as unacceptable.

NP9E can cause irritation and damage to the skin and eyes. Quantitative risk assessments for irritation are not derived; however, from a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling NP9E. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of NP9E. Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard indices 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 NP9E.

For the acute/accidental scenarios, exposure resulting from the consumption of contaminated water from a spill is of greatest concern. Exposure resulting from the consumption of contaminated fruit is of somewhat less concern. None of the other acute exposure scenarios represent a risk of effects to the public from NP9E exposure.

Acute or accidental exposure scenarios involving consumption of contaminated water or consumption of contaminated vegetation represent some risk of effects. None of the other acute exposure scenarios represent a risk of effects to the public from NP9E exposure. At typical rates of application, the drinking of contaminated water after a spill (HQ = 4.6) approaches the level that could present a risk of subclinical effects to the liver and kidney (HQ values between 5 and 10). The upper HQ of 6.9 represents an increasing risk of clinical effects to the kidney, liver, and other organ systems. The exposure scenario for the consumption of contaminated water is an arbitrary scenario: 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 HQ. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of NP9E, all of the HQs would be a factor of 10 less. This scenario involving water contamination assumes that a small pond is affected, rather than a creek or river as would be more likely in this forested setting. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are substantially below one.

At high application rates only (HQ = 5.0) the short-term consumption of fruit is at the lower end the level that could present a risk of subclinical effects to the liver and kidney (HQ values between 5 and 10). At the typical rate of application, the HQ is less than one. Signing and the presence of dye on vegetation would reduce the potential of freshly sprayed material to be consumed.

The public exposure scenario involving the consumption of fruit, both short-term (above) and long-term, most closely proxies the use of native material by basketweavers. The highest estimated HQ value for the long-term exposure scenario is 0.08. Plant materials in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable and very unlikely to be selected for basketweaving, medicine or food (Segawa et al., 2001), reducing the likelihood of additive doses.

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 is 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 x 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.

Methylated Seed Oil and Silicone/Modified Vegetable Oil Blend

No formalized risk assessment has been done for these products however analysis has been done on their use and toxicity (USDA, 2007). These surfactants both have a potential to cause slight skin and eye irritation. These products have low acute oral and dermal toxicity.

Cumulative Effects

The proposed use of herbicides could result in cumulative doses of herbicides to workers or the general public. Cumulative doses to the same herbicide result from (1) additive doses via various routes of exposure resulting from the management scenarios presented in the Proposed Action and (2) additive doses if an individual is exposed to other herbicide treatments.

Additional sources of exposure include: use of herbicides on adjacent private timberlands or home use by a worker or member of the general public. Using Forest Service and State of California pesticide-use records, Table 3HH.1 displays the use of herbicides by total use and Forestland use within Amador County.

Table 3HH.1 Reported herbicide use (lbs active ingredient) within Amador County

Forestry						
Chemical	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Aminopyralid	0	0	0	16	35	50
Clopyralid	0	0.24	1.08	0.49	0.02	2
Glyphosate	2,357	471	67	1,186	770	4851
Triclopyr BEE	9	0	0	0	0	9
All Reported Uses						
Chemical	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Aminopyralid	39	301	227	120	111	798
Clopyralid	10	31	7	8	14	71
Glyphosate	6,775	8,212	4,759	13,181	7,204	40,131
Triclopyr BEE	214	218	162	390	258	1,243

Glyphosate is primarily used in forestland, other crops, right-of-way, and landscape maintenance. Clopyralid is primarily used for rangeland, landscape maintenance, and right-of-way. Aminopyralid are primarily used in right-of-way and landscape maintenance. Triclopyr BEE is primarily used in right-of-way, and Rangeland/Pastureland.

Additional sources of exposure on National Forest Lands – Past use on the Eldorado National Forest includes the use of glyphosate, triclopyr, aminopyralid and clopyralid. There is the potential for exposure from projects on the Eldorado National Forest involving the herbicides proposed for use on this project. They include the Forest-wide Eradication and Control of Invasive Plants (aminoplyralid, clopyralid, and glyphosate), PG&E/SMUD Transmission line (clopyralid), Callecat Ecological Restoration Project (glyphosate) and the King Fire Restoration Project (glyphosate). It is assumed that there would not be any extensive changes in these use patterns into the near future. Potential future use of herbicides proposed on this project may include glyphosate due to its possible use on the Panther Fuels Reduction Project.

Under the Proposed Action, it is estimated that approximately 3,500 acres would be treated with herbicide at least two times over the life of the project. This is estimated to be approximately 28,000 lbs total herbicide active ingredient (ai) spread over 6 years. Based on the pesticide use from 2010-2014 displayed in Table 3HH.1, the Proposed Action would result in a 66% increase in herbicide within Amador County over the life of the project.

It is conceivable that workers or members of the public could be exposed to herbicides as a result of treatments on surrounding public or private forestlands or from fire restoration efforts on Forest Service lands. Where individuals could be exposed by more than one route, the risk of such cases can be quantitatively characterized by simply adding the HQs 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 HQ of 0.02. Similarly, for all of the chronic glyphosate exposure scenarios, the addition of all possible pathways lead to HQs 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 1 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 (glyphosate, up to 66 weeks), however, these levels were less than 1 part per million (Segawa et al. 2001). Based on the re-treatment schedule in the proposed action, 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.

Table 3HH.1 indicates that several of these herbicides are used primarily outside of forestlands in the county area. In order to consider the cumulative effects of these other 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 chronic dose estimates 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 change the risk conclusions based on the project-related HQ values.

Table 3HH.2 TMRC values for US population as a whole

Herbicide	TMRC (mg/kg/day)	% of RfD	Data Source
Aminopyralid	0.0033*	6.0	US EPA 2005
Clopyralid	0.00903	6.0	US EPA 1999
Glyphosate	0.02996	1.5	US EPA 2000b
Triclopyr	0.00105	2.1	US EPA 2002a

*Short-term dietary and non-dietary exposure estimate for children 1-2 years old

Cumulative effects can be caused by the interaction of different chemicals with a common metabolite or a common toxic action. With the exception of triclopyr and chlorpyrifos discussed below, none of the other herbicides have been demonstrated to share a common metabolite with other pesticides.

As previously stated, the primary metabolite of triclopyr is TCP. TCP is also the primary metabolite of an insecticide called chlorpyrifos. U.S. EPA (1998, 2002a) considered exposures to TCP from both triclopyr and chlorpyrifos in their general dietary and drinking water exposure assessments. The U.S. EPA estimated dietary exposures at the upper 99.5% level for a young woman – i.e., the most sensitive population in terms of potential reproductive effects, the endpoint of greatest concern for triclopyr.

The upper range of acute exposure to triclopyr was estimated at 0.012 mg/kg/day and the upper range of exposure to chlorpyrifos was estimated at 0.016 mg/kg/day. Thus, making the assumption that both triclopyr and chlorpyrifos are totally converted to TCP, the total exposure is about 0.028 mg/kg/day, a factor of 8.9 below the level of concern. For chronic exposures, the U.S. EPA based the risk assessment on infants – i.e., individuals at the start of a lifetime exposure. The dietary analysis indicated that the total exposure expressed as a fraction of the RfD was 0.044 for TCP from triclopyr and 0.091 for TCP from chlorpyrifos for a total of 0.135 or a factor of about 7.4 below the level of concern [1÷0.135 = 7.4]. Based on this assessment, the U.S. EPA (1998) concluded that:

...the existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic dietary risks from TCP. Based on limited available data and modeling estimates, with less certainty, the Agency concludes that existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic drinking water risks from TCP. Acute and chronic aggregate risks of concern are also unlikely to result from existing uses of triclopyr and chlorpyrifos. – U.S. EPA (1998, p. 34).

This conclusion, however, is based primarily on the agricultural uses of triclopyr – i.e., estimated dietary residues – and does not specifically address potential exposures from forestry applications. In forestry applications, the primary concern would be the formation of TCP as a soil metabolite. TCP is more persistent than triclopyr in soil and TCP is relatively mobile in soil (U.S. EPA 1998) and could contaminate bodies of water near the site of application. In order to assess the potential risks of TCP formed from the use of triclopyr, the TCP metabolite was modeled in the SERA risk assessment (SERA 2011b) along with triclopyr. The results for TCP are summarized in SERA (2011b) Table 26 and used in the worksheets for TCP.

Notwithstanding the above assessment in U.S. EPA (1998, 2002a), this analysis does specifically include a consideration of exposures to TCP that may result from activities in the use of triclopyr. Thus, oral exposures to TCP which may result from the use of triclopyr are addressed in in this risk assessment, and the risks that might be associated with these exposures are discussed the risk characterization for triclopyr, above.

Recent studies have shown drift of chlorpyrifos, and other insecticides, from agricultural lands in the Sacramento/San Joaquin Valley to the Sierra Nevada range (McConnell et al. 1998). In the four-county Eldorado National Forest area, chlorpyrifos use in 2010 totaled 1,965 pounds, primarily used in walnut orchards. Levels of chlorpyrifos have been measured in watercourses in the Sierra Nevada as high as 13 ng/L (0.013 μg/L or ppb). These upper levels have been measured in the southern Sierra. As a comparison, the use of chlorpyrifos in Fresno County was over 100 times higher in 2010 then the four Eldorado National Forest counties combined. This would indicate that it is unlikely that such high aquatic levels of chlorpyrifos would be found in the Eldorado National Forest area as a result of atmospheric movement. Assuming that 100% of measured chlorpyrifos would degrade to TCP (an over-exaggeration of the rate of degradation), this would add 0.013 ppb of TCP. If this amount is added to the modeled peak exposure of 68 ppb, it would not result in any appreciable increase in risk.

Estrogenic effects (a common toxic action) can be caused by additive amounts of NP, NPE, and their breakdown products. In other words, an effect could arise from the additive dose of a number of different xenoestrogens, none of which individually have high enough concentrations to cause effects (USDA 2003a). This can also extend out to other xenoestrogens that biologically react the same. Additive effects, rather than synergistic effects, are expected from combinations of these various estrogenic substances.

Other sources of exposure to NP and NPEs include personal care products (skin moisturizers, makeup, deodorants, perfumes, spermicides), detergents and soaps, foods, and from the environment away from the forest herbicide application site. In Environment Canada 2001 (as referenced in USDA, 2003a), the authors made estimates of these background exposures assuming a 100% dermal absorption rate of NP and NPs. This assumption was based on the inadequacy of the one *in vitro* study of absorption in human skin that showed absorption rates below 1%. Based on a review of the literature on surfactants and absorption (USDA, 2007) it would appear that a 100% figure is extremely conservative. The use of a 1% absorption rate would appear to be a realistic figure; the 100% figure should be considered a worst-case figure.

Contributions from the air, water, soil, and food of NP and NPEs in adult Canadians was estimated at 0.034 mg/kg/day (Environment Canada 2001, as referenced in USDA, 2003a). The contribution of NP and NPEs from the exposure to skin moisturizers, makeup, deodorant, fragrances, detergents, cleaners, paints, and spermicides are also estimated in Environment Canada (2001, as referenced in USDA, 2003a).). Both of these exposure sources are based on very small sample sizes and should be considered worst-case. Using the skin absorption figure of 100%, and the highest concentration estimates, these products contribute up to 27.0 mg/kg/day, assuming each is used every day. If a 1% dermal absorption figure is used, this total would be 0.27 mg/kg/day. In another study from Europe, the daily human exposure to NP is estimated at 0.002 mg/kg/day (2 µg/kg/day) as a worst-case assumption (note that this estimate does not include the ethoxylates) (Bolt 2001, as referenced in USDA, 2003b).

In addition to xenoestrogens, humans are exposed to various phytoestrogens, which are hormone-mimicking substances naturally present in plants. In all, more than 300 species of plants in more than 16 families are known to contain estrogenic substances, including beets, soybeans, rye grass, wheat, alfalfa, clover, apples, and cherries. Background exposures of Europeans to natural phytoestrogens (isoflavones (daidzein, genistein) and lignans), mainly from soybeans and flaxseed, is estimated at 4.5-8 mg/kg body weight for infants on soy-based formulae, and up to 1 mg/kg body weight for adults (USDA, 2003a). In East Asian populations where soy-based foods are more commonly consumed, estimates of intake of phytoestrogens are in the range of 50-100 mg/kg/day (*ibid*). Some might consider that the contribution from these natural phytoestrogens should be disregarded, as the human species has adapted over time to daily exposures to such compounds. However, at a biochemical level, these phytoestrogens can react similarly to the estrogenic xenoestrogens, such as NP.

Based on the studies by Chapin et al. and Nagao et al. (as referenced in USDA 2003a) the lowest reproductive NOAEL for NP is 10 mg/kg/day from these studies in rats. Assuming a 100X safety factor to convert to a human reproductive NOAEL would result in a value of 0.10 mg/kg/day. Adding together the contributions from the worst-case background environment and consumer products, as described in Environment Canada 2001, (as referenced in USDA, 2003a) there would be a background dose to a female worker of 27.034 mg/kg/day (assuming 100% dermal absorption) or 0.304 mg/kg/day (assuming 1% dermal absorption). Using a derived NP human NOAEL of 0.10 mg/kg/day (as described in USDA, 2003b) these exposure estimates result in HQs of 270 to 3. In terms of this risk assessment, the non-acute contribution of NP9E (backpack workers exposure ranged from 0.01 to 0.07 mg/kg/day) would contribute up to 0.7 to any HQ. At typical application rates, the worker exposure would add 0.1 to the HQ. For the public chronic exposures at the upper range of application, the doses of NP9E would add 0.00002 to 0.06 to any HQ. These may be negligible depending upon the background exposures, lifestyles, absorption rates, and other potential chemical exposures that are used to determine overall risk to environmental xenoestrogens.

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). See pages 4-111 through 4-114 in USDA 1989, for a detailed discussion on synergistic effects.

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). Synergistic effects are not expected from multiple exposures to NP, NPEs, and their breakdown products (Payne et al 2000, Environment Canada 2001, as referenced in USDA 2003b).

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. As Dost explains:

"While there is little specific published study of forestry herbicides in this particular regard, there is a large body of research on medical drugs, from which principles arise that govern such interactions. Amplifications of effect are not massive; one chemical cannot change the impact of another by hundreds or thousands of times. Rarely will such change be more than a few fold. This difference can be dangerous when dealing with drugs that are already at levels intended to significantly alter bodily functions, but is insignificant when both compounds are at the very low levels of exposure to be found associated with an herbicide treatment."

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.

Summary of Mitigations to Limit Identified Risks

As previously discussed and shown in the tables below (Tables 3HH.3, and 3HH.4) a few different scenarios result in HQs over 1. Given that scenarios are considered conservative there is still a need to minimize the potentially unacceptable risk. Design Criteria described in Chapter 2 that will decrease the exposure to chemicals with unacceptable risk include, safe handling procedures and proper use of personal protective equipment to limit direct exposure for workers. In the case of triclopyr, the chronic exposure will be limited to a subset of the overall planned treated areas. In other words in any given year it estimated that the total time spent on this project applying triclopyr will be less than a month. For the scenario of eating contaminated fruit or vegetation, addition of colorant to spray mixtures and signing of treatment areas should minimize risk of persons unknowingly eating contaminated vegetation.

Table 3HH.3 Summary of HQs for workers by proposed chemical.[1]

Scenario	Receptor	Central Level HQs for Workers				
Accidental/Incidental Exposures		**Glyphosate**	**Clopyralid**	**Aminopyralid**	**Triclopyr**	**NPE**
Contaminated Gloves, 1 min.	Worker	3E-06	4E-07	1E-07	3E-02	2E-03
Contaminated Gloves, 1 hour	Worker	2E-04	2E-05	6E-06	1.9	1E-01
Spill on Hands, 1 hour	Worker	4E-04	7E-05	2E-05	4E-03	5E-04
Spill on Lower Legs, 1 hour	Worker	9E-04	2E-04	6E-05	9E-03	1E-03
General Exposures		**Glyphosate**	**Clopyralid**	**Aminopyralid**	**Triclopyr**	**NPE**
	Worker	3E-02	3E-03	3E-03	1.5	1E-01

1. As a standard for formatting, numbers greater than 1.0 are expressed in standard decimal notation and smaller numbers are expressed in scientific notations – e.g., 7 E-7 equivalent to 7×10^{-7} or 0.0000007.

Table 3HH.4 Summary of HQs for the general public by proposed chemical.[1]

Scenario	Receptor	Central Level HQs for the Public				
Accidental Acute Exposures		**Glyphosate**	**Clopyralid**	**Aminopyralid**	**Triclopyr**	**NPE**
Direct Spray of Child, whole body	Child	1E-02	4E-03	9E-04	1E-01	2E-02
Direct Spray of Woman, feet and lower legs	Adult Female	1E-03	4E-04	9E-05	3E-01	2E-03
Water consumption (spill)	Child	3E-01	5E-02	2E-02	3E-01	4.6
Fish consumption (spill)	Adult Male	3E-03	1E-03	5E-04	6E-04	1E-01

Scenario	Receptor	Central Level HQs for the Public				
Fish consumption (spill)	Subsistence Populations	2E-02	7E-03	2E-03	3E-03	7E-01
Non-Accidental Acute Exposures		**Glyphosate**	**Clopyralid**	**Aminopyralid**	**Triclopyr**	**NPE**
Vegetation Contact, shorts and T-shirt	Adult Female	3E-03	5E-04	1E-04	5E-01	Not calculated
Contaminated Fruit	Adult Female	3E-02	4E-03	1E-03	7E-01	Not calculated
Contaminated Vegetation	Adult Female	4E-01	5E-02	2E-02	10	Not calculated
Swimming, 1 hour	Adult Female	1E-08	3E-09	3E-09	8E-05	Not calculated
Water consumption	Child	2E-03	5E-04	8E-04	9E-05	Not calculated
Fish consumption	Adult Male	2E-05	2E-05	2E-05	2E-07	Not calculated
Fish consumption	Subsistence Populations	1E-04	7E-05	1E-04	8E-07	Not calculated
Chronic/Longer Term Exposures		**Glyphosate**	**Clopyralid**	**Aminopyralid**	**Triclopyr**	**NPE**
Contaminated Fruit	Adult Female	5E-03	8E-03	6E-04	3E-01	4E-03
Contaminated Vegetation	Adult Female	6E-02	1E-01	8E-03	6E-01	Not calculated
Water consumption	Adult Male	1E-05	3E-04	3E-04	3E-06	2E-03
Fish consumption	Adult Male	2E-08	2E-06	1E-06	1E-09	1E-05
Fish consumption	Subsistence Populations	2E-07	1E-05	1E-05	8E-09	8E-05

1. As a standard for formatting, numbers greater than 1.0 are expressed in standard decimal notation and smaller numbers are expressed in scientific notations – e.g., 7 E-7 equivalent to 7×10^{-7} or 0.0000007.

Alternative 2

Direct, Indirect, and Cumulative Effects

No project related direct, indirect, or cumulative effects on human health from herbicides would occur under this alternative.

Hydrologic Resources

Relevant Laws, Regulations, and Policy

National Forest Management Act (16 U.S.C. 1604) (NFMA)

NFMA ensures that forest planning and management activities provide for the conservation and sustained yield of soil and water resources.

Clean Water Act of 1977

The Clean Water Act was created to restore and maintain the chemical, physical and biological integrity of the Nation's waters. (Section 101(a)). It also regulates discharge of dredged or fill material into navigable waters (waters of the U.S.) (Section 404). Section 303(d) of the Clean Water Act requires states to identify waters that are not meeting water quality objectives and are at risk of not fully supporting their designated beneficial uses. These water bodies are called Water Quality Limited Segments (WQLS).

Executive Order 11990, 1977; (Wetlands Management)

This order requires federal agencies to follow avoidance, mitigation, and preservation procedures with public input before proposing new construction in wetlands. To comply with Executive Order 11990, the federal agency would coordinate with the Army Corps of Engineers under Section 404 of the Clean Water Act, and mitigate for impacts to wetland habitats.

Executive Order 11998, 1977; (Floodplain Management)

This order requires all federal agencies to take actions to reduce the risk of flood loss, restore and preserve the natural and beneficial values in floodplains, and minimize the impacts of floods on human safety, health, and welfare.

Central Valley Water Quality Control Board Basin Plan and Water Quality Objectives

Each basin plan provides a definitive program of actions designed to preserve and enhance water quality and to protect beneficial uses of water in the Central Valley Region. An Memorandum of Understanding (MOU) between the State Water Quality Control Board and the Forest Service designated the Forest Service as the Water Quality Management Agency on National Forest System Lands, and establishes a system for implementing best management practices (BMPs) as the mechanism for meeting water quality requirements (complete list of BMPs located in Appendix A of the Hydrology Report, Power Fire Reforestation Project (Arias 2016).

Forest Service Soil and Water Conservation Best Management Practices (BMPs)

BMPs have been designed to protect and restore watershed resources (USDA Forest Service, 2011). BMPs have been certified by the State Water Quality Resources Control Board and approved by the Environmental Protection Agency (EPA) as the most effective way to protect water quality from impacts stemming from nonpoint sources of pollution. Throughout the Forest Service, BMPs have been developed over time based on research, monitoring, and modification, to ensure the measures are effective (Burroughs and King, 1985; Burroughs and King, 1989; Burroughs, 1990; Seyedbagheri, 1996; Schuler and Briggs, 2000).

Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Central Valley Regional Water Quality Control Board CVRWQCB, 2011)

The Clean Water Act directs that where water quality is limited, state agencies develop total maximum daily load (TMDL) plans to improve water quality to support the beneficial uses of water. The most recent listing was approved for California in 2010, which compiles all the information from each of the regional water boards. This information was reviewed in context of the project area boundary.

Eldorado National Forest Land Resource Management Plan (LRMP), as amended (USDA FS 1989, USDA FS 2004)

The LRMP provides guidance for implementing projects on the Eldorado NF. Watershed design features generated for the Power Fire project are provided in this report.

Table 3HH.5 Resource indicators and measures for assessing effects for the Power Fire Reforestation Project

Resource Element	Resource Indicator	Measure	Source
Cumulative Watershed Effects	Watershed disturbance	Equivalent Roaded Acre, Threshold of Concern	ENF LRMP, National BMP
Channel Shape and Function	Sediment and water yield	Sediment yield (tons/acre)	ENF LRMP, SNFPA, National BMP
Water Quantity	Water yield and stream flow	Percent change in basal area	ENF LRMP, SNFPA, National BMP
Water Quality	Erosion and Sediment delivery	Sediment yield (tons/acre)	ENF LRMP, SNFPA, National BMP
Riparian Areas, Floodplains, and Wetlands	Sediment delivery and streamside cover	Percent change in streamside cover	ENF LRMP, SNFPA, National BMP

Methodology

Field reconnaissance was conducted in June 2013 by Hydrologist, Camilo Arias, to evaluate existing channel, riparian and wetlands conditions within the project area and the potential effects to these resources related to the proposed action. Field notes and photos are located in the project file (Arias, 2013). In addition to field data, best available science, literature reviews, Geographical Information System (GIS) data, and professional judgment support the conclusions in this report.

Spatial and Temporal Context for Effects Analysis

The extent of watershed effects is dependent on the watershed size and the issues of concern (MacDonald, 2000). Potential effects as they relate to hydrological resources include changes channel shape and function, water quantity, water quality, riparian areas, and watershed condition.

Detectable changes from the proposed action are analyzed at the sub-drainages (HUC 7th) scale and would be considered direct/indirect effects from a single activity. For long term effects, the beginning of scope goes back to 30 years based on cumulative effects analysis protocol. The scope continues to approximately five years after project implementation and the amount of time estimated for effects from this project to be no longer perceptible. For short term effects, the temporal scope can range from hours to months post treatment.

The cumulative watershed effects (CWE) analysis for watershed resources was conducted by HUC 6^{th} watershed areas. Any sub-drainages (equivalent to the HUC 7th scale) found over their Threshold of Concern (TOC) are also discussed at the watershed (HUC 6^{th}) scale in order to provide consideration for the possible downstream accumulation of effects from multiple sub-drainages that are over TOC. At this scale, the magnitude of cumulative effects from different management activities including the proposed action would be detectable. The established timeframe for evaluating CWEs on the ENF is 30 years as mentioned above.

Affected Environment

Watershed Description

Precipitation in the area is commonly induced by orographic air masses moving inland from the Pacific Ocean. The project area and vicinity is characterized by hot dry summers and cool, moist winters. Overall, the climate in the mountains around the Salt Springs Reservoir (Station # 047689, Western Regional Climate Center 2015) at about 3,700 feet above sea level is relatively mild. Annual average rainfall from this station is about 45 inches. Snowfall makes up a larger portion of the total precipitation with an annual average of approximately 75 inches, and annual average snow depth of 6 inches. Both rainfall and snow mostly fall between December and March.

Watershed boundaries were identified from the Forest watershed GIS layer. Boundaries are based on Hydrologic Unit Code (HUC) sixth and seventh level watersheds. The project area is located in portions of the Bear River, Cole Creek, North Fork Mokelumne River Panther Creek, North Fork Mokelumne River-Devils Nose and North Fork Mokelumne River Salt Springs Reservoir 6th-level watersheds. The 14 digit Hydrologic Unit Code (HUC 7th) sub drainage was used to define watershed analysis boundaries. Ten sub drainages are within the project area and displayed in Table 3HH.6 and Figure 3HH.1.

Table 3HH.6 6th and 7th Level HUC Watersheds Found within the Power Fire Project Area.

Watershed (HUC 6th)	Sub-drainage Code (HUC 7th)	Total HUC 7th Area Acreage	% of HUC 7th within Project Boundary
Bear River, HUC 6th 180400120201 (33,694 acres)	Lower Bear River, 18040012020106	7372	48
	Bear River Reservoir, 18040012020104	7673	1
	Beaver Creek, 18040012020105	2465	77
Cole Creek, HUC 6th 180400120105 (15,081 acres)	Lower Cole Creek, 18040012010502	4972	38
North Fork Mokelumne River Panther Creek, HUC 6th 180400120203 (11,984 acres)	West Panther Creek, 18040012020301	6519	5
	East Panther Creek, 18040012020302	5466	43
North Fork Mokelumne River-Devils Nose , HUC 6th 180400120204 (23,719 acres)	NF Mokelumne River – Camp Creek, 18040012020402	10,589	39
North Fork Mokelumne River Salt Springs Reservoir , HUC 6th 180400120206 (28,070 acres)	NF Mokelumne River – Calaveras Dome, 18040012010604	1596	36
	Tanglefoot Canyon, 18040012010602	2742	4
	Salt Springs Reservoir, 18040012010603	7038	29

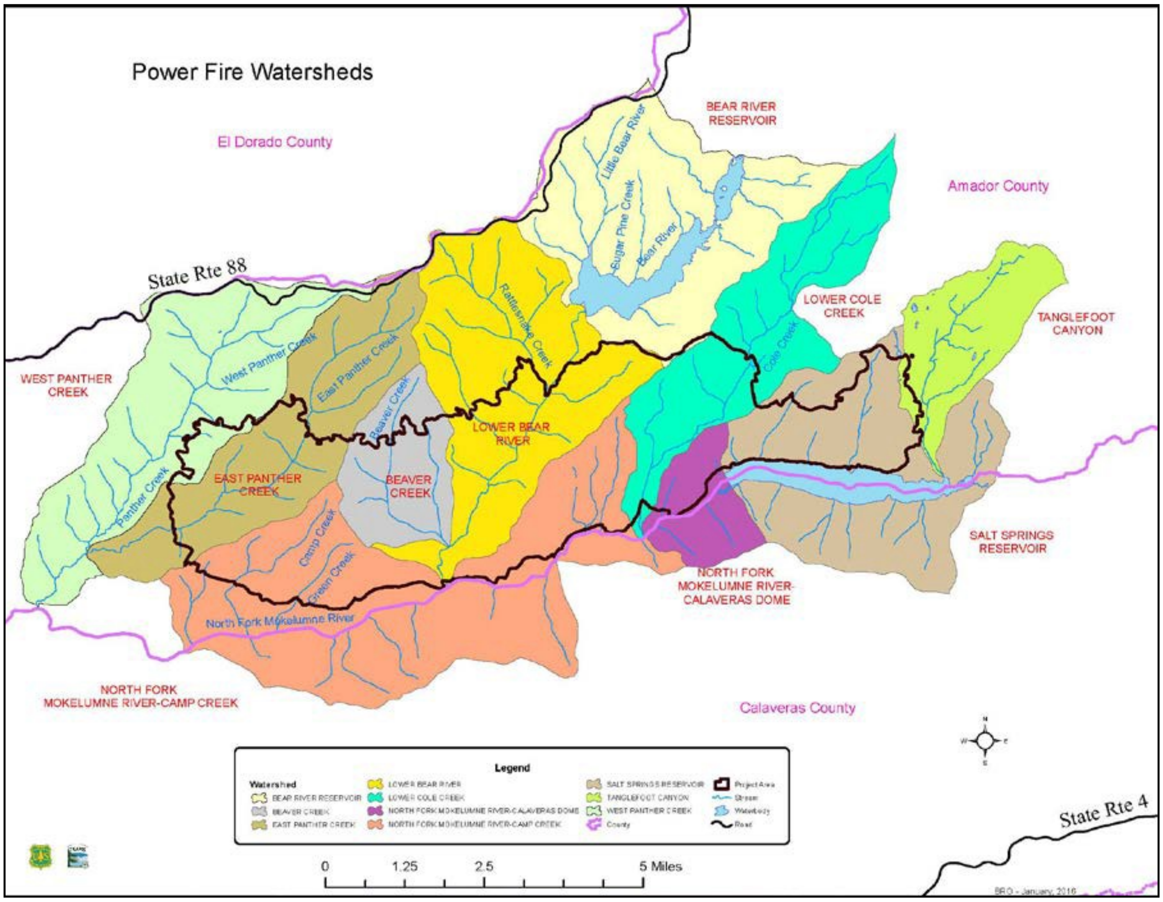

Figure 3HH.1. Watershed Map for the Power Fire Reforestation Project Area Depicting the 7th Field Watersheds.

Channel Shape and Function

The Eldorado National Forest streams dataset was used to determine the miles of perennial, intermittent, and ephemeral streams located within the project area. There are 16.9 miles of perennial, 23.8 miles of intermittent and 147.1 miles of ephemeral streams. Main stems include the Bear River, Beaver Creek, Camp Creek, Cole Creek, and the East Panther Creek. The stream system of the project area, due to rapid tectonic uplift, is a transporting one, bringing mostly decomposed granite material eventually to the washes and basins at the foot of the mountain. Channel types range from headwater channels that are relatively steep and confined (Rosgen A), to moderate/high gradient Rosgen B channels (Rosgen, 1994). Channel slopes in the project area typically range from between 2-5% in the main stems, side slopes often range from between 30-50% with some areas such as Cole Creek with steeper side slopes.

Nearly 50% of the 2004 Power Fire area burned at high intensity, killing 75-100% of the trees and burning the duff and litter that protects the soil. The fire resulted in high rates of soil erosion, and sedimentation to streams. DeBano et al. (1996) demonstrated that following a wildfire in ponderosa pine, sediment yields from a moderate to high severity fire can take 7 and 14 years respectively to recover to normal levels. Field observations

(Arias, 2013) showed that post-fire effects still prevail mostly along ephemeral channels which had significant amounts of sediment deposited. Stream aggradation is particularly visible along areas where side slopes have limited ground cover and vegetation. Several culverts in these ephemeral drainages are partially filled with sediment as well. This sediment unbalance has consequently affected the stability of higher order streams, as evidenced by channel head-cuts observed in intermittent streams.

Water Quantity

Studies suggest that changes in peak flows from forest disturbances are generally measurable at recurrence intervals of less than one year and up to 5 years (Beschta et.al, 2000; Jones and Grant, 1996). The reduction of forest canopy cover from a wildfire results in an increase of water input to soils and streams, primarily due to decreases in interception and transpiration. Alteration of annual water yield and peak flows in the project area are difficult to quantify due to streamflow regulation. Therefore, gage records are not entirely conclusive but do show a trend that based on field observations and literature can be partially attributed to post-fire effects. The channel instability and sedimentation observed provided field evidence of the higher amount of energy (runoff) still available to transport sediment as a result of the wildfire.

Figure 3HH.2 shows the Cole Creek mean monthly flow hydrograph which shows a general representation of the system’s behavior. Spring runoff in the project area generally begins in early April. High stream flows are controlled primarily by snowmelt runoff with a snowmelt peak occurring in late May. Low flows generally occur during the fall, with the lowest flows occurring in September.

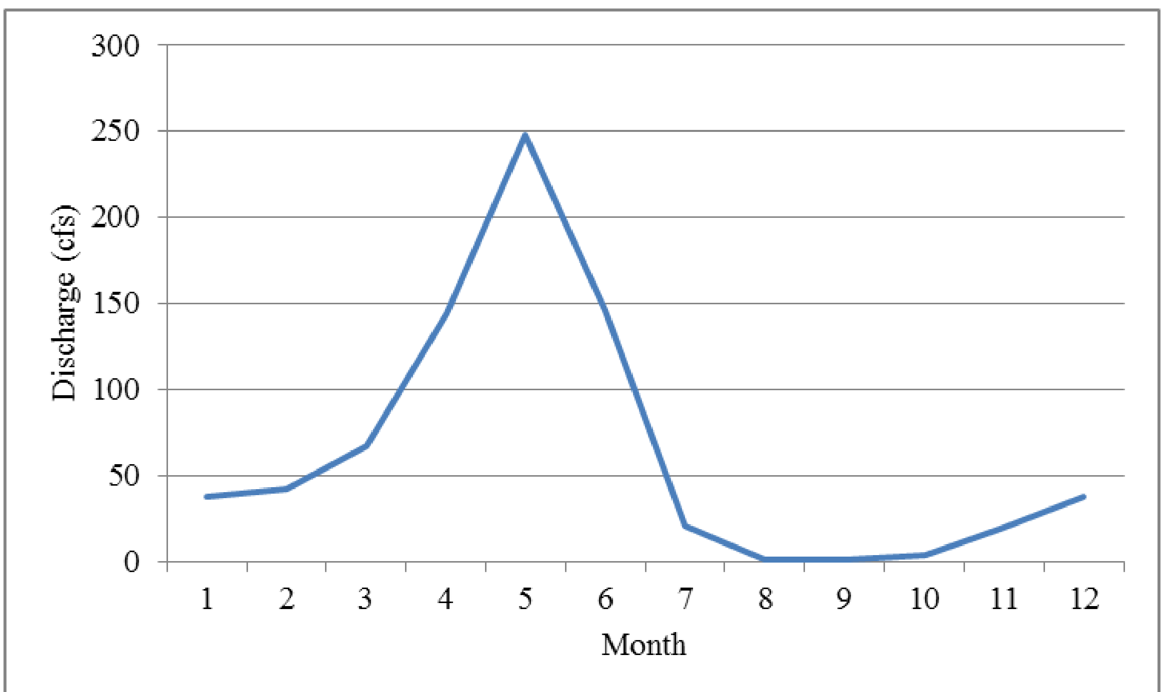

Figure 3HH.2 Mean Monthly Stream flow: USGS 11315000 Cole Creek (88-year average)

Water Quality

According to the 2012 Clean Water Act, Section 303(d) list of water quality limited segments for California (http://www.waterboards.ca.gov/water_issues/programs/tmdl), the Bear River (Lower Bear River Reservoir to Mokelumne River) has approximately four miles of limited segments within the project area. The Bear River is listed for copper. Also, the Rattlesnake Creek channel segment is outside the project area but within project area watershed boundaries. This Creek segment is listed for Escherichia Coli.

No municipal watersheds occur within the project area. Presently, there are no domestic or municipal uses of surface water within the project area; however, such use does occur downstream so this is still considered as a beneficial use. The Water Quality Control Plan defines the following beneficial uses for the project area.

Table 3HH.7 Designated Beneficial Uses for project area streams (Mokelumne River - Sources to Pardee Reservoir) based on the Water Quality Control Plan

Beneficial Uses
MUN – Municipal and Domestic Supply
POW – Hydropower Generation
REC1 – Water Contact Recreation, Canoe and Rafting
REC2 – Non-Contact Water Recreation
WARM – Warm Freshwater Habitat (including reproduction and early development)
COLD – Cold Freshwater Habitat
MIGR – Warm for Striped bass, sturgeon, and shad
SPWN – Warm and Cold
WILD – Wildlife Habitat

Disturbed Water Erosion Prediction Project (WEPP) modeling was conducted to estimate the amount of sediment that is currently generated from existing forest conditions. To simulate the existing condition, the model was set up to replicate forest conditions as they have progressed in the first 10 years since the fire. These conditions are based on field observations and are a general representation of the overall status. There are several assumptions in the model structure and parameters, in addition to a plus or minus 50% accuracy of predicted sedimentation. Model details are expanded in the Environmental Consequences section below and Appendix B of the Hydrology Report (Arias 2016) in the NEPA Project Record, which shows a general overall reduction in sediment delivery as the forest transitioned from a high severity fire into what is observed today, a combination of grasses along with limited shrub development (modeled by averaging cover to 90 percent). After approximately 10 years, it is estimated that the existing forest condition is contributing approximately zero tons of sediment to project area streams.

Table 3HH.8 Post-fire Progression of Sediment Delivery – WEPP model

Years After Power Fire	Forest Condition	Average Annual Sediment Delivery (tons/acre)
1	High severity fire	0.6
2	Poor Grass	0.5
4	Good Grass	0.1
10	Grass/Shrubs	0.0

Riparian Areas, Floodplains and Wetlands

Based on Forest GIS data approximately 7,289 acres of Riparian Conservation Areas (RCAs) exist throughout the project area. There are five meadows totaling approximately 13 acres. These meadows are found in the upper reaches of the Beaver Creek and East Panther Creek, and along the lower portions of the Cole Creek and Tanglefoot Canyon. Based on the National Wetland Inventory (NWI), there are 10 mapped wetlands within the project area. These wetlands have mostly developed along stream corridors, and include two alpine lakes off the Tanglefoot Canyon area. Floodplains along streams in the project area are highly limited by the stream valley confinement.

Seeps and springs are found throughout the project area and often mark the upper extent of perennial flow. Percolation into granite is slow, and much of the yield driven by precipitation events and snowmelt is very shallow ground water flow between the soil mantle and parent rock. The solum throughout the project area has sufficient ground water storage to maintain seeps well into the dry season. Many low order streams are fed by these springs/meadow complexes. Spring complexes were noted along tributaries to the Bear River and Cole Creek, and were partially used for or fed livestock watering holes. Based on Forest GIS data, there are two mapped springs along tributaries to the West Panther Creek and Beaver Creek.

Table 3HH.9 Project Area RCA Acres by Sub-drainages

Watershed (HUC 6th)	Sub-drainage Code (HUC 7th)	Total RCA Acreage within Power Fire Boundary
Bear River, HUC 6th 180400120201 (33,694 acres)	18040012020106	1377
	18040012020104	9
	18040012020105	721

Watershed (HUC 6th)	Sub-drainage Code (HUC 7th)	Total RCA Acreage within Power Fire Boundary
Cole Creek, HUC 6th 180400120105 (15,081 acres)	18040012010502	802
North Fork Mokelumne River Panther Creek, HUC 6th 180400120203 (11,984 acres)	18040012020301	75
	18040012020302	841
North Fork Mokelumne River-Devils Nose , HUC 6th 180400120204 (23,719 acres)	18040012020402	1898
North Fork Mokelumne River Salt Springs Reservoir , HUC 6th 180400120206 (28,070 acres)	18040012010604	340
	18040012010602	60
	18040012010603	1165

Environmental Consequences

Alternative 1 and 3

Direct and Indirect Effects

Water Quantity

Under these alternatives, vegetation removal would not result in detectable changes in the magnitude and timing of stream flow. For rain-dominated areas, changes in peak flow can only be detected where 29% of the area is harvested (Grant et al. 2008). For areas where rain-on-snow events can occur, the detection level for peak flow increases is 19% including harvest and area in roads. Under this alternative, changes in basal area are not proposed as treatments target brush and grass removal. The most intensive treatments include mastication and tractor piling and burning on approximately 630 acres or 4% of the total project area. This is a worst case scenario figure as all these acres would not be treated.

The proposed hand planting and inter planting is designed to accelerate the development of old forest conditions. Methods used for treatment would have negligible effects on water infiltration into soil and associated surface runoff. Any short term effects that would occur would not be discernible given the natural variability of stream flows. The gradual transition to a forested landscape will result in long term changes in canopy cover which would result in beneficial effects to hydrological resources including natural regulation of stream flows.

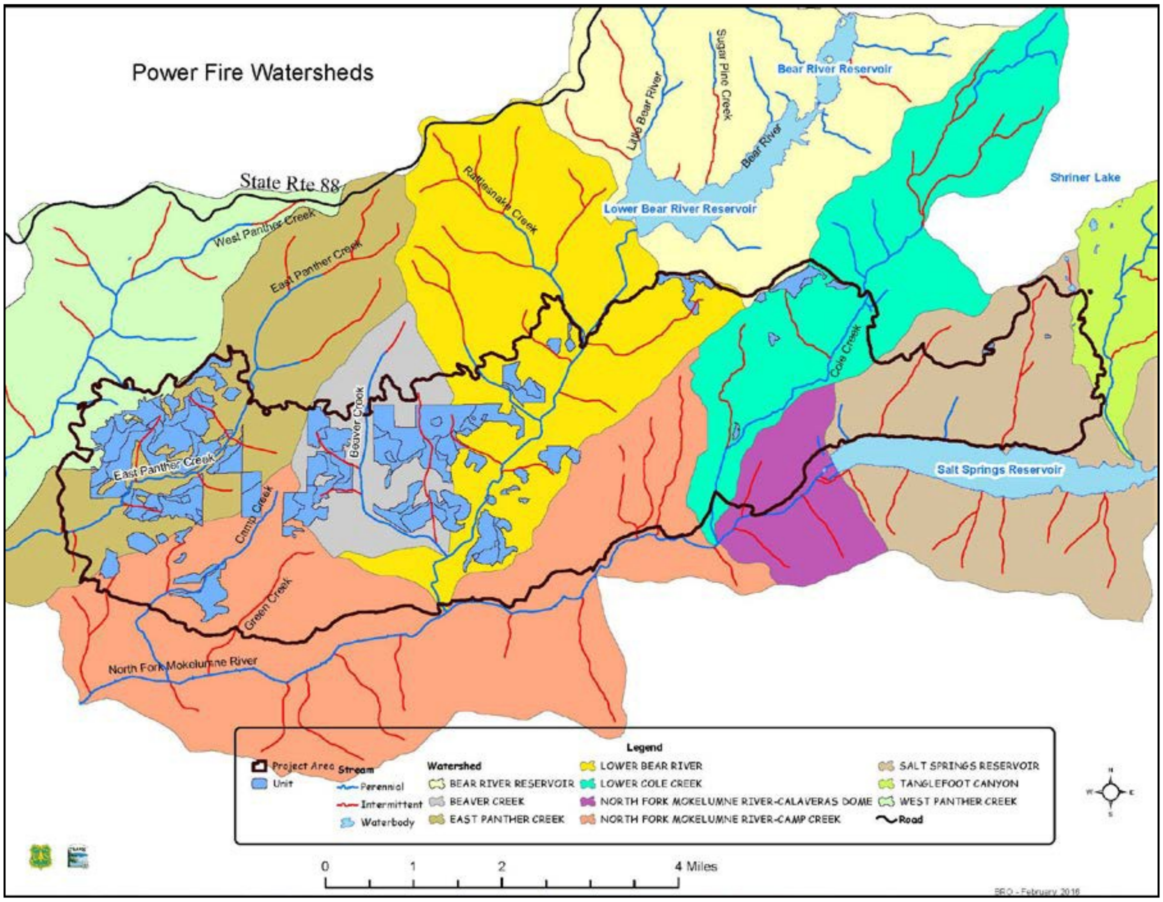

Figure 3HH.3 Proposed Power Fire treatments

Water Quality

Vegetation Manipulation

Under these alternatives, impacts from mechanical site preparation are expected to be limited and confined to ground disturbance areas, and sediment would be expected to be trapped in adjacent vegetated areas before reaching project area streams. The WEPP model was used to estimate changes in sediment delivered to streams and to show differences by alternatives. For these alternatives, the model was adjusted to simulated forest conditions under a vegetation restoration scenario.

Table 3HH.10 shows the short and long term effects post-treatment. There is a probability of sediment yield of 0.1 tons/acre in the short term or within one year, followed by a reduction to zero after five years. These results show that as vegetation matures and contributes to ground cover, sediment delivery is quickly reduced to background levels. Hatchett et al.(2006) showed that ground cover in the form of grass or woodchips dramatically reduced sediment loss after mechanical mastication in the Lake Tahoe area. Robichaud and Brown (1999b) reported erosion rates after a wildfire decreasing by one to two orders of magnitude by the second year and to no sediment by the fourth in an unmanaged forest stand in eastern Oregon. Erosion rate reduction was due to recovery of natural vegetation. Similar results are expected under this alternative as the proposed site preparation would remove competing vegetation, enhancing planted and natural seedling survival, and shrub/tree growth. The gradual transition to a forested landscape would result in beneficial effects to hydrological resources including riparian shading which could improve local temperatures on some streams.

Table 3HH.10 WEPP modeling of progression of sediment yield from project implementation

Years After Proposed Restoration	Forest Condition	Average Sediment Yield (tons/acre)
1	Good grass/shrub	0.1
5	Shrubs	0.0
5>	Five-year-old forest	0.0

Herbicide Treatment

Under these alternatives, the proposed treatments with chemicals and its metabolites are not expected to accumulate or negatively affect water quality in the project area or downstream. The proposed chemical control methods include directed foliar and radius application using clopyralid, aminopyralid, triclopyr or glyphosate. Additionally, surfactants would be used to break up surface tension of herbicides and increase the ability for plants to absorb the herbicide. Dyes would also be used to identify areas treated and reduce the chance of misdirection spray. Since any surfactants used would be mixed as a small percentage of an herbicide, the effects on the environment, including soils and water quality would be considered the same as the herbicide (Bakke, 2007). Dyes or similar biodegradable colorant to facilitate visual control are water soluble dye and contains no listed hazardous chemicals. They are considered virtually non-toxic to humans (Bakke, 2007).

General characteristics for the proposed herbicides are displayed below in Table 3HH.11; these were compiled from the label information and Syracuse Environmental Research Associates (SERA) Risk Assessments. Additional description and details on these chemicals, surfactants and dyes can be found in the NEPA Administrative Record.

Table 3HH.11 Herbicide Behavior in the Soils and Water.

Chemical	Fate in the Environment	Hazards	Leaching Potential	Solution Runoff Potential	Adsorbed Runoff Potential
Aminopyralid	Highly soluble in water and mobile in soils. Degrades rapidly in water. Relatively stable in soils. Non-toxic to soil microorganisms.	Can leave residues in soil. May leach to groundwater.	High	Low	Low

Chemical	Fate in the Environment	Hazards	Leaching Potential	Solution Runoff Potential	Adsorbed Runoff Potential
Glyphosate	Adsorbs tightly to soils. Subject to rapid microbial degradation. Non-toxic to soil microorganisms. Low drift potential.	Should not be used prior to predicted rainfall. May require re-treatment.	Very Low	Low	High
Triclopyr	Butoxyethyl ester (BEE) formulation not persistent in soil or surface water. Potential for off-site movement through drift, runoff, and wind erosion. Relatively non-toxic to soil organisms.	BEE formulation may leave residues in soils and may leach to groundwater.	High	Moderate	Moderate
Clopyralid	Weakly adsorbed, and degraded by soil microbes. Increased soil moisture decreases degradation time.	May leach to ground water. Limit used prior to predicted high rainfall.	Moderate	Moderate	Low

The proposed commercial formulation of triclopyr contains triclopyr in the form of butoxyethyl ester (BEE). A breakdown product of triclopyr BEE, 3,5,6-trichloro-2-pyridinol (TCP), is more toxic than triclopyr itself. Research or data on TCP concentrations following terrestrial applications of triclopyr is not available. Estimates are entirely from modeling and show that there are no substantial differences between the concentrations of triclopyr and TCP modeled in streams (SERA, 2011).

Clopyralid contains low levels of hexachlorobenzene. Hexachlorobenzene binds tightly to soils, therefore it is not likely to percolate and directly contaminate ground water (SERA, 2004). Also, as it adheres tightly to soils, it is unlikely to be carried into a stream unless the soil particle is carried into the stream. This is unlikely to happen during the time periods when herbicides would be applied because there is less rain in the summer and more vegetation growth to hold soil particles in place.

For the remainder of this analysis, the discussion of effects resulting from herbicide application takes into consideration the effects of the herbicide's active and inert ingredients, metabolites, surfactant, and dyes. The routes by which these may contaminate water would be direct application, drift into water bodies from spraying, runoff from a large rain storm soon after application, and leaching through soil into shallow ground water or into a stream. This section addresses each of these delivery routes.

No direct application of herbicide to water is proposed with the Power Fire Project. The majority of the Power Fire Project area consists of well-drained soil. The concern with these soils is that there is potential for herbicide to move through the soil profile into ground water. Restricting treatment to avoid wetted soil profiles will minimize this potential.

The Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model was used to estimate the amount of herbicide that may potentially reach a reference stream via runoff, drift and leaching. The Power Fire project GLEAMS model incorporated site specific conditions including climate, soil characteristics, water bodies, and chemical formulation. Model parameters can be found in the project file (Arias, 2015). GLEAMS software details including assumptions and limitations can be found in the software documentation (SERA, 2007).

Buffers have been established to protect water resources from herbicide application. These buffers are modeled in GLEAMS as nontarget sites. Nontarget sites are fields adjacent to the treated field. GLEAMS assumes a broadcast herbicide application within the treated field. This is a worst case scenario as not every single acre will be treated within the proposed treatment units. Assuming no degradation, the total loss from runoff and sediment from the treated unit is used to calculate the concentration of herbicide in the buffer or nontarget site. Table 3HH.12 shows that 0.00 mg/L of herbicide concentration will reach the buffer, and none is expected to pass the buffer and reach streams.

Table 3HH.12 GLEAMS model results

Herbicide Type	Herbicide concentration in soil of buffer/non-treated area (mg/L)
Aminopyralid	0.00
Glyphosate	0.00
Triclopyr	0.00
Clopyralid	0.00

Project design criteria and BMPs effectively diminish the possibility of off-site transport via runoff and limit herbicides from entering surface waters through overland flow, or through leaching. Region 5 BMP effectiveness on vegetation manipulation projects showed that no adverse effects extended to a stream channel during the reporting period (USDA, 2013). Therefore, the proposed treatments with chemicals and its metabolites are not expected to accumulate or negatively affect water quality in the project area or downstream.

Channel Shape and Function

Based on the discussion above in the “Water Quantity” and “Water Quality” sections, and the implementation of BMPs, no discernible change in flow volume, alteration to timing of peak flows or sediment delivery would be expected due to the implementation of this alternative. Hydrology related BMPs were selected and designed to prevent, or limit, upland sediment introduction into streams. Additionally, equipment exclusion zones would provide protection against direct disturbances to stream channels and riparian areas. As riparian vegetation establishes, root systems would provide streambank stability and in the long term large woody debris recruitment. These long term direct effects would be expected to benefit channel shape and function.

Riparian, Floodplain and Meadow Function

As the proposed methods target individual plants, the risk from application of herbicides to native riparian vegetation is small. Design criteria minimize the chance of herbicides reaching streams or wetlands through drift, runoff, or leaching into soils. Accelerating the diameter growth of riparian stands would assist in creation of late-successional conditions sooner and provide for a faster development of large woody material sources for instream and aquatic habitat.

Where manual methods remove invasive plants near streams, minor loss of ground cover and soil disturbance leading to erosion are expected, as well as a minor localized increase in fine sediments particularly if vegetation is removed from stream banks. This increase would only last a season or two until vegetation re-establishes and is not considered significant. Many treatment sites are small and would reseed naturally with existing native vegetation. Proposed planting would ensure revegetation occurs and erosion is controlled.

Floodplain development within treatment units in the project area is limited. BMPs and project resource protection measures would be expected to protect any of the very limited floodplain development within the project area. Hence, there would be no direct or indirect effects to floodplains under this alternative.

Cumulative Effects

Past, present and reasonably foreseeable site specific conditions within project area watersheds have been evaluated by using the Equivalent Roaded Acreage (ERA) process. The ERA is a watershed disturbance index model developed by the Forest Service to assess cumulative watershed effects. In the ERA model, the % ERA in a sub-drainage is used as an index of watershed disturbance and the risk of impacts to watershed function. Each acre of activity is multiplied by a coefficient to express its level of disturbance to watershed function.

The ERA method is used, for the purpose of this project and discussions to follow, as an index of management intensity that would alter hillslope hydrology and erosion, and the effect of both to channels. The degree of activity, or thresholds that would cause detrimental effects to channels was determined by the amount of naturally sensitive ground occurring in project area watersheds, and observations on project area stream channels. The following are assumptions that apply to the CWE analysis:

Sub-drainages vary in their sensitivity to management based on their watershed characteristics, including percent of unstable lands, percent of sensitive soils, and the bifurcation (breaking into two) ratio of the channels in the Sub-drainage.

Each sub-drainage has a tolerance for disturbance based on its sensitivity, which is expressed as the lower threshold of concern (TOC). The purpose of the lower TOC is to identify those Sub-drainages with a risk of CWE resulting in the need to conduct a field-based Detailed CWE analysis.

Hand treatments do not contribute to CWEs and are not included in ERA calculations.

ERA results are provided for 2018 to reflect the cumulative effects of two years of new treatments, in addition to the last 30 years of activities.

Disturbance activities represented in the ERA analysis included roads and OHV trails; past, present, and foreseeable vegetation management and logging activity, grazing; and land development. All known disturbances that occurred within the past 30 years and all reasonably foreseeable disturbances are included in the ERA analysis.

There are limitations to the ERA model, including: ERAs are only an indicator and cannot be used to estimate quantitative changes in stream channel conditions; the higher risk associated with near-stream disturbance (as opposed to disturbance far from any stream channel) is not factored into the analysis; and the method does not account for site specific BMPs (i.e., all roads are weighted the same, regardless of their management and condition).

The detailed assessment allows for more specific knowledge of the area, including the position of the disturbances relative to the drainage network, whether BMPs are in place and the sensitivity and condition of stream channels, to be factored into the final determination of the risk for CWEs.

Table 3HH.13 Results of the ERA Analysis for Each Alternative.

Sub-drainage Code (HUC 7th)	TOC Range (%)	ALT 1 Proposed Action % of TOC	ALT 2 No Action % of TOC	ALT 3 Modified Proposed Action % of TOC
WEST PANTHER CREEK 18040012020301	10 to 12	50	49	50
EAST PANTHER CREEK 18040012000302	12 to 14	49	52	49
NORTH FORK MOKELUMNE RIVER-CAMP CREEK 18040012020402	10 to 12	36	36	36
BEAVER CREEK 18040012020105	10 to 12	74	71	74
LOWER BEAR RIVER 18040012020106	10 to 12	58	58	58
NORTH FORK MOKELUMNE RIVER-CALAVERAS DOME 18040012010604	10 to 12	15	15	15
BEAR RIVER RESERVOIR 18040012020104	14 to 16	30	33	30
SALT SPRINGS RESERVOIR 18040012010603	10 to 12	23	24	23
LOWER COLE CREEK 18040012010502	10 to 12	74	76	74
TANGLEFOOT CANYON 18040012010602	12 to 14	1	1	1

Table 3HH.13 shows a slight increase in the percent of TOC for some sub-drainages in the project area. Even with these increases none of the sub-drainages would exceed the TOC range, therefore the risk of any effects to beneficial uses in these ten sub-drainages is low and overall watershed condition would not be affected by the implementation of this Alternative.

Table 3HH.14 Resource indicators and measures for alternatives 1 and 3 direct/indirect and cumulative effects

Resource Element	Resource Indicator	Measure
Watershed Condition	Watershed disturbance	Below TOC
Channel Shape and Function	Sediment and water yield	0.1 (tons/acre)
Water Quantity	Water yield and stream flow	3.5%
Water Quality	Sediment and herbicides delivery	0.1 (tons/acre) and 0.0 (mg/L)
Riparian Areas, Floodplains, and Wetlands	Sediment delivery and streamside cover	No % change in streamside cover

Alternative 2

Direct and Indirect Effects

Water Quantity

Under the no action alternative, site preparation and/or other mechanical treatments would not be implemented to restore vegetative composition and structure that is fire resilient. Vegetation would not be removed and the transition to a forested landscape will take longer. As the Power Fire area continues to reach a hydrological balance, the lower revegetation rates would delay the post-fire natural re-regulation of stream flows.

Water Quality

Under this alternative, chemical application and/or ground disturbing activities would not be implemented. As revegetation of native plants takes longer, ground cover will continue to be limited in some areas, delaying the balance of sediment yields. Additionally, stream shading will be diminished as native hardwoods and conifers are outcompeted by weeds.

Channel Shape and Function

Under this alternative, stream bank stabilization will be diminished as invasives continue to replace deeper rooted native plants. Channel aggradation and headcuts will continue as the channels take longer to reach a dynamic equilibrium of erosion and deposition.

Riparian, Floodplain and Meadow Function

Under this alternative, the restoration of vegetative composition would be delayed, resulting in slower development of large woody material sources for instream and aquatic habitat.

Cumulative Effects

There are no cumulative effects related to the No Action No Action alternative because cumulative effects can only arise from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions. There are no actions associated with this alternative.

Conclusions

Researchers view the forest floor and soil as a superb environment for minimizing the potential impact of herbicides on the watershed. High infiltration rates of most forest soils prevent overland movement of herbicides to water bodies. The absorptive phenomena of soils and organic matter retard chemical movement through the soil while chemical and biological processes alter the herbicide to a substance not considered harmful to vegetation. Leaching of herbicides, stream pollution, and harmful effects to the soil microorganisms would be negligible when carefully controlled applications of herbicides are made.

The design of this project is such that minimal effects to watershed and soil resources would be expected from both Alternative 1 and Alternative 3. From a watershed and hydrology perspective, there are no elements that differ between the two action Alternatives. Both action Alternatives would have the same level of effects because the work area footprint is the same and the differences in planting arrangements would not result in discernible differences in hydrologic impacts.

Social and Economic

Relevant Laws, Regulations, and Policy

Management Direction is contained in the ENF Land and Resource Management Plan as amended by the Sierra Nevada Forest Plan Amendment (SNFPA) Standards and Guidelines.

Effects Indicators

Indicator Measure - Cost (per acre and total).
Indicator Measure - Jobs (total direct jobs).

Methodology

An economic analysis was done for all the activities proposed in each alternative to determine a net present value (NPV). Only the cost of the proposed activities were considered as future returns on timber harvest are unknown or speculative at this time. The QuickSilver program (USDA, 2016) was used to enter cost and determine NPV. A discount rate of 4% was used for all costs. Jobs were determined using typical experienced crew sizes and production rates for similar work on the Eldorado National Forest.

Affected Environment

The Eldorado National Forest's economic area of impact consists of Alpine, Amador, El Dorado, and Placer Counties. The project area is wholly within Amador County, on the Amador Ranger District. Amador County's economic base include tourism, recreation, lumber and wood products, and agriculture. The Amador Ranger District contributes to the regional economy in two primary ways: through generation of income and employment for residents in the immediate area, and through direct and indirect contributions to local county revenues. The District also contributes in secondary ways, such as through the production of commodities that are consumed in local and regional markets. The proposed forest management activities most directly impact this county's residents in terms of local social and economic impacts. Relative to the local economy, employment opportunities would be created from this project from tree planting, site preparation and release, and invasive plant treatments. Furthermore, indirect and induced economic employment and monies would be generated when income received by contractors is spent within the local economy.

Environmental Consequences

The economic consequences are a measure of the overall value of alternatives for managing the project area. The level and mix of goods and services available to the public varies by alternative, which creates impacts on the social and economic environment. The impacts discussed in this section include estimated jobs and government expenditures and revenues, as well as monetary impacts on local communities.

The direct monetary impacts are discussed in terms of net cash value to the U.S. Treasury, including the direct, indirect, and induced job opportunities. In general, the monetary value of the alternatives depends on the amount and method planned for site preparation, release, invasive plant, and reforestation treatments.

Employment

Contractors from local forest communities are often hired to perform restoration activities and this can be critically important since employment opportunities in these areas can be limited. A study examining forest and watershed restoration work found that approximately 16 to 24 jobs are supported for each $1 million that is invested in restoration activities (Nielsen-Pincus and Moseley 2010). This range is dependent on the type of activities that are performed in restoration. Therefore, investments in labor intensive activities such as site preparation, tree and shrub planting, and cutting small trees and brush by hand, support the greater number of jobs, whereas equipment and technical intensive activities such as forest thinning, small-diameter and selective logging, masticating ground fuels, constructing stream habitat features and excavating of floodplain and wetland features, support fewer jobs.

On this project, mechanical and chemical treatments have a direct effect by employment of contractors to perform the work. These contractors would in turn spend money at hotels, restaurants, parts and equipment, supply and retail stores. Indirect effects also account for employment in these service industries, which serve the contractor. These service industries in turn would spend money to other service industries or suppliers and pay wages to employees. Wages paid to workers by the direct and indirect industries are then circulated through the local economy for food, housing, transportation, and other living expenses, which is an induced economic effect.

The sum of direct, indirect, and induced effects is the total economic impact in terms of jobs. These multiplier effects arise from materials and equipment being purchased from suppliers as well as restoration workers spending their paychecks for goods and services. The top two economic sectors typically affected by this multiplier effect are wholesale and retail trade, including transactions for fuel, wood products, rock, metal, and other building and landscaping products. Other common but less affected sectors include employment services, commercial and industrial machinery rental, commercial and industrial machinery repair and maintenance, and professional services (insurance brokers, accountants) (Nielsen-Pincus and Mosely 2010).

Treatment Costs

The primary factors affecting costs are: reforestation costs, based on the method and amount of site preparation, planting and release required, invasive plant treatment costs, based on the method and amount of treatments required, depending on the method and amount of projects. Costs to implement each alternative differ because of the method and amount of activities under each alternative. An economic analysis provides a means to rank the relative economic cost/value of the vegetation management alternatives within the Power Fire area.

Non-Priced Costs and Benefits

Assessing economic value is complex, since vegetation management can yield many long-term benefits that are not easily quantifiable in monetary terms, e.g., wildlife habitat associated with late successional forests, protection of soils and water resources from the effects of large-scale wildfire, scenic values, etc. Thus, this analysis does not include monetary values assigned to resource outputs such as wildlife, watershed, soils, recreation, timber outputs, controlling invasive plants, firefighting costs, and fisheries. It is intended only as a relative measure of differences between alternatives based on those direct costs and values used. Other values are discussed in the appropriate section of this document. It should be noted that all costs and values are not represented in the analysis. The calculations do not include costs and values for those items that cannot be estimated in dollar terms. Examples of costs not estimated in dollar terms are the reduction in scenic value in the early years of reforestation treatments or the decrease in water production as forests are re-established. Examples of benefits not estimated include the accelerated restoration of a forested ecosystem; reduction of fuels and fire hazards;

improved habitat for wildlife dependent on forested environments; improved visual quality and aesthetic values; and an improved environment for recreational use within the project area.

For a discussion of these non-priced benefits and costs, refer to the sections of the document where the effects by alternative are described. These non-priced benefits and costs must be considered along with the net economic value of each alternative in order to make a judgment as to which alternative offers the best overall mix of costs and benefits to society.

Alternative 1 and 3

Direct Effects

Alternative 1: Implementation of the reforestation, and invasive plant treatments for this alternative is estimated to cost $4,499,681. This equates to approximately $1,099/ac. As described above, this economic analysis does not take into account non-priced benefits. This dollar value includes the cumulative or multiple treatments (i.e., site preparation, planting, release, invasive plants) being completed on the same acres.

Based on experience with similar projects on the ENF, site preparation, planting, and release would generate an estimated 4,810 person days of crew time and 1,406 person days of contract administrator time spread over a five year period of implementation (refer to Power Fire FEIS jobs spreadsheet in the Project File). The crew time is made up of contracted laborers with a crew supervisor. Contract crews may be local, although typically they travel to the work site from out of the area. Contract administrators are typically Forest Service employees or subcontractors from the local area.

Table 3SE.1 shows the scheduled activities and costs for the proposed action. The total present value costs for the proposed action is approximately $4,499,681.

Table 3SE.1 NPV for Alternative 1

Treatment	Cal Year	Qty	Units	Cost/Unit (2015)	Present Value
Chemical site prep	2018	450	acres	$400.00	-$202,475.52
Noxious Weeds Treat/Monitor	2018	1	each	$55,000.00	-$61,867.52
Oak Thinning/Pruning	2018	586	acres	$200.00	-$131,834.06
Chemical Release Area	2018	2400	acres	$400.00	-$1,079,869.44
Mechanical site prep	2018	630	acres	$600.00	-$425,198.59
Hand plant conifers	2019	1080	acres	$250.00	-$303,713.28

Treatment	Cal Year	Qty	Units	Cost/Unit (2015)	Present Value
Noxious Weeds Treat/Monitor	2019	1	each	$55,000.00	-$61,867.52
Interplant conifers	2019	500	acres	$250.00	-$140,608.00
Noxious Weeds Treat/Monitor	2020	1	each	$55,000.00	-$61,867.52
Interplant conifers	2020	500	acres	$250.00	-$140,608.00
Chemical Release Area	2021	2680	acres	$400.00	-$1,205,854.21
Interplant conifers	2021	500	acres	$250.00	-$140,608.00
Noxious Weeds Treat/Monitor	2021	1	each	$55,000.00	-$61,867.52
Noxious Weeds Treat/Monitor	2022	1	each	$55,000.00	-$61,867.52
Chemical Release Radius 8 ft	2022	848	acres	$375.00	-$357,706.75
Noxious Weeds Treat/Monitor	2023	1	each	$55,000.00	-$61,867.52
				Total NPV	-$4,499,680.97

Alternative 3: Implementation of the reforestation, fuels reduction, and invasive plant treatments for this alternative would cost $5,510,708. This equates to approximately $1,346/ac. The economic analysis does not take into account the non-priced benefits. This dollar value per acre includes the cumulative or multiple treatments (i.e., planting, release) being completed on the same acres.

Site preparation, planting, and release would generate an estimated 6,440 person days of crew time and 1,579 person days of contract administrator time spread over a five year period of implementation. Personnel would be similar to that described for Alternative 1. Alternative 3 generates more employment than Alternative 1 because of the anticipated need for additional follow-up release treatments and the lower production rate per acre for hand brush cutting.

Table 3SE.2 shows the scheduled activities and costs for Alternative 3. The total present value costs for Alternative 3 is approximately $5,510,708.74.

Table 3SE.2 NPV for Alternative 3.

Treatment	Cal Year	Qty	Units	Cost/Unit (2015)	Present Value
Chemical site prep	2018	450	acres	$400.00	-$202,475.52
Mechanical site prep	2018	630	acres	$600.00	-$425,198.59
Chemical Release Area	2018	1090	acres	$400.00	-$490,440.70
Noxious Weeds Treat/Monitor	2018	1	each	$55,000.00	-$61,867.52
Oak Thinning/Pruning	2018	586	acres	$250.00	-$164,792.58
Hand Brush Cutting	2018	1310	acres	$700.00	-$1,031,500.29
Interplant conifers	2019	500	acres	$250.00	-$140,608.00
Noxious Weeds Treat/Monitor	2019	1	each	$55,000.00	-$61,867.52
Hand plant conifers	2019	1080	acres	$250.00	-$303,713.28
Chemical Release Radius 5 ft	2019	1310	acres	$350.00	-$515,750.14
Chemical Release Area	2020	1090	acres	$400.00	-$490,440.70
Interplant conifers	2020	500	acres	$250.00	-$140,608.00
Noxious Weeds Treat/Monitor	2020	1	each	$55,000.00	-$61,867.52
Chemical Release Radius 5 ft	2021	1310	acres	$350.00	-$515,750.14
Interplant conifers	2021	500	acres	$250.00	-$140,608.00
Noxious Weeds Treat/Monitor	2021	1	each	$55,000.00	-$61,867.52
Noxious Weeds Treat/Monitor	2022	1	each	$55,000.00	-$61,867.52
Noxious Weeds Treat/Monitor	2023	1	each	$55,000.00	-$61,867.52
Chemical Release Radius 5 ft	2023	1310	acres	$350.00	-$515,750.14
Noxious Weeds Treat/Monitor	2024	1	each	$55,000.00	-$61,867.52
				Total NPV	-$5,510,708.74

Indirect Effects

For both alternatives, additional short term employment opportunities would be created in service industries that serve the reforestation and fuel reduction contractors, such as hotels, restaurants, tractor supply companies, fuel supplies, and so forth. Induced effects, wages that are paid to workers by the primary and service industries would be circulated through the local economy for food, housing, transportation, and other living expenses. These multiplier effects would be slightly larger for Alternative 3 than Alternative 1 due to more person days of employment under Alternative 3.

Cumulative Effects

Alternatives 1 and 3: The Power Fire Reforestation Project would continue to contribute to the local economy. Reforestation activities on the King Fire, Georgetown Ranger District and Pacific Ranger Districts, have contributed recently, and may continue to contribute to the local economy. Reforestation activities on private land in the analysis area are primarily Sierra Pacific Industries. These activities have contributed recently, and may continue to contribute to the local economy.

Alternative 2

Direct and Indirect Effects

This alternative would not reforest or reduce the fuels in the project area. No employment opportunities would be generated from reforestation and fuel reduction activities. Monies spent on reforestation efforts to date would cease. Any future treatments would also be at higher cost than at present.

No additional employment opportunities or wages paid to the primary and service industries employees would be circulated through the local economy.

Cumulative Effects

With no direct or indirect effects, there are no cumulative effects.

Soils

Relevant Laws, Regulations, and Policy

National Forest Management Act (16 U.S.C. 1604)

With respect to soils, NFMA requires that the Forest Service manage lands so as not to impair their long-term productivity. Further, activities must be monitored to ensure that productivity is protected. This law led to subsequent regulation and policy to execute the law at various levels of management.

National Soil Management Handbook

The National Soil Management Handbook defines soil productivity and components of soil productivity, and establishes guidance for measuring soil productivity. In determining a significant change in productivity, a 15% reduction in inherent soil productivity potential will be used as a basis for setting threshold values. Threshold values would apply to measurable or observable soil properties or conditions that are sensitive to significant change. The threshold values, along with areal extent limits, would serve as an early warning signal of reduced soil productive capacity, where changes to management practices or rehabilitation measures may be warranted.

Management activities have potential to cause various types and degrees of disturbance. Soil disturbance is categorized into compaction, displacement, puddling, severe burning, and erosion. Direction was established that properties, measures, and thresholds relative to these disturbance types would be developed at the Regional and Forest levels, known as Soil Quality Standards.

Eldorado National Forest Land Resource Management Plan (USDA Forest Service 1989)

The Forest Plan includes the following standards and guidelines:

- Conserve or improve the inherent long-term soil productivity through the incorporation of soils information into land management decisions and through soil quality monitoring.
- Maintain at least 40% ground cover on soils with low erosion hazard, 50% on soils with moderate erosion hazard, and 60% on soils with high or very high erosion hazard.

Region 5 Forest Service Manual Soil Supplement 2500-2012-1

Three soil functions are utilized within Region 5 in order to determine whether national soil quality objectives are being met:

Support for Plant Growth Function; Soil Hydrologic Function; and Filtering-Buffering Function. Each function has several indicators with specific desired conditions. These indicators are used to assess the existing condition of a Soil Function. The following soil functions are applicable to the analysis of effects for this project:

Soil hydrologic function is the inherent capability of the soil to absorb, store and transmit water within the soil profile. The capability is dependent upon an adequate level of cover to reduce rainfall impact and runoff energy, stable soil structure, and sufficient macro-porosity to permit water infiltration and movement through the soil (USDA 2012a). Soil compaction and soil stability and erosion are indicators that can be used to examine the current and potential changes in soil hydrologic function.

The soil stores water, nutrients, and provides favorable habitat for soil organisms which cycle nutrients. Chemical, physical, and biological soil processes sustain plant growth which provides forage, fiber, wildlife habitat, and protective cover for watershed protection.

The natural physical structure of the soil provides a favorable environment for root growth. The organic matter on the soil surface and within the mineral soil are major sources of ecosystem nutrients such as nitrogen, essential for plant growth. It is important to realize that surface organic matter levels fluctuate naturally over time. The amount of organic matter is a balance of inputs from vegetation and decomposition rates dependent upon the local climate. Fire and management can decrease surface organic matter temporarily but accumulation resumes with natural vegetative growth within a relatively short time frame (years to decades). Very fine, amorphous organic matter in the mineral soil, referred to as soil organic matter (SOM), has accumulated over long time periods (decades to centuries) from root turnover and the biomass of soil organisms. And because it is not readily subject to burning per se, the organic matter level in the mineral soil is more stable than that on the surface. SOM is a very valuable source of nutrients, increases the available water-holding capacity, and contributes to the formation and stability of soil structure. The conservation of organic matter in the mineral soil and on top of the soil is fundamental to maintaining the Support for Plant Growth function (USDA 2012).

Sierra Nevada Forest Plan Amendment (USDA Forest Service 2004)

The SFNPA provides guidance for maintaining soil productivity within Riparian Conservation Areas (RCA). Soil function in RCAs is addressed by Standards 103, 111, and 122.

Standard 103 - Prevent disturbance to streambanks and natural lake and pond shorelines caused by resource activities (for example, livestock, off-highway vehicles, and dispersed recreation) from exceeding 20% of stream reach or 20% of natural lake and pond shorelines. Disturbance includes bank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plant roots. This standard does not apply to developed recreation sites, sites authorized under Special Use Permits and designated off-highway vehicle routes.

Standard 111 - Design prescribed fire treatments to minimize disturbance of ground cover and riparian vegetation in RCAs. In burn plans for project areas that include, or are adjacent to RCAs, identify mitigation measures to minimize the spread of fire into riparian vegetation. In determining which mitigation measures to adopt, weigh the potential harm of mitigation measures, for example fire lines, against the risks and benefits of prescribed fire entering riparian vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could be damaging to habitat or long-term function of the riparian community.

Standard 122 - Recommend restoration practices in: (1) areas with compaction in excess of soil quality standards, (2) areas with lowered water tables, or (3) areas that are either actively down cutting or that have historic gullies. Identify other management practices, for example, road building, recreational use, grazing, and timber harvests that may be contributing to the observed degradation.

Effects Indicators

The effects of the proposed activities are evaluated using the following soil quality indicators:

Table 3S.1 Resource indicators and measures for assessing effects for the Power Fire Reforestation Project.

Resource Element	Resource Indicator	Measure	Used to Address	Source
Soil Hydrologic Function	Soil Compaction (Soil Structure and Macro-Porosity)	Acres of tractor pile and burning	Soil Quality Standards	Region 5 Soil Management Handbook Supplement
Support for Plant Growth Function and Soil Hydrologic Function	Soil Stability & Soil Erosion	Tons per acre of sediment reaching stream channels	Soil Quality Standards	Region 5 Soil Management Handbook Supplement
Support for Plant Growth Function	Ground Cover (Organic Matter)	Percentage unit Ground Cover (particularly soil organic matter)	Soil Quality Standards	Region 5 Soil Management Handbook Supplement
Environmental Fate	Herbicide Degradation	Herbicide half-life (days)	Soil Quality Standards	Research – (SERA 2005 and SERA 2009)
Soil Microorganisms	Herbicide Toxicity	Qualitative risk	Soil Quality Standards	Research – (SERA 2005 and SERA 2009)

Methodology

Soil resources on the project area have been reviewed using soil survey data and slope data in GIS, aerial photos, and field reconnaissance. Soil survey data has been used for project scale analysis and for describing the project area. Best Management Practices (BMPs) and resource protection measures for soil protection in treatment units are based on field data. Herbicide risk assessments by the Syracuse Environmental Research Associates, Inc. (SERA) prepared for the USDA Forest Service were used to determine the interaction between chemicals, metabolites and soils.

Spatial and Temporal Context for Effects Analysis

The analysis area or bounding area, for direct, indirect, and cumulative effects for the soil resource includes the treatment units and related proposed vegetation treatments and fuels prescriptions.

Direct/Indirect Effects Boundaries

The analysis or activity area is considered an appropriate geographic unit for assessing soil environmental direct effects because soil productivity is a site-specific attribute of the land and is not dependent on the productivity of an adjacent area. Site-specific effects are limited to the soils in the treatment areas, and even more directly to the individual tree and area directly next to the tree where herbicide treatment is proposed.

Erosion recovery from vegetation treatments is three to five years. Displacement of soils lasts approximately 30 years during which inputs from plant roots, other organic inputs or, physical weathering reestablishes the soil profile. Soil productivity is recovered after two to three years. Effects to soils from herbicides are considered to be short term and limited to when the treatment is taking place, including the duration of degradation of the herbicide until it decomposes and is no longer a threat to the soil environment, which is estimated to be a range of 19-37 days for the four herbicides proposed for use.

Cumulative Effects Boundaries

Evaluation of cumulative effects on soils is a component of analyzing cumulative watershed effects (CWE). Past, present and reasonably foreseeable site specific conditions within project area watersheds have been evaluated in the hydrology report. Refer to the hydrology report for a watershed type approach to cumulative effects.

Affected Environment

Geologically the project area is located along the western edge of the Sierra Nevada of California. Slopes are mostly gentle below 30% with the exception of units partially located along drainages. The project area mostly sits along a broad belt of granitic rocks made of granite intrusions of Mesozoic age associated with the Sierra Nevada Batholith, ranging in composition from granodiorite to quartz monzonite (CDC 1993). Weathering of granitic parent material may be predominantly from physical processes such as freeze-thaw cycle between individual grains of the rock. The area is mountainous with rounded ridges, and moderately steep canyons. The area has been glaciated and the decomposed granite from the glaciation forms Entisols and Inceptisols with a weak granular structure.

Climate

The Human Health and Ecological Risk Assessments prepared by the Syracuse Environmental Research Associates, Inc. (SERA) for the use of herbicides in this project requires the annual amount of precipitation for use in various tables for impacts. A custom climate was generated for the project area using the FSWEPP interface (http://forest.moscowfsl.wsu.edu/fswepp/) using 38.44 N 120.39W and 4,421 foot elevation. Results show an annual precipitation of 49.20 inches from a total of 67 wet days. Treatments will be most likely conducted in the months of June and July.

FSWEPP custom climate indicates that the precipitation for the month of June within the project area is 0.70 inches of rain from a total of 2.08 wet days. This is equivalent to a total of two 2 year, 15 minute typical rainstorm events. The NOAA Atlas 14 point precipitation frequency estimates for the project area (http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ca) shows a typical 2 year, 15 minute rainstorm will each create a total of 0.369 inches of rainfall. This matches very closely to the FSWEPP custom climate for the project area.

Long term potential evapotranspiration simulated by Mapped Atmospheric Plant Soils System (MAPSS) (https://databasin.org/datasets/57fd0deb3b984f96969ae4b3a998e329) for the project area averages about 78 percent. The total evapotranspiration from the typical rainstorm in June with 0.369 inches of rain will be in the range of 0.28 inches of rain leaving a total of 0.08 inches of rain that may infiltrate into the soil profile.

Soil Texture

The SERA reports uses soil texture in their analysis for levels of herbicide in parts per million (ppm). SERA uses three soil textures of clay, loam, and sand in their analysis. The CA 724 Soil Survey Area -Eldorado National Forest Area, California, Parts of Alpine, Amador, El Dorado, and Placer Counties (downloadable from http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) is the primary soil survey for the project area. A small sliver on the western boundary of the Power Fire is located within CA 624 - El Dorado Area, California with no proposed treatments in this area.

Variations of sandy loam predominate with about 67% in the reforestation units. Loam comprises the rest of the project area with soil map units (SMU) 150 and 151. SMUs 150 and 151 are classified as the Jocal Series and more info about this soil series can be found at https://soilseries.sc.egov.usda.gov/OSD_Docs/J/JOCAL.html. The project soils are between SERAs loam and sand categories so the project effects will take a conservative route to use the values for loam since they are generally more restrictive.

Hydrologic Soil Group

SERA’s analysis includes concentrations of herbicide within the top 60 inches of the soil profile. The Hydrologic Soil Group (HSG) is based on estimates of runoff potential. Each soil is rated into one of four groups according to the rate of water infiltration when the soils have no ground cover or vegetation, are thoroughly wet, and receive precipitation from long duration storms.

The following definitions are from the Natural Resources Conservation Service (NRCS, 2014)

Group A soils have a high infiltration rate when thoroughly wet. These soils consists mainly of deep, well drained to excessively drained sands or gravely sands. These soils have a high rate of water transmission.

Group B soils have a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission. The majority of conifers grow in this soil group.

Group C Soils have a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission. There are no Group C soils in the project treatment stands.

Group D Soils have a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Table 3S.2 shows the summary of HSG groups in the treatment stands.

Table 3S.2 Hydrologic Soil Groups (HSG) for the Project Area

HSG Group	Acres
A	653
B	3,524
D	249
Total	4,426

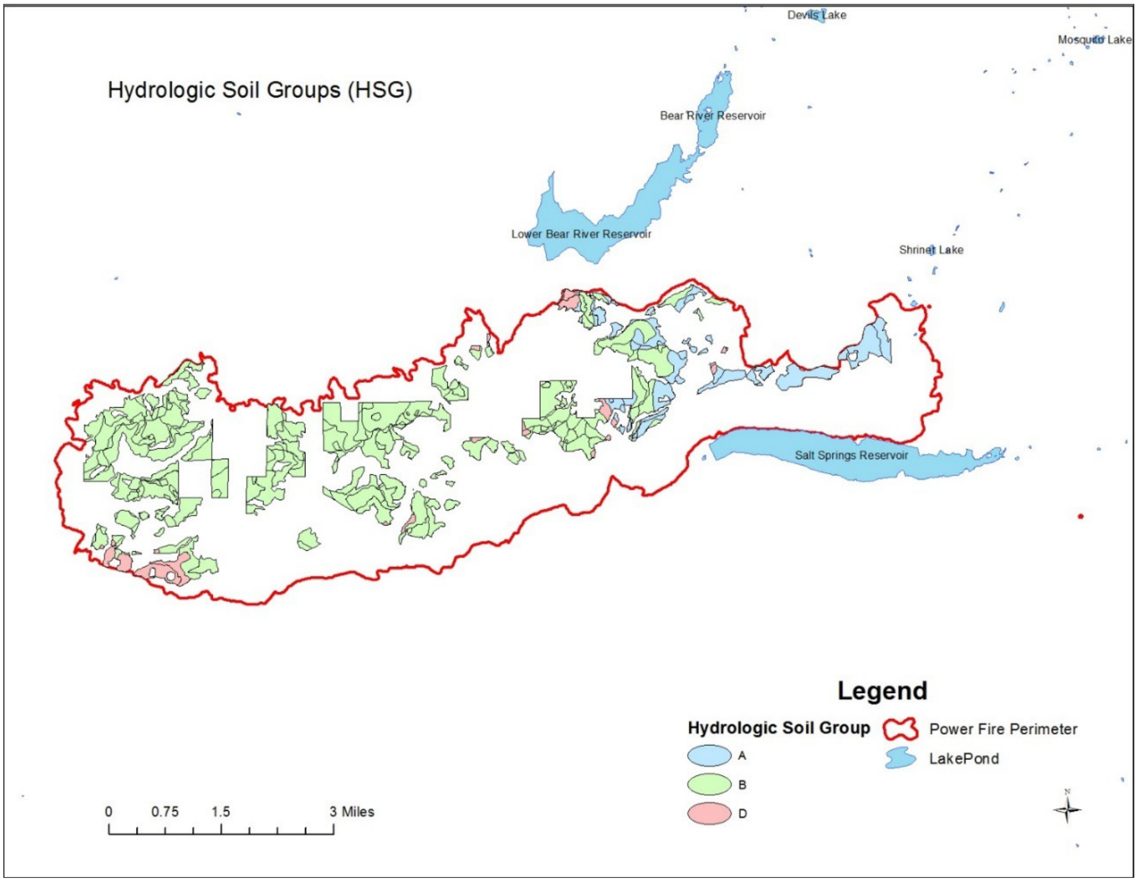

Figure 3S.1 Hydrologic Soil Groups (HSG)

Precipitation drains very quickly through the soil profile on HSG A with a restrictive layer greater than 60 inches deep. Runoff potential is very low.

The Group B soils in the project area have a restrictive layer starting about 43 to 50 inches deep. There is a low runoff potential and the precipitation moves rather quickly through the soil profile to the restrictive layer. From here, gravity drains the accumulated water towards the stream profile and recharges the streams throughout the year.

Group D soils in the project area have a restrictive layer starting at 13 to 15 inches in the soil profile. There is a high potential of runoff occurring. This area is classified as soil map unit 164 - Lithic Xerumbrepts-Rock outcrop complex, 15-75% slopes. The Lithic Xerumbrepts component makes up 40% of the map unit. The parent material consists of residuum weathered from granite. 40% of the map unit consists of rock outcrops (NRCS.) Units 131-0219 and 131-0253 are situated on this Group D area.

Group D soils are most susceptible to runoff during a large rainfall event right after herbicide applications. Portions of units 131-0219 and 131-0253 drain into Camp Creek from the south. The range of two frog species overlaps here in this reach of Camp Creek. FSWEPP using a 30 year modeling scenario was used to determine if there would be sediment reaching the stream channel in such an event. The results of the FSWEPP modeling indicate that an undisturbed forest will not have any measurable sediment reaching the stream channel from projected treatments. The reforestation portion of the units was modeled using the shrub component of FSWEPP and there will be no measurable sediment reaching the stream channel from projected treatments. The significant difference in maintaining forested vegetation in this area as opposed to early successional vegetation (shrub) is the number of storm events that can produce runoff. The results of the 30 year model shows the undisturbed forest component having an annual average total of 12 storm events creating conditions for runoff. The shrub component has an annual average total of 31 storm events creating conditions for runoff. Therefore, there is a small increase in potential runoff if the areas within a close proximity of stream channels are not reforested.

Herbicides

Glyphosate (Rodeo® or equivalent formulation) –

Glyphosate is a non-selective herbicide that controls plants by inhibiting the synthesis of aromatic acids necessary for protein formation. Glyphosate is strongly absorbed by soil particles and therefore, prevented from excessive leaching or absorbed directly from the soil from other plants. (Nature Conservancy)

SERA’s (SERA, 2011) summary of GLEAMS Driver simulations indicate the average concentration of Glyphosate in the top 12 inches of soil is 0.176 ppm for loam soils. The average concentration of Glyphosate in the top 60 inches of soil is 0.035 ppm for loam soils. The maximum penetration into the soil column is 8 inches. The most limiting soil restrictive layer of any soil map unit in the project area is 13 to 15 inches in the HSG D soil area.

Glyphosate is unlikely to enter stream waters through surface or subsurface runoff. Soil erosion would be the only mechanism to move Glyphosate to the stream channels. The FSWEPP modeling results described above indicates that there will be no measurable erosion that will reach the stream channels in the most susceptible HSG D area.

Aminopyralid (Milestone® or equivalent formulation)

Aminopyralid is a new herbicide used for the control of invasive weeds and appears to be a reduced risk herbicide (SERA, 2007). This herbicide does not appear to be very toxic to terrestrial invertebrates or soil microorganisms (SERA, 2007). Based on a bioassay in earthworms, soil invertebrates do not appear to be sensitive to Aminopyralid (SERA, 2007).

Half-life in soil is listed as 30 days in a loam soil (SERA). The average concentration of Aminopyralid in the top 12 inches of soil is 0.0329 ppm for loam soils. The average concentration of Aminopyralid in the top 60 inches of soil is 0.0284 ppm for loam soils. The maximum penetration into the soil column is 60 inches.

Triclopyr (Garlon 4® or equivalent formulation)

Triclopyr is a selective systematic herbicide used to control woody and herbaceous broadleaf plants and has little or no impact on grasses (Nature Conservancy). Triclopyr kills the target plant by mimicking the plant growth hormone auxin which causes uncontrolled growth that leads to plant death (Nature Conservancy)

The average concentration of Triclopyr in the top 12 inches of soil is 0.116 ppm for loam soils. The average concentration of Triclopyr in the top 36 inches of soil is 0.039 ppm for loam soils. The maximum penetration into the soil column is 8 inches. Half-life is estimated to be in the range of 11 to 25 days (Nature Conservancy)

In one study, Triclopyr inhibited growth of four types of ectomycorrhizal fungi associated with conifer roots at concentrations of 1,000 ppm. (SERA, 2011). This threshold is well beyond the average of 0.116 ppm found in the top 12 inches of the soil profile for toxicity to the fungi.

Clopyralid (Transline® or equivalent formulation)

Clopyralid is an auxin mimic type of herbicide similar to Aminopyralid and targets broadleaf weeds especially within the sunflower, legume, and knotweed families. (Nature Conservancy). Clopyralid does not bind tightly with soil and the potential for leaching is greatly reduced by the relatively rapid degradation of Clopyralid in soil as a number of lysimeter studies have indicated that leaching and contamination of ground water are likely to be minimal. (SERA, 2004). Clopyralid was not detected in soil below 25 cm (SERA, 2004).

The half-life of Clopyralid is listed as 19 days in the Roberts et al.study of 1996 (SERA). The average concentration of Clopyralid in the soil profile is 0.01233 ppm for loam soils. Clopyralid is degraded almost entirely by microbial metabolism in soils and aquatic sediments. (Nature Conservancy)

A summary of general herbicide effects to soils and water is described above, in the Hydrology section.

Table 3S.3 Herbicide Soil Indicators

Chemical	Depth of Soil Penetration (inches)	Soil Half-Life (days)
Glyphosate	8	37
Aminopyralid	60	30
Triclopyr	8	25.
Clopyralid	8	19

Environmental Consequences

Alternative 1 and 3

The environmental consequences for Alternatives 1 and 3 in respect to the soils resource are identical so the effects are described together.

Direct and Indirect Effects

Soil Compaction

Mastication and tractor piling are proposed on approximately 630 acres. Localized areas with detrimental levels of soil compaction, displacement, and other physical disturbances would reduce the ability of soils to exchange oxygen and carbon dioxide thus affecting the ability of soil organisms to survive. Large areas (greater than 100 square feet) with detrimental levels of soil disturbance are not expected because of project design features, standard soil operating procedures, and contract provisions. The results of Cumulative Watershed Effects (CWE) modeling indicate that the increase in compaction ranges from 1-4% on a hydrological Unit Code (HUC) 14 watershed basis and compaction levels drops below the existing condition within four years after project implementation. (Arias, 2016)

Burning of tractor piles on these 630 acres may create hydrophobic soil conditions depending on the amount of biomass derived from chaparral species and may last for up to three years depending on the freeze thaw cycles that is dependent on the amount of snowfall. Reforestation in areas with these hydrophobic soil conditions in HSG A and B soils may benefit from increased soil moisture for seedlings.

Although performed with ground based equipment, mastication generally occurs over an existing slash mat created during the mastication process. This material on the surface reduces the compaction risk.

Nearly all forest plants have a strong dependence on mycorrhizal fungi for extracting nutrients and moisture from the soil. In all alternatives, microorganisms would continue to populate the soil, contributing towards site productivity through nutrient cycling and reforming soil aggregates. Any project effects would not be adverse to soil productivity because nutrient replenishment, forest floor, and humus stores would remain on the site (Busse et al. 2009).

Soil Stability & Soil Erosion

The proposed action alternatives will not bare soil completely and design features will ensure that where soils have higher erosion hazards, soil cover will be 70% or greater of the given treatment unit ensuring that soil erosion hazards are reduced.

The results of the FSWEPP erosion modeling mentioned in the affected environment section indicate that there will not be any measurable soil erosion occurring on the most sensitive stands in the HSG D soil types.

Ground Cover (Organic Matter)

Mastication will increase the amount of fine particulate matter on the O horizon and will improve the percentage of organic matter in the developing A horizon over time. Precipitation and weathering of rocks will continue to make additional nutrients available on site. Annual needle, leaf, and twig fall, forbs, and shrub mortality will continue to recycle nutrients as well.

Herbicide Degradation

Glyphosate and Triclopyr bind to soils and can be transported via soil erosion to stream channels. Results of FSWEPP modeling in the affected environment section shows that no measurable soil erosion to the stream channels will occur following the adherence of the design features listed above.

Aminopyralid, Triclopyr, and Clopyralid has the potential to leach into ground water. The review of the NOAA Atlas 14 rainfall data described above indicates that at most a very small amount of precipitation (0.08 inches) could infiltrate into the soil profile at the time of herbicide applications. Design features restricting application during and preceding precipitation will further minimize this potential infiltration.

Half-lives of the active ingredients in Triclopyr, and Clopyralid are listed between 19 to 25 days and tend to indicate that the active ingredients degrade before it reaches greater than eight inches into the soil profile. The depth of the most sensitive soils (HSG D) in the project are 13 to 15 inches deep to a paralithic horizon and are below the eight inch depth of these two herbicides. Restricting application during and preceding precipitation will further minimize this potential infiltration.

Aminopyralid has the highest potential to leach throughout the entire soil profile to reach groundwater in the project area. HSG A soils will tend to be most susceptible to leaching into the groundwater due to the sandy textures and lower percentage of clay particles that would tend to filter out particles draining deeper into the soil profile.

Herbicide Toxicity

SERA’s literature review indicates that all four herbicides proposed for use are relatively non-toxic to soil organisms. Soil organisms would be most susceptible to glyphosate due to the high binding rate of the active ingredients to soil particles. The conclusion of a research article by Zabaloy, Gomez, Garland, and Gomez in 2011 indicates that a single exposure of soils to glyphosate causes only minor changes to microbial community structure or function.

Cumulative Effects

For the soil resource, the area for consideration of cumulative effects is the unit because effects on soils are site specific. Past activities are considered as the current condition of the soil resource (refer to the Affected Environment section above). Proposed treatments would not overlap in time and space with other ongoing or foreseeable future projects therefore cumulative effects to soil are the same as the direct and indirect effects described above.

The table below shows the summary of resource indictors and measures.

Table 3S.4 Resource Indicators and Measures Summary for Alternatives 1 and 3

Resource Element	Resource Indicator	Measure	Value
Soil Hydrologic Function	Soil Compaction (Soil Structure and Macro-Porosity)	Acres of tractor pile and burning	630 detrimental levels of soil disturbance are not expected
Support for Plant Growth Function and Soil Hydrologic Function	Soil Stability & Soil Erosion	Tons per acre of sediment reaching stream channels	0.00
Support for Plant Growth Function	Ground Cover (Organic Matter)	Change in Percentage unit Ground Cover (particularly soil organic matter)	Minor increase
Environmental Fate	Herbicide Degradation	Herbicide half- life (days)	30 days
Soil Microorganisms	Herbicide Toxicity	Qualitative risk	low Risk

Alternative 2

Direct and Indirect Effects

Under the no-action alternative, there would be no new disturbance resulting from forest management activities, and existing disturbance would persist. Freeze-thaw processes, weathering, and soil biota would work to slowly break up compaction over time and vegetation would continue to re-establish on the existing infrastructure of trails as their roots become able to penetrate growth-limiting layers of old compaction. Hydrologic function, such as soil drainage, would be maintained at existing rates.

Under the no-action alternative, the forest canopy would not be altered and organic material covering the soil would not be disturbed by management. Soil cover standards would likely continue to be met and the litter/duff layer would likely continue to thicken and increase in continuity. Coarse woody debris levels would also likely continue to increase. As a result, erosion hazards would likely remain low and soil nutrient cycles would be maintained.

The probability of a high-severity fire within the project area during a given timeframe is unpredictable. However, when a fire breaks out, the chances for high-severity fire effects on soils can be much higher in untreated areas with excessively heavy fuel loads compared to those that have been treated, including post-harvest logging slash (Certini 2005, Cram et al. 2006, Graham et al. 2004, and Keane et al. 2002).

Vegetation and fuel treatments would reduce the chance that a wildfire could have as severe an effect on the soils and surrounding private property in treated areas as it could in untreated areas because there would be fewer tons per acre of dead and dying fuels on treated sites.

A high-intensity wildfire would increase the potential for impacts to soils and soil productivity in severely burned areas, especially since the risk of soil erosion increases proportionally with fire intensity (Megahan 1990). Other effects would include the potential loss of organics, loss of nutrients, and reduced water infiltration (Wells et al. 1979). Fires that create very high soil surface temperatures, particularly when soil moisture content is low, almost completely destroy soil microbial populations, woody debris, and the protective duff and litter layer over mineral soil (Hungerford 1991, Neary et al. 2005). Nutrients stored in the organic layer (such as potassium and nitrogen) can also be lost or reduced through volatilization and as fly ash (DeBano 1991, Amaranthus et. al. 1989).

Cumulative Effects

Not treating the project area could result in unknown effects on productivity in the future in the event of a wildfire. However, due to a lack of direct and indirect effects as a result of this alternative, no cumulative effects are anticipated at this time. Because of the lack of adverse effects, the forest is likely to continue meeting, or make progress toward Forest Plan standards. By meeting soil quality standards, it is expected that desired conditions pertaining to the soil resource would be achieved.

Table 3S.5 Soils Resource Indicators and Measures Summary for Alternative 2

Resource Element	Resource Indicator	Measure	Value
Soil Hydrologic Function	Soil Compaction (Soil Structure and Macro-Porosity)	Acres of tractor pile and burning	0
Support for Plant Growth Function and Soil Hydrologic Function	Soil Stability & Soil Erosion	Tons per acre of sediment reaching stream channels	0
Support for Plant Growth Function	Ground Cover (Organic Matter)	Change in Percentage unit Ground Cover (particularly soil organic matter)	No change

Resource Element	Resource Indicator	Measure	Value
Environmental Fate	Herbicide Degradation	Herbicide half- life (days)	0 days
Soil Microorganisms	Herbicide Toxicity	Qualitative risk	No Risk

Terrestrial Wildlife

Relevant Laws, Regulations, and Policy

Federally Listed Threatened, Endangered, Proposed and Candidate Species (TES)

No federally listed or candidate terrestrial wildlife species were identified for the project based on the list generated by USFWS, November 22, 2016.

Region 5 Listed Sensitive Species

Direction to maintain the viability of Region 5 sensitive species is provided by the National Forest Management Act, the Code of Federal Regulations (219.19), the Forest Service Manual (2672), and the Eldorado National Forest Land Management Plan as amended by the Sierra Nevada Forest Plan Amendment Final Supplementary Environmental Impact Statement Record of Decision (USDA 2004).

Forest Service Manual and Handbooks (FSM 2670)

- As part of the National Environmental Policy Act process, review programs and activities, through a biological evaluation (BE) to determine their potential effect on sensitive species. A BE was prepared for this project and is incorporated by reference herein and included in the administrative record (Loffland 2016).
- Avoid or minimize impacts to species whose viability has been identified as a concern.
- If impacts cannot be avoided, analyze the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole.
- Establish management objectives in cooperation with the States when a project on National Forest System lands may have a significant effect on sensitive species population numbers or distribution. Establish objectives for Federal candidate species in cooperation with the FWS and the States.

National Forest Management Act (NFMA), and implementing regulations (CFR 219.19)

- Under the National Forest Management Act (NFMA), the Forest Service is directed to “provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives.” (P.L. 94-588, Sec 6 (g) (3) (B)).

- Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area.

Eldorado National Forest Land and Resource Management Plan, as amended in January 2001 and January 2004

- Utilize administrative measures to protect and improve endangered, threatened, rare, and sensitive wildlife species.
- General management direction is to avoid or minimize impacts to species whose viability has been identified as a concern, and to manage fish and wildlife habitat to maintain viable populations of existing native and desired non-native vertebrate species in the planning area.
- Specific standards and guidelines from the LRMP and the SNFPA that are pertinent with regard to terrestrial sensitive species potentially affected by the project are described in detail in the Biological Evaluation.

Migratory Landbird Conservation

- January 2000 USDA Forest Service (FS) Landbird Conservation Strategic Plan, followed by Executive Order 13186 in 2001, in addition to the Partners in Flight (PIF) specific habitat Conservation Plans for birds and the January 2004 PIF North American Landbird Conservation Plan all reference goals and objectives for integrating bird conservation into forest management and planning.
- In late 2008, a Memorandum of Understanding between the USDA Forest Service and the US Fish and Wildlife Service to Promote the Conservation of Migratory Birds was signed. The intent of the MOU is to strengthen migratory bird conservation through enhanced collaboration and cooperation between the Forest Service and the Fish and Wildlife Service as well as other federal, state, tribal and local governments. Within the National Forests, conservation of migratory birds focuses on providing a diversity of habitat conditions at multiple spatial scales and ensuring that bird conservation is addressed when planning for land management activities.
- Likely impacts to habitats and select migratory bird populations resulting from this project have been summarized in the Power Fire Reforestation Project Migratory Bird Report (Loffland 2016) and assessed in detail within the project Management Indicator Species (MIS) report (Loffland 2016) and impacts to select TES birds and their habitats have been analyzed in the project terrestrial BE (Loffland 2016). These impacts are summarized below for affected species.

Management Indicator Species (MIS)

MIS are animal species identified in the Sierra Nevada Forests Management Indicator Species Amendment Record of Decision signed December 14, 2007, which was developed under the 1982 National Forest System Land and Resource Management Planning Rule (1982 Planning Rule) (36 CFR 219). This ROD directs Forest Service resource managers to (1) at project scale, analyze the effects of proposed projects on the habitat of each MIS affected by such projects, and (2) at the bioregional scale, monitor populations and/or habitat trends of MIS, as identified in the ENF LRMP as amended. The current bioregional status and trend of populations and/or habitat for each of the MIS is discussed in the 2010 Sierra Nevada Forests Bioregional Management Indicator Species (SNF Bioregional MIS) Report (USDA Forest Service 2010a). A Management Indicator Species Report for the Power Fire Reforestation Project (Loffland 2016) was completed for this project and is hereby incorporated by reference.

Affected Environment and Environmental Consequences by Species

The affected environment and environmental consequences of the project are discussed below by individual species or groups of species that share similar habitat and effects of the project. Based on the analysis in the project BE, the sensitive species potentially affected by the project are California spotted owl, northern goshawk, American marten pallid bat, Townsend's big-eared bat, fringed myotis, and western bumblebee. Based on the analysis in the project MIS report, the MIS habitats that would be potentially affected by the project are shrubland (fox sparrow), oak associated hardwood (mule deer), early seral coniferous forest (mountain quail), late seral open canopy coniferous forest (sooty grouse), and snags in burned forest (black backed woodpecker). There are no known bald eagle or golden eagle nest sites within or adjacent to the Power Fire Reforestation Project units, or within a half mile of the project boundary, therefore these species would not be affected and are not addressed further (Loffland 2016).

California Spotted Owl, Northern Goshawk, and American Marten

Affected Environment

California Spotted Owl (CSO)

The California spotted owl is a Forest Service designated sensitive species and a management indicator species (MIS) on all Sierra Province National Forests in the Pacific Southwest Region. On May 24, 2006 the FWS announced its finding that listing of the CSO under the Endangered Species Act is not warranted, but that the status of the species should continue to be monitored (Federal Register Volume 71, Number 100, pages 29888-29908). The ENF is located in the central portion of the species range and represents about 16% of the known population in the Sierra Nevada based upon data presented in Verner et al.(1992). There is a relatively uniform distribution of owl sites across the forest and the adjoining Tahoe National Forest to the north and Stanislaus National Forest to the south. The SNFPA FEIS, Volume 3, Chapter 3, part 4.4, pages 69-82, summarizes the latest information regarding the biology and status of this species and is hereby incorporated by reference (USDA 2001).

Suitable CSO habitat in the Sierra Nevada consists of dense, multi-layered mature forested stands with greater than 70% canopy closure preferred for nesting and roosting, and greater than 50% canopy closure for foraging (Verner et al. 1992). Also important is availability of large snags and down logs, which are utilized for nesting and support the owl's prey base of mainly flying squirrels and woodrats (Laymon 1988). On the ENF, spotted owls are known to occur between 2,000’ and 7,200’ in elevation, with most of the nesting pairs found in the Sierran mixed conifer habitat type. The reproductive season for spotted owls occurs between mid-February and August with most young fledging by August 31 (Verner et al. 1992).

Suitable Habitat in the Project Area

Suitable habitat for spotted owl has been mapped on the forest, based on vegetation meeting the suitable habitat as described in the SNFPA (USDA 2001). Habitat is represented by California Wildlife Habitat Relations (CWHR) types 4M, 4D, 5M, 5D and 6). Suitable habitat for this species does exist within the Power Fire perimeter and the project area, but the treatment areas do not occur within this habitat.

Protected Activity Centers (PACs)

There are eight spotted owl Protected Activity Centers (PACs), AMA0001, AMA0004, AMA0005, AMA0007, AMA0013, AMA0015, and AM0022 which could be potentially affected by the Power Fire Reforestation Project action alternatives. Due to the distances from the project, treatment types and treatment areas, no direct, indirect, or cumulative effects would be anticipated for known territories outside the eight PACs previously listed.

Home Range Core Areas (HRCAs)

The SNFPA ROD directs that home range core areas (HRCAs) be delineated surrounding all spotted owl activity centers. HRCAs are delineated by selecting the best 1,000 acres within 1½ mile radius of the activity center, including the PAC. The HRCAs were drawn to provide a minimum of 1,000-acres of suitable habitat within each of the HRCAs. There is substantial overlap in acreage between HRCAs, due to the relatively dense configuration of PACs in some locations near proposed units.

Northern Goshawk

The northern goshawk is designated as a sensitive species for the ENF. The population trend in the Sierra is unknown due to the lack of wide-spread demography studies for this species (USDA 2001).

Goshawks utilize mixed conifer, ponderosa pine, red fir, subalpine conifer, lodgepole pine, montane riparian and montane hardwood vegetation types on the ENF. Suitable nesting habitat generally includes overstory trees greater than 24 inches dbh with a canopy closure greater than 60% on gentle north to east facing slopes. Keane (1999) found that in the Lake Tahoe region, goshawk nest sites had greater numbers of large live trees (greater than40” dbh), higher canopy cover (70 percent), less shrub/sapling cover, and fewer small live trees (less than 12 inches dbh) than in random plots in the area

(Keane 1999 In USDA 2001). Goshawks tend to build multiple nests within a given area, and may alternate between these sites from year to year. Habitat patches surrounding nest locations are known to range from 25 to 250 acres in size, therefore, the SNFPA recommended a 200-acre PAC around all known goshawk sites (Fowler 1988, Woodbridge and Detrich 1994, USDA 2001). The northern goshawk breeding cycle extends from mid-February through mid-September on the ENF.

Suitable Habitat

Suitable habitat for northern goshawk is essentially the same as spotted owl habitat, closed canopied medium to large treed stands. As was described for the spotted owl, suitable habitat for this species does exist within the Power Fire perimeter and the project area, but the treatment areas do not occur within this habitat.

PACs

There is only one goshawk Protected Activity Center (PAC), G35-01, which overlaps the project area, and only a small portion (<25acres) of this PAC is within the Power Fire perimeter. There are no proposed actions within this PAC.

American Marten

The American marten is designated as a sensitive species for the ENF. Based on incidental sightings, and track plate/camera surveys marten appear to be well distributed above 5,500 feet in elevation on the Eldorado National Forest.

Preferred marten habitat is characterized by dense (60-100% canopy), multi storied, multi species late seral coniferous forests with a high number of large (> 24 inch dbh) snags and downed logs (Freel 1991). These areas are often in close proximity to both dense riparian corridors (used as travel ways), and include an interspersion of small (<1 acre) openings with good ground cover (used for foraging). Forest stands dominated by Jeffrey pine did not appear to support marten on the Tahoe National Forest (Martin 1987).

Suitable Habitat

Suitable habitat for American marten is essentially the same as spotted owl and goshawk habitat, closed canopied medium to large treed stands. As was described for the spotted owl and goshawk, suitable habitat for this species does exist within the Power Fire perimeter and the project area, but the treatment areas do not occur within this habitat. Approximately half of the proposed units fall within the elevational range for marten. Key habitat areas for marten are den sites and there are no known den sites located within the project area, or on the Amador District, therefore no key habitat would be affected.

Environmental Consequences

California Spotted Owl, Northern Goshawk, and American Marten

Alternative 1

Direct and Indirect Effects

Alternative 1 would result in no potential for direct or indirect effects to individuals from the proposed chemical treatments. The likelihood of individuals coming into contact with the chemicals used is extremely low, as no direct spray of individual animals or birds would be expected, and with the spray activity taking place during the day, owls are not likely to be out to contact sprayed vegetation until after it is dried and the chemicals are inert. Incidental contact with goshawks or marten is unlikely during foraging, as these species do not forage to any large extent in non-forested areas, such as the treatment areas. Any exposure of individuals to the herbicides would be too low to have any effect on individuals, behavior, or reproduction.

Existing suitable habitat would not be impacted by the proposed action, as the treatments are targeting early seral/mid-seral habitat, which is not presently suitable habitat for these species.

Alternative 1 would be expected to accelerate the development of habitat for all three species. Planting arrangement 1.A is designed to accelerate the development of old forest conditions, which would provide foraging and potentially nesting habitat in the future. Planting Arrangement 1.B units are within the existing spotted owl PAC boundaries, and are designed to grow trees more quickly to a 50% or greater canopy closure, with an average tree diameter of 11” or greater, which would provide suitable foraging habitat in the next 15-25 years, and may contribute to nesting habitat into the more distant future. Planting arrangement 1.C is designed to result in more open forest conditions; these areas would not be expected to provide high quality nesting habitat in the future. Foraging may take place in these areas but they would not be classified as suitable habitat, even when they reach their target state. These areas did not provide suitable habitat pre-fire either. Of the planted areas, habitat suitability would be accelerated on approximately 1,500 acres of presently unsuitable habitat.

The remaining treatments proposed in Alternative 1are not expected to have noticeable effects to the overall habitat capability for these species, or present or future occupancy of the area by spotted owls, goshawks, or martens.

PACs

Alternative 1 would not directly affect existing suitable habitat within spotted owl PACs. Alternative 1 would target some of the unsuitable acreage (182 acres) in the existing PACs and attempt to bring these areas into suitability for foraging more quickly. Alternative 1 would not treat any area within any goshawk PAC, therefore would not directly affect existing suitable habitat.

HRCAs

No existing suitable habitat within HRCAs would be affected by this alternative. Alternative 1 would move habitat into a suitable state faster than is occurring without treatment. Alternative 1 would move an estimated 1,500 acres in that direction more quickly toward suitability for foraging, as well as future nesting. This potential habitat would be available to spotted owls and other species, and may be incorporated into spotted owl HRCAs in the future based on the forest and species response.

Disturbance Effects

Alternative 1 has some potential for disturbing spotted owls or goshawks, possibly during the nesting/reproductive period. The potential is relatively low, as the areas treated are not currently suitable habitat, and unlikely to place either the spotted owls or goshawks, and project activity in the same place at the same time. Should the spotted owl PACs be occupied the highest potential for disturbance would be in the units that fall within the PAC boundaries, and are therefore most likely to be in proximity of spotted owls during treatment. None of the proposed treatment units are near known nest locations for goshawks. Any potential for disturbance has been greatly reduced by putting the LOP design criteria in place. This LOPs will protect known, and future located nests, and in the absence of good nest location data areas within and immediately adjacent to the PACs.

Marten have been detected within the project area during past surveys. Denning disturbance effects are unlikely to occur due to timing of project activities, and the fact that suitable denning habitat is not proposed for treatment. Should disturbance occur, disturbance is unlikely to affect more than one or two individuals, due to large species home ranges and the relatively low percentage of home range habitat potentially affected at any one time. Should disturbance occur, during foraging or travel activities, the result could be temporary displacement of individuals. Effects on reproduction and population numbers, or species viability would not be expected to occur for marten.

Due to the low likelihood of disturbance occurring and protection afforded by design criteria, disturbance effects are not expected to impact spotted owls, goshawks, or marten from this alternative. In the unlikely event that disturbance occurs, temporary displacement of individuals might be expected, but no impacts to reproduction would result from the disturbance.

Cumulative Effects

The geographic scope of this analysis was selected considering the affects to the local spotted owl and goshawk population (affected HRCAs and PACs). This analysis is intended to provide an evaluation of the project’s cumulative effects upon the owl PACs and HRCAs most likely to experience effects, through changes to habitat capability and dispersal capabilities within and adjacent to the project area. For marten, the cumulative effects area analyzed for spotted owl and goshawk serves as a proxy, since marten share similar habitat needs. Spotted owl and marten habitat is essentially the same, with some differences in how it is used by each species, therefore the analysis for marten relies mainly on the analysis completed for spotted owl.

Within the cumulative affects area past timber harvest, fuels treatments, and hazard tree removal projects have altered the quantity and quality of habitat, affecting sites within and adjacent to the project area. The single largest impact was the 2004 Power Fire which reset the project area and habitat quite dramatically.

Past activities in the analysis area have resulted in approximately 3,600 acres of existing suitable habitat for spotted owls and goshawks and 1,800 acres of existing suitable habitat for marten within the Power Fire perimeter. Reasonably foreseeable future activity that may affect PAC or HRCA areas within the Power Reforestation Project include the Panther Fuels Reduction and Forest Health Project, which proposes to reduce understory fuels in two HRCA territories occurring in both project boundaries. No changes to PAC habitat are foreseen in proposed or ongoing activities.

When including the proposed project, Alternative 1 would move an estimated 1,500 acres toward habitat suitability more quickly than would Alternative 2, the no action alternative.

Increasing the amount of habitat that is available over the long-term would contribute beneficially to the cumulative effects for each of these species.

Alternative 2

Direct, Indirect and Cumulative Effects

Under current management, the existing conditions and associated risks of wildfire, and habitat trends in the project area would remain unchanged. There would be no increased rate of suitable habitat development, early and mid-seral stands would not move more quickly to a more closed canopied, medium and eventually large treed forest stands. The no action alternative would therefore result in a slow development and replacement of suitable habitat that was removed by the Power Fire.

Alternative 3

Direct and Indirect Effects

As Alternative 3 would be expected to utilize less chemicals than Alternative 1, this alternative has an even lower likelihood of owl exposure to chemicals. Alternative 3, as discussed for the proposed action, would be expected to result in no potential for direct or indirect effects to individuals from the proposed chemical treatments for the same reasons. Under both alternatives any exposure would be too low to have any effect on individuals, behavior or reproduction.

Existing habitat would not be impacted, as the treatments are targeting early seral/mid-seral habitat, and are working towards reforesting these areas, and in some cases moving the habitat toward spotted owl habitat suitability.

Planting arrangements 3.A and 3.B would not be expected to develop high quality habitat as the desired tree stocking would not result in closed canopied, multi-storied stand. Planting arrangement 3.C similarly would not be expected to develop into suitable habitat, except at the highest end of the desired stocking level of 90-100 trees per acre. Only a portion of this arrangement is likely to achieve that stocking. For this analysis 40% of the acreage (245 acres) is assumed to provide some level of suitable habitat in the future. Most of Planting arrangements 3.D and 3.E (270 acres combined) should provide long term foraging habitat, and arrangement 3.E is the most likely to develop spotted owl and goshawk nesting habitat character and maintain it over time.

The remaining treatments are not expected to have noticeable effects to the overall habitat capability, or present or future occupancy of the area by these species.

PACs

Alternative 3 would not directly affect existing suitable habitat within the spotted owl PACs. Applying planting arrangement 3.D and 3.E within 78 acres in the PACs should accelerate development of suitable habitat for spotted owls. Alternative 3 would not directly affect existing goshawk PACs.

HRCAs

Similar to the PAC analysis results, no existing suitable habitat would be affected within HRCAs. Alternative 3 would develop suitable habitat faster than is occurring without treatment. Alternative 3 would move approximately 545 acres in that direction, about one third as many acres as Alternative 1. All of this potential habitat would be available to spotted owls and other species, and may be incorporated into HRCAs in the future based on the species response.

Disturbance Effects

Disturbance effects for Alternative 3 are essentially the same as for the proposed action. No disturbance is expected, due to location, types of treatment, and the design features to reduce potential for disturbance. Should disturbance occur, individuals may be affected, but impacts on reproduction would not be expected to result from implementation of Alternative 3.

Cumulative Effects

Cumulative effects of Alternative 3 are the same as described above for Alternative 1, except Alternative 3 would have less effect on developing suitable habitat more quickly than no action.

Pallid Bat, Townsend's Big-eared Bat, and Fringed Myotis

Affected Environment

Pallid Bat

Pallid bat is a designated sensitive species for the ENF. Throughout California, the pallid bat is usually found in low to middle elevation habitats below 6,000 feet elevation. (ENF 2001), however, the species has been found up to 10,000 feet in the Sierra Nevada (ENF 2001). Pallid bats are most common in open, dry habitats that contain rocky areas for roosting. They are a year-long resident in most of their range and hibernate in winter near their summer roost (Zeiner et al. 1990). Day roosts may vary but are commonly found in rock crevices, tree hollows, mines, caves, and a variety of human-made structures. Tree roosting has been documented in large conifer snags, inside basal hollows of redwoods and giant sequoias, and bole cavities in oaks (ENF 2001). Cavities in broken branches of black oak are very important and there is a strong association with black oak for roosting (ENF 2001).

Pallid bat are known to feed predominantly on ground-dwelling arthropods, such as scorpions and Jerusalem crickets (USDA 2001). Foraging occurs over open ground, where pallid bats are more often found along edges and open stands, particularly hardwoods (USDA 2001).

There are no known mine or cave sites within the project area that would provide suitable roosting habitat in rock crevices. Large conifer trees and snags are present in the project area. There have been no comprehensive surveys for pallid bat on the ENF. Surveys associated with the SNFPA were conducted in 2001 for pallid bats along the Highway 50 corridor about 20 miles north of the project area. There was a capture of a pallid bat during that survey effort (ENF 2002).

Pallid bat tends to be both a roosting and foraging generalist. Suitable roost sites, such as large snags, oaks and rock crevices; suitable foraging occurs from grasslands to higher elevation coniferous forests. For this reason all acres within the project area which are proposed for treatment are considered to be suitable habitat for this species. Because pallid bats use of a variety of habitats, no key habitat has been defined for this species.

Townsend's Big-eared Bat

Townsend's big-eared bats are associated with a variety of habitats including desert, native prairies, coniferous forests, mid-elevation mixed conifer, mixed hardwood-conifer forests, riparian communities, agricultural lands, and coastal habitats. For this reason, the entire project area is believed to provide suitable habitat. Key habitats for Townsend's big-eared bats are roosts sites. This species is highly selective in their choice of roost locations, which include old buildings, mines, or caves that remain undisturbed. No roosting structures have been identified within any of the treatment areas; therefore, key habitat will not be affected, nor analyzed further in this analysis.

Fringed Myotis

In northern California it appears that male and female *Myotis thysanodes*, fringed myotis, use tree snags exclusively for day roosts (Weller and Zabel 2001). In areas where tree roosting is the norm, vegetative structural complexity of habitat around roost sites is likely more important than plant species composition or general topographic features in determining local distribution. The best habitat model for predicting bat presence in an area contained only these variables (the number of snags ≥ 30 cm dbh combined and percent canopy cover), where increasing numbers of snags and decreasing canopy cover increased the probability of bat occurrence (Weller 2000).

Fringed myotis is a designated sensitive species for the ENF. The fringed myotis is usually found in low to middle elevation habitats below 6,000 feet elevation, but has been found near sea level and at much higher elevations. There is some evidence that this species may migrate to lower elevations for winter roosts, but does not appear to be a long distant migrant. Day roosts may vary but are commonly found in rock crevices, tree hollows, mines, caves, and a variety of human-made structures. Tree roosting has been documented in large conifer snags.

Fringed myotis are considered to be foraging generalists, but do seem to be tied to day roost habitat associated with old forest conditions, especially large diameter snags. Large conifer snags are present in the project area. There have been no comprehensive surveys for fringed myotis on the ENF, but they have been detected on the ENF in the past. All acres within the project area which are proposed for treatment are considered to be suitable habitat for this species.

Environmental Consequences

Pallid Bat, Townsend's Big-eared Bat, and Fringed Myotis

Alternatives 1 and 3

Direct, Indirect, and Cumulative Effects

The herbicide application under either alternative would not be expected to impact these species, as they would not be present where the herbicide would be applied, and are unlikely to come in contact with it indirectly in quantities high enough to affect behavior or reproduction. The other activities planned under these alternatives would not be expected to impact the species, or their habitat.

Both Alternative 1 and 3 would potentially affect habitat for bats in the same manner. Some existing snag roosting sites in both alternatives could be removed where mechanical site preparation would occur on approximately 630 acres. This would reduce the potential for roosting in these treatment areas. The value of these roost sites is presently believed to be low as many of the snags have fallen or broken off in the more than 10 years after the fire, and the level of use by these species is not presently known. There would remain many acres of similar snag habitat within the project area which would not be mechanically treated for these species to use should they be present.

Foraging habitat may be slightly improved by project activities under both alternatives where understory vegetation is thinned or removed which could allow for easier foraging, and possibly open up some foraging areas that are presently not available due to dense vegetation. The value of this change in habitat is not known, and is unlikely to have a large impact on these species.

Disturbance Effects

Potential for disturbance to foraging bats would be negligible from the proposed activities, as the planned activities take place during daylight hours, and bat foraging primarily occurs at dusk, dawn, and overnight. Disturbance could occur to day roosting bats where roosting locations coincide with project activities. The amount of potential disturbance and effect on individuals is difficult to assess as the bat population status and use of the project area is not known. Temporary displacement would be possible where roosting sites and project activities coincide. Due to the wide variety of roosting habitats used, this alternative would not be expected to have any long term population effects on these species, as few individuals would be likely to be affected.

Cumulative Effects

Effects from the Alternatives 1 and 3 would not be of sufficient magnitude to contribute adverse cumulative effects for these species, and future actions on National Forest lands are likely to be favorable to them. Snags and oaks are retained in large numbers under current Forest Plan direction, except where they pose a hazard, such as: recreational sites, administrative sites, and along roadways. Cumulative effects to bats from activities on National Forest lands should therefore be quite limited. Where this project opens up the understory, speeds development of roost sites, and improves prey availability, it may result in a small improvement in bat habitat and will not contribute to substantial cumulative impacts.

Alternative 2

Direct, Indirect and Cumulative Effects

Under current management, the existing conditions and associated risks of wildfire, and habitat trends in the project area would remain unchanged. Effects to bats or their habitat are negligible.

Western Bumble Bee

Affected Environment

Western bumble bees are associated with a variety of habitats; they forage on flowering plants and use rodent boroughs for nesting and overwintering. Early seral habitat with flowering plants may provide habitat for both nest/overwintering and foraging, with later seral, high canopy closure habitat expected to provide some boroughs for nesting/wintering, but little foraging opportunities. The project area is a mix of these habitat types. Roughly 6,000 acres of the Power Fire area would be expected to support both foraging and nesting/wintering by western bumble bees.

During the spring and summer of 2015 bumble bee (*Bombus* spp.) surveys were conducted throughout the area burned by the Power and Fred's fires, using a standardized survey protocol. The goal of these surveys was to determine which post-fire vegetation communities and specific areas within the fire areas provide the most important habitat for bumble bee species, and provide information on which species of bumble bees, including western bumble bees, were present in the fire areas surveyed. The surveys indicated that the Power Fire supports a diversity of bumble bee species. Twelve species of bumble bees were detected across the two fire areas, but the western bumble bee, *B. occidentalis,* was not detected (H. Loffland personal communication, draft results 2016). This was not too surprising, given the species declining status and range of this species based on past observations.

The surveys indicated that the Power Fire does support habitat which is suitable for bumble bees, and that riparian areas may provide higher capability habitat than the upland habitats. Chaparral stands were more heavily used by the bumble bees than others, bearclover (*Chamaebatia foliolosa*) was positively correlated with species richness, and whitethorn and deerbrush, although abundant on the landscape, was rarely used for foraging by bumble bees (H. Loffland personal communication, draft results 2016). Approximately 690 acres (23%) of the proposed treatment areas have been identified as having bearclover as the dominant vegetation.

Environmental Consequences

Alternative 1

Direct, Indirect, and Cumulative Effects

Hand Planting and Inter Planting

The tree planting proposed under this alternative could affect western bumble bees in two ways, direct impacts to habitat, (nests, nesting habitat), and disturbance (to nests, and foraging individuals). The impacts to habitat would occur when and where nest location and tree planting occur at the same location. The planting of the tree would disrupt, if not destroy the nest when the planting shovel or hoe dad penetrates the nest. The potential for this occurring is only moderately likely, as the planting densities are relatively low compared to the available ground for nesting, with a maximum of 400 trees/acre planting site per acre on the densest planting arrangement. Where the planting and nesting do coincide, there could be loss of individuals, and the nest. The majority of the planting (80-90%) would take place in the spring, when bee nests are being established. This would reduce the number of individuals impacted at any nest as individual numbers are lower than later in the season, and potentially allow for nest repair or the queen to move to another nest location and continue to reproduce. Planting crews moving through the planting units is most likely to disturb individuals foraging, however this disturbance would be short term, temporary, and unlikely to impact individuals to an extent which would compromise either individual fitness, or reproduction at the nests.

Herbicides

Toxicity

Western bumble bees could potentially see impacts from the application of herbicides, and related toxic impacts in two ways, through either direct spray, and/or through foraging in recently sprayed units and potential ingestion of the chemical through eating plant parts/nectar or preening behavior. In the direct spray instance, the bees would not be targeted during the application, but if the bee is present on flowers, or flying through the units, it is possible that they could be sprayed and or contact recently sprayed plants. Early results from the bumble bee surveys conducted in both the Power Fire and Fred's fire areas indicated that riparian areas have high species richness, and as these areas would not be sprayed bees using these areas would be very unlikely to be directly sprayed. Additionally only about 40% of the existing habitat within the Power Fire perimeter is proposed for treatment under this alternative, which further reduces the potential exposure of bumble bees to effects from herbicides.

Foraging within treated areas could result in contact with the herbicides, and potentially ingestion of the herbicides. The amount of incidental contact with the chemical and ingestion is likely to be low due to the low likelihood of the bees being present during and immediately after the application, the short period of time that the chemical is available to transfer to the bumblebees before the chemicals become less active, and lowering levels of toxicity. As the herbicides begin to affect the plant, flowering and plant vigor would decrease and the palatability and foraging value would greatly decrease making it unlikely that bumblebees would continue to forage on the treated vegetation once the herbicide has become active in the plant.

Four herbicides are proposed for use in this project, glyphosate (Rodeo or equivalent trade name) aminopyralid (Milestone or equivalent trade name), Triclopyr (Garlon 4 or equivalent trade name), and clopyralid (Transline or equivalent trade name). For these chemicals, toxicity data was not available for any bumble bee species, but toxicity testing and analysis was conducted on honey bees, and will be used in this analysis as a close surrogate for both behavior and biology to give an indication of potential for impacts to western bumble bees. For the direct spray analysis, an assumption of half (50%) of the bees body receiving contact from the chemical, and 100% absorption of the chemical by the honey bee was assumed. The 50% direct spray assumption is believed to be on the high side of a realistic scenario, and the 100% absorption is a worst case scenario, used in absence of better information on absorption rates.

Two of the chemicals, aminopyralid, and clopyralid, had very low toxicity levels for direct spray; it would take exposure levels of 50 or 17 times (respectively) of what would be expected from the proposed action to approach the level of concern for bees from direct spray. The ingestion results were very similar, with no statistically significant mortality observed from forced ingestion for either chemical at levels above what would be expected to occur from foraging and preening behavior.

The remaining two chemicals, glyphosate, and triclopyr, had a higher toxicity level than aminopyralid and clopyralid. At the application rates planned for these chemicals, it would take on the order of double or triple (respectively) the potential level of exposure to approach the level of concern for bees from these chemicals, for both direct spray and ingestion toxicity.

Preliminary results from the bumble bee surveys conducted in the Power and Fred's fire, pooling captures across all species, 61% of the captured bees were workers, 35% were drones, and 4% were queens (H. Loffland personal communication, draft results 2016). Assuming that the likelihood of individuals being directly sprayed is similar to these capture rates; it is most likely that worker bees and drones might be sprayed, versus queens, therefore individual impacts would have less of an impact on the nest/colony than if the queen were sprayed and experienced adverse toxic impacts. As the risk of toxic impacts from direct ingestion are low, likelihood of impacts to the nest from transport and ingestion by indirect exposure are even more unlikely. For all of the chemicals proposed for use in this project, the SERA analysis concluded that effects on terrestrial invertebrates (honey bees were the species studied) are most likely to be associated with changes in habitat and food availability rather than direct toxic effects.

Habitat

The chemical application would reduce the availability of flowering plants for western bumble bee foraging in the units treated. This would affect nests within the units, as well as potentially affecting nests in adjacent untreated areas by reducing or eliminating foraging within treatment areas for that season. Longer term, reducing the flowering plants available to western bumble bees and other pollinators would reduce the quality of the habitat in areas treated. Based on the initial survey results, this may be most keenly felt in the 690 acres of planned release in bearclover dominated stands. The Power Fire area has a large amount of habitat that supports early seral chaparral habitats (in excess of 9,500 acres), much of which would not be treated by either mechanical or chemical site preparation, release, or invasive plant treatments. Impacts would occur on approximately 40% of the existing habitat, and would not be expected to greatly impact either habitat availability or species occupancy within Power Fire area, especially given the design features which protect/retain habitat in riparian areas including streams, and special aquatic features.

Disturbance

There could be some disturbance to nests and individuals from the crews spraying the herbicide. This disturbance is unlikely to directly impact the nests (as the application would be by hand crews above ground), and would likely result in a temporary displacement and disruption of foraging individuals. These disturbance impacts are negligible compared to longer lasting impacts of removing the plants that the bees would be foraging on. The combined effect of reduced foraging resources and disturbance would likely result in greatly reduced or eliminated reproduction for the treatment season on these acres for western bumble bees. The scale of these impacts is limited to approximately 40% of the existing habitat available to this species in the fire area.

Mechanical Site Preparation

Habitat

The mechanical site preparation would reduce the availability of flowering plants for western bumble bee foraging in the units treated. This would affect individuals and nests within the units, as well as potentially affecting nest in adjacent untreated areas. The Power Fire area has a large amount of early seral habitat (in excess of 9,500 acres), that supports foraging/nesting habitat for this and other species, much of which would not be treated by either mechanical or chemical site preparation. There would also be loss of some nest habitat, through crushing form the use of tractors. This could eliminate potential nest locations and destroy some existing nests where they are active within the treatment units.

Disturbance

Disturbance to nesting/reproduction and foraging individuals would be likely to occur for all activities proposed for mechanical site preparation. Tractor use could crush nests, lead to abandonment of nest due to noise and activity, disrupt foraging and remove plants for foraging. Burning of piles could disrupt early nesting if burning takes place in the spring, and disrupt overwintering queens in nests should burning take place in the fall. All of this activity could result in direct mortality of individuals, and portions or all of individual nests. These impacts would likely greatly reduce or eliminate reproduction for the treatment season on these acres for western bumble bees. The scale of these impacts is limited to a small portion of the existing habitat available to this species in the fire area.

Oak Stand Improvement

The proposed oak stand improvement would likely not have a noticeable impact on habitat for western bumble bees. The pruning of the oaks would not reduce habitat capability. The actual pruning activity, and fence installation/maintenance may disturb individuals, where both the activity and species are in the same place at the same time. This potential disturbance would likely result in temporary displacement of individuals during foraging activities, and would not be expected to affect reproduction. There is some limited potential for disturbing nesting habitat during fence installation, if post location and nest locations coincide. The potential for this is very low, due to the limited amount of fencing proposed, and likelihood that nests would be located where post are installed. Should this disturbance occur it is unlikely to impact more than 1-5 nests across the project area, and only one breeding season during installation.

Cumulative Effects

For western bumble bee, the Power Fire is the largest and most impactful past action in the project area. The fire resulted in much higher quantity of quality habitat (estimated in excess of 9,500 acres) than was present before the fire (approximately 4,000-5000 acres).

Past tree planting and manual grubbing and release projects have had short term impacts, but have not resulted in longer term vegetation and habitat changes. The adjacent privately owned industrial timber land has been actively controlling shrubs within their plantations, but how these activities have affected the availability of foraging habitat for Western bumblebee is difficult to assess, and surveys have not been conducted to ascertain how the vegetation changes on private lands impact bumble bees in the Power Fire area. These areas may provide differing timing of flowering plants, and foraging opportunities, than federal lands, due to these vegetation changes. The project area is also part of an active grazing allotment, with annual cattle grazing reducing the amount of available flowering plants to some extent, and potential for some impact to nests/overwintering through crushing.

This alternative would change both the quantity of available habitat, reducing or removing habitat on approximately 4,000 acres and moving this habitat toward a less suitable to unsuitable state as forest stands become reestablished. The cumulative impact of this alternative would be to reduce existing habitat quality and quantity by approximately 40% while retaining a large amount of habitat in a highly suitable state, both in untreated buffers and across the landscape, on 4,500-5,500 acres.

Longer term impacts of reforesting these areas would be a reduction in foraging and nesting habitat for this species. As the stands develop there would be some reduction in both flowering plants and rodent activity, and when a mid to late seral forested stand is produced, these areas would no longer provide high quality foraging and nesting habitat. However, much of the fire area would remain in an early to mid-seral status for many years, providing habitat for this and other bumble bee species.

It is expected that the proposed action would incrementally contribute to adverse cumulative effect but not to an extent which would greatly affect the local population, species status, or trend for western bumble bee.

Alternative 3

Direct, Indirect, and Cumulative Effects

Impacts due to differences in planting arrangements, and density of trees planted in Alternative 3 are not expected to be measurably different from Alternative 1 . There would be some potential for a difference between Alternative 3 and Alternative 1 due to the release treatments, which will be discussed below. All other planned activities under this alternative would result in the same or very similar impacts as were described for Alternative 1 above.

Toxicity

This alternative was designed to minimize the amount of chemical herbicides use to control shrub/brush species where possible. Where brush species are cut first and sprouting brush are sprayed, less chemical may be needed to achieve the same control. Because less of the herbicides would be used under this alternative, there is less potential for any toxic impacts to western bumble bees, as their potential exposure is reduced. This alternative would result in less likelihood of individuals being impacted, and even lower likelihood of impacts to nests from chemical exposure.

Habitat

Habitat impacts would be similar to what was described for the proposed action. Where this alternative differs is that the brush cutting before treatment immediately kills potentially flowering species that the bees may be foraging on. This would result in essentially the same impact as Alternative 1. The flowering plants that are cut would be removed from availability for foraging at the time of the cutting, versus the time lag for the herbicides to take effect in Alternative 1. This difference and resulting impacts to individuals, nests, and local populations is difficult to assess, and would vary depending on how much of the area is treated at any given time. The net result would be very similar, and impacts to the nest and local population would be expected to be similar to Alternative 1.

Disturbance

Initially, where spraying is replaced by hand treatments of brush, there would be an increase in potential disturbance to individuals, especially foraging individuals, and nests based on the increased noise and manipulation/removal of the shrubs by hand. How much of an impact this would have is difficult to compare; however, the change in available foraging plants is the greater impact. After this initial increase in disturbance, the disturbance potential of Alternative 3 would be expected to be the same as described for Alternative 1.

Cumulative Effects

The cumulative effects of this alternative would be essentially the same as described for Alternative 1. Any differences are unlikely to be detectable, and would not change the conclusions. It is expected that Alternative 3 would incrementally contribute to adverse cumulative effects but not to an extent which would greatly affect the local population, species status, or trend for western bumble bee.

MIS Habitat: Shrubland (Fox Sparrow)

Affected Environment

The fox sparrow was selected as the MIS for shrubland (chaparral) habitat on the west-slope of the Sierra Nevada, comprised of montane chaparral (MCP), mixed chaparral (MCH), and chamise-redshank chaparral (CRC) as defined by the California Wildlife Habitat Relationships System (CWHR) (CDFG 2005). Recent empirical data from the Sierra Nevada indicate that in the Sierra Nevada, the fox sparrow is dependent on open shrub-dominated habitats for breeding (Burnett and Humple 2003, Burnett et al. 2005, Sierra Nevada Research Center 2007). There are currently 1,009,681 acres of west-slope chaparral shrubland habitat on National Forest System lands in the Sierra Nevada. Over the last two decades, the trend is slightly increasing (changing from 8% to 9% of the acres on National Forest System lands). There are approximately 160 acres of montane chaparral, mixed chaparral habitat found within the proposed units. These areas have relatively recently seen large scale disturbance from wildfire (Power Fire 2004), and in many cases were generated by this event.

Environmental Consequences

Alternatives 1 and 3

Direct, Indirect, and Cumulative Effects

A maximum of 160 acres of habitat would be treated by one or multiple treatments proposed under these alternatives. The mechanical and/or chemical site preparation treatments would kill much of the existing shrub habitat on these acres, at least in the short term, and result in a reduced amount of larger, older shrub dominated habitat for the foreseeable future. The planting of trees in various arrangements would do little in the short term (1-5 years) to alter the shrub habitat while the trees are established and released, It is unlikely that all or even most of the shrub habitat type would be treated in a single given year, and this would result in a heterogeneous habitat quality, which would in turn allow for continued species use where it remains. The fact that the project would affect no more than 160 acres puts in context the potential adverse impacts to this habitat type when compared to the total acreage estimated to be available within the Power Fire area (450 acres). The proposed action treatments would over time convert the habitat treated from early seral into a mid-seral state, and longer term (20+ years) into a range of mid to late seral forested types.

The different planting arrangement proposed in Alternative 1 and 3 would not result in significantly different effects to this habitat, except that Alternative 3 may take more years to reach later seral stages due to plant fewer trees planted per acre.

Since only a portion of this habitat type within the Power Fire Area would be affected by the proposed treatments, and since some portion of this habitat would persist for the next 5-10 years (during treatments), this alternative would not be expected to result in a change in species trend, and will only contribute a negligible increase in adverse cumulative effects for this habitat type/species. Current data at the rangewide, California, and Sierra Nevada scales indicate that, although there may be localized declines in the population trend, the distribution of fox sparrow populations in the Sierra Nevada is stable.

Alternative 2

Direct, Indirect, and Cumulative Effects

Alternative 2 is expected to have no direct, indirect, or cumulative effects on the habitat or species.

MIS Habitat: Oak-Associated Hardwoods and Hardwood/Conifer Habitat (Mule deer)

Affected Environment

The mule deer was selected as the MIS for oak-associated hardwood and hardwood/conifer in the Sierra Nevada, comprised of montane hardwood (MHW) and montane hardwood-conifer (MHC) as defined by the California Wildlife Habitat Relationships System (CWHR) (CDFG 2005). Mule deer range and habitat includes coniferous forest, foothill woodland, shrubland, grassland, agricultural fields, and suburban environments (CDFG 2005). Many mule deer migrate seasonally between higher elevation summer range and low elevation winter range (Ibid). On the west slope of the Sierra Nevada, oak-associated hardwood and hardwood/conifer areas are an important winter habitat (CDFG 1998). There are currently 808,006 acres of oak-associated hardwood and hardwood/mixed conifer habitat on National Forest System lands in the Sierra Nevada. Over the last two decades, the trend is slightly increasing (changing from 5% to 7% of the acres on National Forest System lands).

There are approximately 35 acres within the proposed treatment units which fall into the montane hardwood, or montane hardwood conifer CWHR types. These areas have had no recent wildland fire activity, and have resulting conifer shading resulting from the fire suppression. The existing oaks are in competition with the conifers for light and water, and the oaks are slowly being reduced in number and vigor as the conifer shading increases over time.

Environmental Consequences

Alternatives 1 and 3

Direct, Indirect, and Cumulative Effects

The proposed action is not anticipated to create or remove habitat for this species, but should improve habitat capability. The action alternatives propose a combination of thinning, oak pruning, and chemical and hand releases to reduce competition and release oaks on 35 acres of this habitat type. The oak pruning may increase the speed at which stump sprouted oaks reach maturity, and increase vigor of the remaining stems.

Outcomes due to Alternatives 1 and 3 would not be expected to differ greatly. Alternative 3 may favor more oaks where lower conifer planting densities and oaks coincide.

Since these alternatives will neither create nor remove any of the habitat types, but would reduce competition, and may increase the speed with which stump sprouted oaks reach maturity, their implementation would improve oak vigor. No adverse cumulative effect should result from implementation of these alternatives. The small area affected, 35 acres, which would see quality improvement under the proposed action alternatives, would not alter the existing trend in the habitat, nor will it affect a change in the distribution of mule deer across the Sierra Nevada bioregion. Current data at the rangewide, California, and Sierra Nevada scales indicate that, although there may be localized declines in some herds or Deer Assessment Units, the distribution of mule deer populations in the Sierra Nevada is stable.

Alternative 2

Direct, Indirect, and Cumulative Effects

Alternative 2 is expected to have no direct, indirect, or cumulative effects on the habitat or species.

MIS Habitat: Early and Mid Seral Coniferous Forest Habitat (Mountain quail)

Affected Environment

The mountain quail was selected as the MIS for early and mid-seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat in the Sierra Nevada. Early seral coniferous forest habitat is comprised primarily of seedlings (<1" dbh), saplings (1"-5.9" dbh), and pole-sized trees (6"-10.9" dbh). Mid seral coniferous forest habitat is comprised primarily of small-sized trees (11"-23.9" dbh). The mountain quail is found particularly on steep slopes, in open, brushy stands of conifer and deciduous forest and woodland, and chaparral; it may gather at water sources in the summer, and broods are seldom found more than 0.8 km (0.5 mi) from water (CDFG 2005).

There are currently 530,851 acres of early seral and 2,776,022 acres of mid seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat on National Forest System lands in the Sierra Nevada. Over the last two decades, the trend for early seral is decreasing (changing from 9% to 5% of the acres on National Forest System lands) and the trend for mid-seral is increasing (changing from 21% to 25% of the acres on National Forest System lands).

There presently are approximately 625 acres of early seral (size class 1-3) coniferous habitat, and approximately 590 acres of mid seral (size class 4) coniferous habitat within proposed units for this project.

Environmental Consequences

Alternatives 1 and 3

Direct, Indirect, and Cumulative Effects

In the short term, 1-25 years, the proposed activities in these alternatives would not greatly change the amount of early to mid-seral habitat available to quail. The chemical and mechanical site preparation, planting, and noxious weed treatments would change the species make up of these areas, but retain the early to mid-seral habitat types. The immediate effect of site preparation treatments would shift some of the mid-seral habitat toward early seral habitat types. The tree planting and mechanical and chemical vegetation management would over time transform the early to mid-seral habitat that currently exists, approximately 1200-1300 acres, to mid and late seral forest habitat types. The various planting arrangements, depending on survival rates, future fire and other variables, may affect the rate of change. A generalization is that the denser planting (assuming similar survival rates all planting arrangements) would achieve a closed canopied, mid to late seral habitat type faster than the more open and clustered planting arrangements. In all cases, some of the mid seral habitat type would persist for 15-30 years post implementation.

Alternative 3 may retain early to mid-seral habitat on the landscape longer than the proposed action, as decreased conifer densities and resulting canopy shading would slow the conversion from mid-seral to later seral forested habitat. How much longer this alternative would retain the early/mid seral habitat types is speculative, and depends on many variables (planted tree survival, growth rates, shrub, and forb response to treatments). This alternative would not be expected to slow the move from early to mid/late habitat types by more than 5 years, when compared to the proposed action.

The project is treating less than 1,300 acres of the 6,000 acres of early and mid-seral habitat types in the Power Fire area. For this reason, any immediate affects from the project would not be expected to limit or greatly affect the availability of these habitat types for quail and other species for many years. Any effects would also be offset to some degree by wildfire elsewhere in the Sierra Nevada, which generates early and mid-seral habitats. Current data at the rangewide, California, and Sierra Nevada scales indicate that the distribution of mountain quail populations in the Sierra Nevada is stable. These alternatives would not alter the existing trend in the habitat change, nor would they lead to a change in the distribution of mountain quail across the Sierra Nevada bioregion.

Alternative 2

Direct, Indirect, and Cumulative Effects

Alternative 2 is expected to have no direct, indirect, or cumulative effects on the habitat or species.

MIS Habitat: Late Seral Open Canopy Coniferous Forest Habitat (Sooty (blue) grouse)

Affected Environment

The sooty grouse was selected as the MIS for late seral open canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat in the Sierra Nevada. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures less than 40%. Sooty grouse occurs in open, medium to mature-aged stands of fir, Douglas-fir, and other conifer habitats, interspersed with medium to large openings, with available water, and occupies a mixture of mature habitat types, shrubs, forbs, grasses, and conifer stands (CDFG 2005). Empirical data from the Sierra Nevada indicate that Sooty Grouse hooting sites are located in open, mature, fir-dominated forest, where particularly large trees are present (Bland 2006).

There are currently 63,795 acres of late seral open canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat on National Forest System lands in the Sierra Nevada. Over the last two decades, the trend is decreasing (changing from 3% to 1% of the acres on National Forest System lands). There are approximately 8 acres of late seral open canopied habitat within the project area. These areas have been salvage logged with other management in the past.

Environmental Consequences

Alternatives 1 and 3

Direct, Indirect, and Cumulative Effects

Where habitat presently exists, it would be expected to remain post implementation of any of the action alternatives. The existing 8 acres would be expected to retain habitat status post project, with no change to existing large tree and canopy closure in the short term. These areas would begin to lose this character as the planted trees mature, and canopy closure and tree density increases. The differences between alternatives for this species are negligible, as they would not change the short term characteristics of the existing habitat, or create habitat for this species. Long term, over 50 years or more, the action alternatives would be expected to convert some portion, or possibly all of the treatment acres, into a more closed canopied, multi-storied state, when the planted trees become more mature and canopy closure increases.

Since the action alternatives would only potentially affect 8 acres of this habitat type and would retain it where it presently exists, these alternative would not contribute immediately to adverse cumulative effects. They would contribute only slightly to longer term adverse cumulative effects to late seral, open canopied habitat as the planted trees mature, and canopy closure changes over time.

Current data at the rangewide, California, and Sierra Nevada scales indicate that the distribution of sooty grouse populations in the Sierra Nevada north of the Kern Gap is stable. Long term effects would not be large enough in magnitude to lead to a change in the distribution of sooty grouse across the Sierra Nevada bioregion.

Alternative 2

Direct, Indirect, and Cumulative Effects

Alternative 2 is expected to have no direct, indirect, or cumulative effects on the habitat or species.

MIS Habitat: Snags in Burned Forest Ecosystem Component (Black-backed woodpecker)

Affected Environment

The black-backed woodpecker was selected as the MIS for the ecosystem component of snags in burned forests. Recent data indicate that black-backed woodpeckers are dependent on snags created by stand-replacement fires (Hutto 1995, Kotliar et al. 2002, Smucker et al. 2005). The abundant snags associated with severely burned forests provide both prey (by providing food for the specialized beetle larvae that serve as prey) and nesting sites (Hutto and Gallo 2006).

The Power Fire burned in the fall of 2004, approximately half of the high tree mortality areas of the fire within the fire perimeter, on Forest Service lands, was salvage logged. Snag were retained in patches, both small and large, across the fire area and provided habitat for black backed woodpeckers. These areas continue to provide some level of habitat, but have greatly diminished in value for both foraging and nesting for this and other species as snags have fallen or broken off naturally through time, and the insect populations that the woodpeckers feed on have diminished over time within these stands. Black-backed woodpeckers typically colonize burned areas shortly after fire, but densities decline within 6–10 years (Siegel 2016).

Environmental Consequences

Alternatives 1 and 3

Direct, Indirect, and Cumulative Effects

The action alternatives would have little impact on the remaining habitat for this species, and no differences between the effects of the action alternatives would be expected. Most of the proposed activities would not alter the existing snags in burned forest habitat, with the exception of the mechanical site preparation treatments. Approximately 612 acres of low value habitat (remaining snags) would be reduced or removed by using mechanical equipment. The impacts of these activities would not be significant to the species or amount of available habitat, as the species prefers recently dead and not heavily decayed snags for nesting and foraging (Seavy 2012). Recent research indicates that black-backed woodpeckers may not abandon sites due to time since they burned, but are less likely to colonize sites that are too old (burned more than 6-10 years in the past) as the species populations shift across the landscape. An occupied site may cease to be occupied due to age related quality of the habitat, including decreasing snag density (Siegel 2014). The snags in the fire area are now over 10 years dead, and heavily decayed, reduced in size, height, and density as many have become downed logs. For these reasons little direct or indirect impacts would result from the treatment of remaining snags in the proposed units. The value as habitat of the snags remaining in the project area has decreased, so the likelihood of colonization has decreased, and so would not be impacted by these alternatives. For the above stated reasons, this project would add little to adverse cumulative effects for this species habitat availability or quality.

With the current and foreseeable wildfire activity in the Sierra Nevada, high quality habitat is being generated regularly. Recent salvage harvest projects have been retaining habitat, and addressing effects to this species and its habitat across the species range. The change in availability of highly decayed snags on 612 acres of burned forest within this project will not alter the existing trend in the ecosystem component nor will it lead to a change in the distribution of black-backed woodpecker across the Sierra Nevada bioregion, due to the low value of the habitat.

Alternative 2

Direct, Indirect, and Cumulative Effects

Alternative 2 is expected to have no direct, indirect, or cumulative effects on the habitat or species.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

No irreversible commitments of resources are anticipated to occur under any alternative. Continued mortality of planted and natural regenerated trees due to competition is an irretrievable commitment of resources under Alternative 2, No Action, and is described in more detail above in the Forest Vegetation section.

Legal and Regulatory Compliance

NEPA at 40 CFR 1502.25(a) directs “to the fullest extent possible, agencies shall prepare environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders.” The proposed action and alternatives must comply with following:

Principle Environmental Laws

The following laws contain requirements for protection of the environment that apply to the proposed action and alternatives:

Endangered Species Act

Refer to Botany, Terrestrial Wildlife, and Aquatic Wildlife Effects Sections.

Clean Water Act

Refer to Water Quality/Hydrology Effects Section.

Clean Air Act

Refer to Air Quality Effects Section.

National Historic Preservation Act

Refer to Cultural Resources Effects Section.

National Forest Management Act

All project alternatives meet requirements for the National Forest Management act through compliance with the 1989 Eldorado Forest Plan as amended by the 2004 SNFPA. Analysis of threats to Threatened, Endangered, and Sensitive wildlife and plant species were disclosed.

Executive Orders

The following executive orders provide direction to federal agencies that apply to the proposed action and alternatives:

Indian Sacred Sites, Executive Order 13007 of May 24, 1996

See Cultural Resources Effects Section

Invasive Species, Executive Order 13112 of February 3, 1999

See Botany Effects Section.

Recreational Fisheries, Executive Order 12962 of June 6, 1995

Fish and wildlife on the Eldorado National Forest are managed by the State of California Department of Fish and Wildlife, while habitat is managed by the Forest Service. Affects to aquatic habitat are discussed in the Aquatic Wildlife Effects Section.

Migratory Birds, Executive Order 13186 of January 10, 2001

A migratory bird report was developed for the project (Loffland, 2016). Though the project may in the short-term indirectly (loss of habitat or habitat components, disturbance) or directly (mortality) affect some species, the impacts will be site specific and not occur over the entire landscape at the same time enabling species to adjust and locate currently unoccupied territories for nesting or adjacent areas for wintering or foraging (Ibid).

Environmental Justice, Executive Order 12898 of February 11, 1994

This project would not disproportionately affect minority or impoverished persons. Conversely, the project alternatives would have a beneficial impact on these demographics from increased employment opportunities and economic benefits to the local community. Crews employed in tree planting and herbicide application are typically comprised of Hispanic employees.

Use of Off-Road Vehicles, Executive Order 11644, February 8, 1972

Through compliance with the Wheeled Motorized Travel Management Final Environmental Impact Statement (FEIS) (2008).

Special Area Designations

The Mokelumne River Canyon Archaeological District occurs within the project area. The effects to cultural resources, including those located within this Special Interest Area is discussed under the Cultural Resources section in Chapter 3. No direct or indirect effects to cultural resources are anticipated under this project.

Short-term Uses and Long-term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101). Long and short term effects of project activities under each alternative are described in the effects section specific to each resource. Under Alternatives 1 and 3, reforestation will enhance long-term productivity by restoring conifer forests and associated habitat for wildlife, and reduce carbon dioxide in the atmosphere by enhancing carbon sequestration in growing trees as discussed in the Climate Change section.

Unavoidable Adverse Effects

Implementation of any of the alternatives would result in some unavoidable adverse environmental effects. Formation of the alternatives and design criteria include avoidance of potential effects, although some adverse effects could occur that cannot be completely mitigated. The environmental consequences section for each resource area discusses these effects and selected resource effects are summarized below.

Smoke from pile burning and emissions from equipment would occur under alternatives 1 and 3, however both alternatives comply with air quality rules and regulations. Some soil disturbance could occur from piling and/or mastication activities, however implementation of BMPs and adherence to soil quality standards will minimize effects. Unknown occurrences of sensitive plants could be affected by project activities, although this will be mitigated by survey and will not result in loss of species viability. Alternatives 1 and 3 may affect individual wildlife or habitat however no alternative will lead to listing of sensitive species. The human health section discusses risks to workers and the public from use of herbicides and no significant effects are anticipated.

CHAPTER 4. CONSULTATION AND COORDINATION

Preparers and Contributors

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

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Distribution of the Environmental Impact Statement

This environmental impact statement has been distributed to individuals who specifically requested a copy of the document. In addition, copies have been sent to Federal agencies, federally recognized tribes, State and local governments, and organizations: U.S. Environmental Protection Agency (EPA, Region 9); Advisory Council on Historic Preservation; Natural Resource Conservation Service; National Agricultural Library; NOAA Fisheries Service; U.S. Coast Guard; U.S. Army Corps of Engineers; U.S. Navy; Department of Energy; Federal Aviation Administration; Sierra Forest Legacy; El Dorado County Supervisor; California Department of Fish and Wildlife; Washoe Tribe of Nevada and California; United Auburn Indian Community and Shingle Springs Rancheria.

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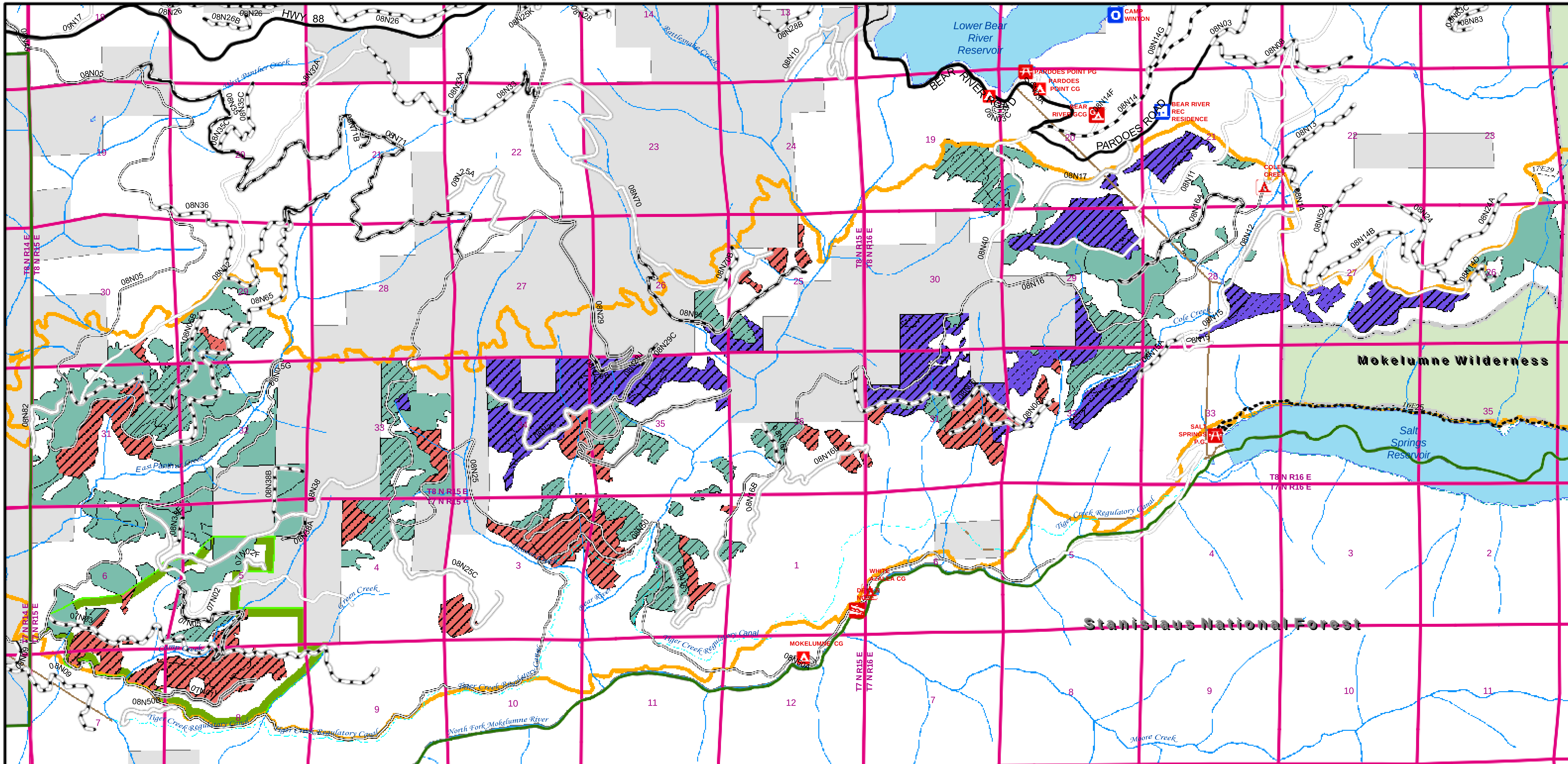
APPENDICES

A. Maps

B. Response to Comments



Eldorado National Forest

Amador Ranger District

Power Fire Reforestation

Site Preparation and Planting Area

Power Fire Perimeter

Oak Management Area

Site Preparation

Chemical

Mechanical

None

Planting

Inter-planting

Planting

Planting/Inter-planting

Areas with Adequate Tree Stocking

Release

Occurring on All Units

(symbology not displayed on map)

Waterbody

Perennial Stream

Intermittent Stream

Canal / Ditch

Pipeline

Section

Township
Eldorado National Forest

Non-National Forest

Wilderness

Administrative Boundary

MVUM Road Allowed Uses

Roads Open to All Vehicles, Yearlong

Roads Open to All Vehicles, Seasonal

Roads Open to Highway Legal Vehicles Only, Yearlong

Roads Open to Highway Legal Vehicles Only, Seasonal

State or US Highway

Other Public Roads

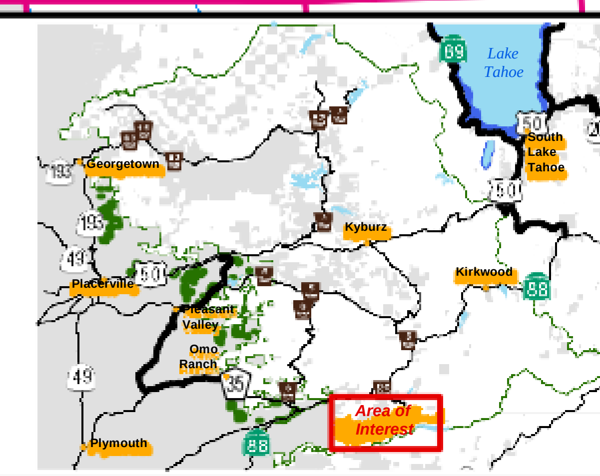
Non-Motorized Trail

0 0.5 1
Miles

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific data source dates and/or additional digital information contact the Forest Supervisor.

Eldorado National Forest
100 Forni Road
Placerville, California

This map has no warranties to its contents or accuracy.



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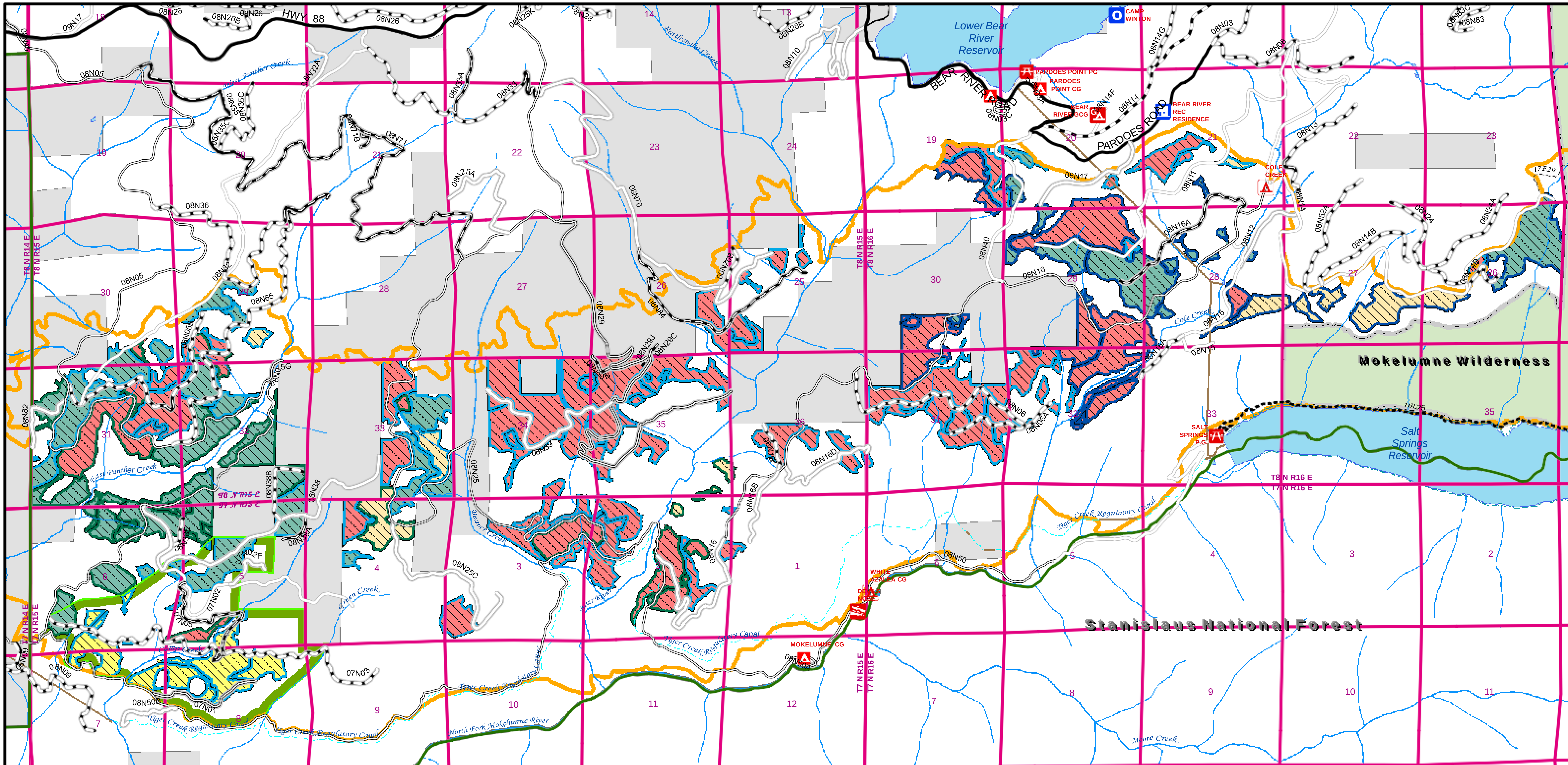


Eldorado National Forest

Amador Ranger District

Power Fire Reforestation

Proposed Action
Planting Arrangement and Release Method

Power Fire Perimeter
Oak Management Area

Planting Arrangement
A
B
C
Areas with Adequate Tree Stocking

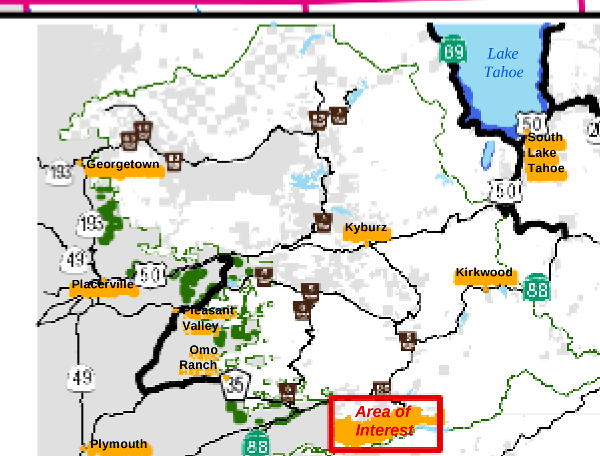
Initial Release
Area

Follow-Up Release
Area
Area/Radius
Radius

Waterbody
Perennial Stream
Intermittent Stream
Canal / Ditch
Pipeline
Section
Township
Eldorado National Forest
Non-National Forest
Wilderness
Administrative Boundary

MVUM Road Allowed Uses
Roads Open to All Vehicles, Yearlong
Roads Open to All Vehicles, Seasonal
Roads Open to Highway Legal Vehicles Only, Yearlong
Roads Open to Highway Legal Vehicles Only, Seasonal
State or US Highway
Other Public Roads
Non-Motorized Trail

0 0.5 1
Miles



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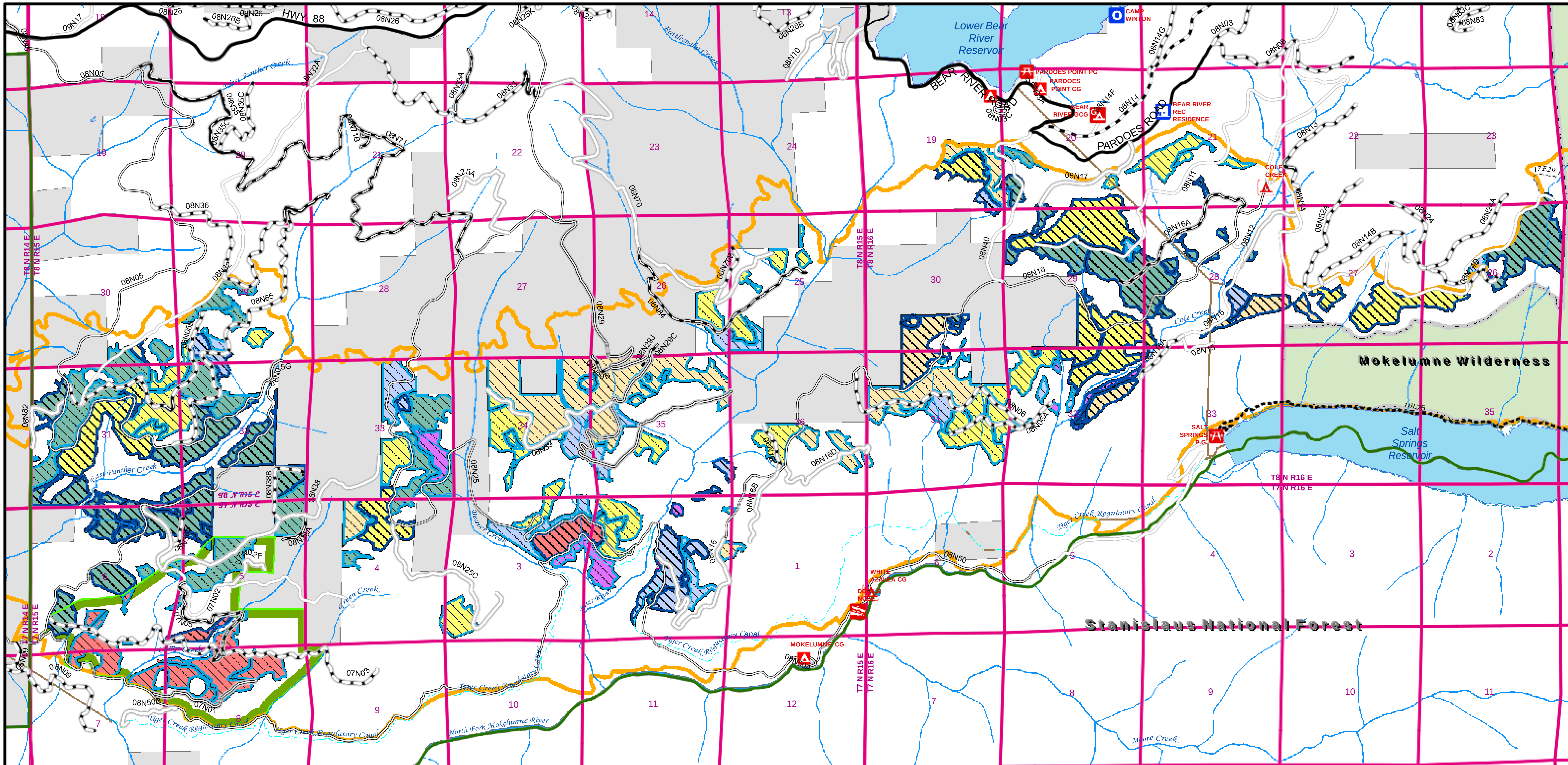
4/13/2017



Eldorado National Forest

Amador Ranger District

Power Fire Reforestation

Alternative 3

Planting Arrangement and Release Method

Power Fire Perimeter

Oak Management Area

Planting Arrangement

A

B

C

D

E

Areas with Adequate Tree Stocking

Initial Release

Area

Radius

Follow-Up Release

Area

Radius

Waterbody

Perennial Stream

Intermittent Stream

Canal / Ditch

Pipeline

Section

Township

Eldorado National Forest

Non-National Forest

Wilderness

Administrative Boundary

MVUM Road Allowed Uses

Roads Open to All Vehicles, Yearlong

Roads Open to All Vehicles, Seasonal

Roads Open to Highway Legal Vehicles Only, Yearlong

Roads Open to Highway Legal Vehicles Only, Seasonal

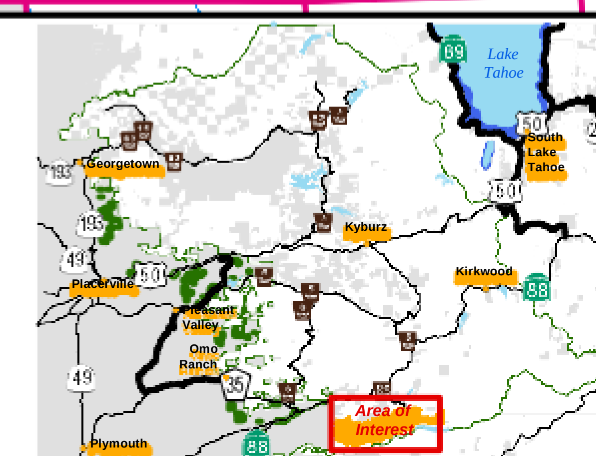
State or US Highway

Other Public Roads

Non-Motorized Trail

0 0.5 1

Miles



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4/13/2017

Appendix B: Response to Comments

The Environmental Protection Agency published a Notice of Availability (NOA) for the DEIS in the Federal Register on April 21, 2017. The 45-day comment period ended on June 5, 2017. In response to the Forest's request for comments, interested parties submitted six letters from organizations and individuals and one letter from United Auburn Indian Community of Auburn Rancheria. For tracking purposes, the interdisciplinary team assigned a respondent number to each letter as it was received. Forest Service direction requires that a Final EIS respond to substantive comments on the Draft EIS (FSH 1909.15, 25.1). Specific comments are within the scope of the proposed action, have a direct relationship to the proposed action, and must include supporting reasons for the Responsible Official to consider (36 CFR 218.2).

This Appendix contains the summary comment statements, organized by commenter and general topics shown below. Table 1 provides a listing of all commenters and their corresponding commenter number.

AL Alternatives
AE Alternatives Eliminated
AQ Air Quality and Climate
FF Fire and Fuels
HB Herbicides
PN Purpose and Need
RF Reforestation
SP Sensitive Plants
SC Society, Culture and Economy
VG Vegetation
WL Wildlife

Table 1. List of Respondents

Letter ID	Date Received	Name	Organization
1	5/2/2017	Artley, Dick	Interested Person
2	4/24/2017	Brink, Steve	California Forestry Association (CFA)
3	6/5/2017	Goforth, Kathleen	Environmental Protection Agency (US EPA)
4	7/11/2017	Micheau, Jill	Amador-Calaveras Consensus Group (ACCG)
5	6/5/2017	Thomas, Craig	Sierra Forest Legacy (SFL)
6	6/4/2017	Whitlock, Janet	United States Department of the Interior (USDI)

Alternatives

AL1. **Comment (Commenter 4):** Release treatment for both the Proposed Action and Alternative 3 rely primarily on additional application of herbicides. The ACCG agrees with district staff that prescribed fire is not applicable for site preparation activities but thinks that fire should be analyzed for follow-up treatments. Why was prescribed fire not included as a major component of reestablishing a forested landscape that is fire resilient? The action of returning fire onto the landscape of the project area should be at a minimum included in the final EIS at some time-frame post planting to show the supported efforts and universal goal to return fire on this landscape. Have other options been considered for follow-up treatment? Could prescribed burns, mechanical treatment, hand grubbing or cutting, or use of goats be used instead, matching the most effective methods to the type of vegetation, terrain, and appropriate time lapsed from initial treatment?

Response: *The Forest Service agrees that the reintroduction of fire is desirable at some point in the future to aid in fuel reduction, wildfire resilience, and ecological restoration. A recent study applying prescribed fire to plantations in the Sierra Nevada concluded that prescribed fire can be effective in reducing fuel and increasing wildfire resiliency (Kobziar 2009), however the plantations in the study were 25 to 30 years old, approximately 12" in dbh, with a height to live crown pre-burn of approximately 8 to 13 feet. Applying prescribed fire in the project area under the current vegetation conditions is likely to lead to extensive mortality of existing conifer regeneration where it exists.*

To apply prescribed fire without substantial tree mortality, the canopy base height must be sufficiently high to avoid initiation of a crown fire. In addition, the planted and naturally regenerated trees in the Power Fire area are less than ten years old and susceptible to death from cambium scorch due to thin bark. As the trees grow and age, the bark will thicken, particularly on Ponderosa pines.

This project is a necessary precursor to the reintroduction of fire in the future when trees are sufficiently large and the crown height above the shrubs sufficient to carry fire without substantial mortality to the conifer forest. Table 3FF.3 (FEIS p.103) in the Fire and Fuels section of the FEIS indicates that conditions suitable for the introduction of prescribed fire could occur when trees are approximately 20 years of age, or about 10 years hence under the proposed action.

The Forest Service has utilized other treatments such as hand grubbing in the current plantations. These methods have failed because brush and grasses consumed the limited water and nutrients and the seedlings died. Tree survival and growth are at continued risk of mortality due to high levels of competing vegetation as described the Purpose and Need for this project (FEIS pp.8-10).

AL2. Comment (Commenter 4): Would the Forest Service consider a combination of the proposed action and other alternatives that could be monitored and used to compare the differences between treatment types in terms of efficacy, fire danger, habitat enhancement, diversity, and invasive plant recruitment or eradication?

Response: *Thank you for your comment. The Responsible Official will consider your input.*

AL3. Comment (Commenter 5): <u>Effectively and efficiently establish a forested landscape.</u>
The Power Fire DEIS eliminated what was called the "No Herbicide" alternative. The elimination of our conservation alternative was based on mischaracterization and failure to legally address the content of our scoping letter. The alternatives dismissed from further consideration (DEIS p. 21) is an incomplete and arbitrary discussion of fragments of our scoping proposal, where developing "founder stands" and adding increased fire use in place of chemicals to achieve forest conditions that might have the possibility of surviving climate warming, periodic severe drought conditions and increasing high severity fire trends is rational and forward thinking.

We have added another component (see #3 above) including the use of one or more mulching masticator machines for short term (replanting) and longer-term maintenance of the site. This would aid in fire control and lower flame lengths, add mulch for soil and increase water retention, and be much more cost effective then the chemical treadmill you are considering.

Table 2.7 Stocking levels in the various planting arrangements are for the most part completely unrealistic based on fire and climate trends cited above. Evidently climate change denial has become the new defense of traditional silviculture.

The costs/ac and totals for the mix of 4 herbicides in DEIS Table 2.7, p.25 **is an astounding $4.5 million (Alt 1) and $5.5 million for Alt 3.** For that price tag, a couple of mulching machines and additional fire support crews could render the fire/shrub a non-issue for much less than the toxic soup you are planning to apply to this landscape.

Effective—NO, not likely and historically prone to failure time and again

Efficient—NO, not cost efficient, and considering the planting densities, the Forest Service will begin 25yr burn-salvage-plant-reburn-replant cycles into the future.

Response: *The proposed alternative has been added to the FEIS and addressed in Chapter 2 under Alternatives Considered but Eliminated from Detailed Study (FEIS pp.24-31). Refer to this section for the rationale.*

AL4. Comment (Commenter 5): Combining tools to reinitiate fire in 2017 (from biomass mulching machine manufacturer)

We propose you use Power Fire settlement funds to purchase a cost-effective alternative (a forest mulcher/masticator machine) instead of the chemical treadmill pathway the Forest Service seems intent upon in the proposed action. We invite you to view three mulching machines that would reduce brush fuels where need (where holding a first entry prescribed burn might be challenging).

http://www.bobcat.com/attachments/forestry-cutter/features

Turn trees and underbrush and overgrowth to mulch with the forestry cutter attachment.

Punch into large-diameter trees and bring the uppermost limbs quickly to the ground. The forestry cutter's tube-style drum and spiral tooth pattern allow one tooth to engage at a time, so operation is smooth and less horsepower is required to do the job.

The compact size of the forestry cutter allows for any type of removal job, turning unwanted material into a bed of mulch that slows growth and provides organic material.

Top Tasks

- Clear trees and brush for:
- Pre/post disaster mitigation
- Utility line and road right-of-way maintenance
- Site preparation
- Orchard and vineyard maintenance
- Cut firebreaks
- Clean lots
- Maintain property
- Fuel Reduction

Forestry Applications Kit

Designed to protect you and your investment in the toughest conditions, the forestry applications kit must be installed on the loader to operate the forestry cutter attachment. The exclusive forestry door protects you from flying debris and objects. Other benefits include ISO 3449 Level II Falling Object Protective Structure (FOPS) and debris guards for muffler, lights and hydraulic components.

http://www.advancedforest.com/ ← view link to see another shredder/mulching machine in action.

Below are two more examples of machines in forestry operations in the U.S.


*Note: these machines are more than ample to reduce the Power Fire shrub fields to a finely mulched surface cover that can easily burned or planted in. They can be used to control brushfields for planting and for maintaining areas after planting. They can also be used for fuel breaks and to support control line construction for future fire use.

Response: *Thank you for the suggestions. The Eldorado National Forest currently owns three masticators that are used forest wide. All are tracked, articulated arm type machines with either Fecon rotating drum heads or disc heads (each machine can use either type head).*

The machines are:

- *Kobelco 160 BR (small)*
- *CAT 321 D (medium small)*
- *Valmet 430 EXL (fairly large)*

The Amador Ranger District purchased two masticators and two chippers within the last two years using fire settlement funding. One masticator is a Bobcat T870 Tracked skid steer with a bobcat masticator head and other accessories. The other one is a Caterpillar 308 mini excavator with a Fecon 36 masticator head and a Rotobec grapple attachment and thumb. One of the chippers is a Brush Bandit 1590 XP remote controlled tracked model and the other chipper is a Brush Bandit 1390XP pull behind model.

The Eldorado National Forest also contracts as needed for additional mastication work. Purchases are governed by Forest Service procedures and equipment is selected to maximize applicability to a wide range of vegetative conditions and slopes. Mastication is part of the proposed action and Alternative 3 for site preparation.

AL5. Comment (Commenter 5): Re-stating our Conservation Alternative from our scoping letter of June 27, 2014:

Purpose

We are proposing a Conservation Alternative that should supplant the Proposed Action for the following reasons:

1) The activities suggested in the Proposed Action contradict and impede the intentions of the Power Fire Purpose and Need discussed above.

2) The activities in the Proposed Action ignore the best available climate science related to increased shifts in vegetation patterns, increased drought risk, increased risks to rare species, and increased fire extent and intensity from increased carbon emissions and warming;

3) The activities in the Proposed Action significantly increase the extent of homogenous stands of even-aged plantations that are not represented in any historic NRV metrics for the Power Fire landscape nor in design features in current policy documents such PSW-GTR-220; 4) The activities in the Proposed Action increase fire risk and threaten vegetation resilience by creating large, dense swaths of young trees with connected crowns.

5) The activities in the Proposed Action will impact ecological integrity of complex early seral forest structure, function and composition. Managing CESFs is not a passive or “no action” activity.

6) The Eldorado National Forest cannot support the notion that high intensity plantation forestry will ever create or replicate old forest species composition, structure or function on the areas chosen for planting. It is pure speculation that human beings can “create” old growth forests; and,

7) The Eldorado National Forest cannot support the Proposed Action with any evidence that repeating the past (high density plantations) over thousands of acres will create anything resembling a fire resilient forest that is ecologically healthy or rich in biodiversity.

Specific Actions to support Complex Early Seral Forest--Coarse Filter Components for Power Fire Reforestation

Definition

CESF is the stage of forest development following a disturbance in a mature forest that produces significant mortality, generally greater than 50 percent of the basal area. The death of over-story trees creates openings that allow other plants and tree seedlings to reoccupy the site. The CESF stage is characterized by high densities of snags, the development of shrub cover and other native post-disturbance vegetation, downed wood, and natural conifer regeneration. This stage can develop unassisted after natural ignitions managed for resource benefits, or after prescribed fire is reintroduced after the initial stand replacing event.

Desired Conditions

1. The percentage of the forested landscape that is complex early seral forest habitat is well distributed and within the range of natural variation for fire and other disturbance processes. Note: Ecosystem components for each forest type would be based on the best available science information.

2. The percentage of post-fire areas composed of high severity and moderate severity burned forest is within the range of natural variation to provide complex early seral forest habitat and forest heterogeneity (not including plantations that burn at high severity).

Ecosystem components for each forest type would be based on the best available science.

3. High severity patch sizes and the percentage of the post-fire area composed of larger high severity patches is within the range of natural variation to provide a range of patch sizes that will

support viable populations of wildlife that thrive in these habitats (i.e., black-backed woodpecker and other post-fire associated birds).

4. The duration of CESF stage is moderated only by forest type, site conditions, and appropriate disturbance regimes, and results in a biologically diverse progression of forest development.

5. Cavities for secondary cavity nesters are sufficiently abundant and well distributed to support birds and other animals that depend on them.

Objectives

1. The total amount of complex early seral habitat for each forest type has increased by X percent over 10 years and X percent over 20 years.

Note: Set values based on current condition and expected disturbance frequencies in the desired conditions for specific forest type.

2. Fifty percent of the CESF created in the first decade of the plan will be treated with prescribed fire in the second decade of the plan and consistent with the fire regime for the forest type.

Standards

1. Herbicide use to reduce competition with conifer seedlings, or reforestation shall not occur in areas that meet the desired conditions for complex early seral forest or are important to sustain wildlife.

2. No trees with green needles shall be removed during reforestation efforts (except hazard trees). This standard applies to all post-wildfire environments.

3. Snags and other fuels may be managed in strategic areas identified specifically to provide for firefighter safety as part of a landscape-wide and long-term prescribed fire program. Intensive planting in strategic fuels management areas is avoided.

4. Outside of strategic areas identified specifically to provide for firefighter safety as part of a landscape-wide and long-term prescribed fire program, no standing dead trees shall be felled or downed wood shall be piled and burned or otherwise removed from areas that meet the desired conditions for CESF or are important to sustain wildlife.

5. Do not reforest through rare plant populations and avoid planting in ways that will shade out these populations

6. Do not use herbicides on any hardwoods (oaks, dogwood, alder, cottonwoods) or rare plant populations.

Guidelines

1. Allow natural regeneration to occur within 2,000 feet of green forest. Seeds travel via many pathways including wind and animals and continues to occupy openings created by frequent fire.

2. When necessary, management of competing shrubs in replanted areas shall be limited to hand control or prescribed fire.

3. Planted trees occur in diverse groupings that encourage fire use in and adjacent to planted areas.

4. Beyond 2,000 feet and when natural regeneration is not occurring, reforestation is designed to create founder forests with small planted areas (<2 acres) of variable shape within a larger (10-acre) unplanted area.

5. Founder forests should utilize or culture existing (remaining) living trees as anchors for future regeneration.

6. Reforestation managers select areas for planting using heterogeneity principles including prioritizing areas on the landscape that have higher probability of increased shading, cooling or extended water retention.

7. When a wildfire or portions of a wildfire meet desired conditions, the Public Affairs Program will identify the benefits of disturbance to wildlife and biodiversity in press materials and on the forest's website.

Response: *Refer to AL3 response regarding the proposed alternative. Commenter's objectives, standards, and guidelines reflect disagreement with the desired condition and management direction described in the FEIS and contained in the Forest Plan. As such, these comments would be more relevant to discussion of Forest Plan Revision or other higher-level planning decisions. This project is consistent with existing planning guides and direction. Refer to Chapter 1 Desired Conditions (FEIS pp.8-10) and the Relevant Laws, Regulations, and Policy described in the Forest Vegetation section of Chapter 3 (FEIS p.107).*

Alternative Eliminated from Further Analysis

AE1. Comment (Commenter 5): We are generally disappointed in this business-as-usual traditional tree farming and chemical-dependent forestry approach and see little creativity or thoughtful use of the Power Fire Settlement funds for restoring this landscape. The failure to reintroduce fire early on in the initial post-fire period has limited some options for early fire use where control is an issue, but there are steps that could be taken to lessen risk and establish fire zones in conjunction with mechanical tools such as shrouded (mulching) masticator which should be considered as an alternative to the massive and costly chemical application in the proposed action. The shrubs which have captured much of the site are part of the natural recovery process and should be managed as part of early seral forest development. Note: we do not mean the No Action Alternative. We mean actively managing complex early seral forests with fire, not to speed up the transition out of this important early successional phase, but to embrace the ecological integrity which occurs therein.

The proposed clearing of significant areas to jump-start forest stand initiation proposes to lock in a regimen of chemical use and homogenous plantation tree protection that will undoubtedly call for intensive fire suppression for several decades. This plant-spray-pray strategy relies on a 25-year limiting of any disturbance to achieve a first commercial entry to thin the overstocked stands. These hoped-for thinned conditions will remain uniform, fire-and beetle prone and vulnerable to climate water stress for the foreseeable future.

Response: *Refer to AL1 and AL3 responses.*

Air Quality and Climate

AQ1. Comment (Commenter 3): According to the Draft EIS, site preparation activities for the proposed project would include mechanical and chemical treatment prior to planting on approximately 1,080 acres. The proposed mechanical methods include mastication and tractor piling and burning on approximately 630 acres. Such activities would result in emissions of air pollutants; however, the Draft EIS lacks any discussion of air emissions or their potential impacts on ambient air quality. This is a concern, particularly given that the proposed project is located in an area that is in nonattainment with National Ambient Air Quality Standards (NAAQS) for ozone and particulate matter of 2.5 microns or less. We note that the Clean Air Act is included on a list of statutes with which the proposed project would be required to comply (p. 194); however, that listing refers the reader to a nonexistent "Air Quality Section". Based on phone and email communications with Mark Young on May 26, 2017, it is EPA's understanding that Forest Service is aware of this omission and intends to correct it in the Final EIS.

Response: *Effects to air quality have been included in Chapter 3 of the FEIS (pp.40-45).*

AQ2. Comment (Commenter 3): Based on the above, we have rated all action Alternatives as Environmental Concerns — Insufficient Information (EC-2; see enclosed "Summary of EPA Rating Definitions"). We recommend that the Final EIS include a discussion of ambient air quality conditions, NAAQS, and the potential air quality impacts of the proposed action (including direct, indirect, and cumulative impacts) from all sources, including heavy equipment, pile burning, and other site preparation and management activities. Identify any measures that could mitigate such impacts, and specify those to which the Forest Service will commit. For example, EPA recommends that the following measures be considered:

<u>Fugitive Dust Source Controls</u>:

- Stabilize open storage piles and disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate. This applies to both inactive and active sites, during workdays, weekends, holidays, and windy conditions.
- Install wind fencing and phase grading options where appropriate, and operate water trucks for stabilization of surfaces under windy conditions.
- When hauling material and operating non-earthmoving equipment, prevent spillage and limit speeds to 15 miles per hour. Limit speed of earth-moving equipment to 10 mph.

<u>Mobile and Stationary Source Controls</u>:

- Minimize use, trips, and unnecessary idling of heavy equipment.
- Maintain and tune engines per manufacturer's specifications to perform at EPA certification levels, where applicable, and to perform at verified standards applicable to retrofit technologies.
- Limit unnecessary idling and ensure that equipment is properly maintained, tuned, and modified consistent with established specifications. The California Air Resources Board has a number of mobile source anti-idling requirements which should be employed (http://www.arb.ca.gov/msprog/truck-idling/truck-idling.htm).
- Prohibit any tampering with engines and require continuing adherence to manufacturer's recommendations.

The EPA’s General Conformity Rule, established under Section 176(c)(4) of the Clean Air Act, provides a specific process for ensuring that federal actions will conform with State Implementation Plans to achieve NAAQS. We recommend that the Final EIS include a discussion of the applicability of the General Conformity Rule to the proposed project.

Response: *Effects to air quality are included in Chapter 3 of the FEIS (pp.40-45). No storage piles, grading, or material hauling is anticipated for this project. Heavy equipment usage is anticipated to be limited to track or rubber tired masticators and/or tracked or rubber tired tractors for piling vegetation and debris as described for Alternatives 1 and 3.*

AQ3. Comment (Commenter 5): The Climate Change analysis is completely inadequate since it fails to address increasing fire trends cited in recent literature, including Region 5 ecologists (Miller and Safford 2017, Hurteau et al. 2014). It is these fire trends and tree mortality events (including significant tree losses in treated stands in the Southern Sierra) that work against the Forest Service reforestation theme of high density plantations that you think have a future. We request that the Forest Service disclose the level of plantation loss from fires, drought or neglect (below) since the past 30 years on the Eldorado National Forest.

Photo above: Penny Pines Balderston Plantation, ENF, planted in 1968. The pines are completely dead from drought and beetle kill. The stand, by any measure, at 50 years does not display any of the characteristics of a forest stand approaching old-growth forest characteristics, nor does it display any qualities of fire resilience.

Response: *Potential implications of climate change are included in the FEIS (pp.40-45) and it is acknowledged that increased potential for drought may in turn result in greater wildfire risk. The intent of the analyzed action alternatives is to get conifers established in an effective manner and set them on a trajectory that will make them more resilient to all disturbances including insect, disease and fire. The number of trees that are planted is based on reaching* *objectives of having adequate stocking as well as species diversity. The number of trees planted does not pre-determine future density of the stands, as shown by the approximately 1500 acres of plantations created by the Power Fire that have already been pre-commercially thinned to approximately 135 trees per acre. It is acknowledged that young conifer plantations are susceptible to fire mortality, however increased growth rates will lead to thicker bark and greater height to live crown which will increase survivability during a wildfire.*

Fire and Fuels

FF1. Comment (Commenter 5): Restore Fire to the Landscape

Restoration, by definition, cannot occur without restoring the primary natural disturbance process that shaped the area to be restored. In the mixed conifer forests of the Sierra Nevada, the primary disturbance process was frequent low-and-mixed severity fire. Therefore, the primary goal of restoring the Power Fire landscape should be to re-establish a frequent fire disturbance regime across the landscape (i.e., fire-landscape realignment) based on the Natural Range of Variation. Fire-landscape realignment would use site-specific fire return intervals appropriate to the vegetation type and GTR-220 principals (topographic and micro-site information) to develop a landscape-wide long-term fire and fuels management strategy. This approach is called out in your reports and appendices and recent research we have referenced in our scoping comment letters including the Power Fire Ecological Framework (Estes and Gross 2015), King Fire Appendices A and C.

In our King Fire scoping comments we asked that the restoration project provide a landscape-wide fire and fuels management strategy (i.e., create a fire-landscape realignment strategy) by:

(1) defining and prioritizing burn units based on proximity to communities and large-scale units that maximize the number of acres burned at the lowest cost; (2) defining fuel conditions that indicate burning is necessary and appropriate within burn units and within reforested areas; (3) defining natural and manmade fire breaks that will be used as unit boundaries; (4) defining the biotic and abiotic conditions under which each unit can and should be burned; and (5) the personnel required to implement the strategy based on the average annual number of burn days and fire frequency interval. We also asked that a non-significant forest plan amendment be proposed in the EIS to allow for unplanned ignitions to be managed for resource benefit.

A key part of the fire-landscape realignment strategy is to closely coordinate fire and planting to support holistic recovery. Holistic means fire use and silviculture are a fully integrated disciplines.

Response: *A landscape wide fire and fuels strategy is outside the scope of this project. The Power Fire Ecological Framework (Estes and Gross 2015) informed the development of Alternative 3. The separate Power Fire Fuels Maintenance Study (identified as a foreseeable future action on page 39 of the FEIS) is designed to re-introduce fire to areas within and adjacent to the 2004 Power Fire. The study encompasses approximately 4,000 acres and will improve knowledge of prescribed fire prescriptions and effects in highly variable post-fire forest stands that include regenerating trees and shrubs. The resulting data and findings will be used to guide future restoration efforts utilizing prescribed fire across the Sierra Nevada in* *similar vegetation types. Other activities outside the scope of this analysis are designed to fulfill the overall restoration of the Power Fire, including road maintenance, research projects, adjacent forest health projects, ethnographic study, bumblebee surveys, noxious weed treatments, native seed collection, bird monitoring, and watershed restoration.*

FF2. Comment (Commenter 5): The current failed model for post-fire tree plantations treats forests as if they are agricultural lands that must be manipulated to accelerate the production of the crop (conifers). At the same time, the FS is committed to protecting the crop investment from fire, regardless of the ecological or financial costs. This model is not congruent with modern understanding of the role of fire in maintaining fire-resilient, biologically complex forests containing many rare and diverse species of plants and animals, as discussed above. Restoring the process of regular fire return should be the primary goal for the Power Fire landscape.

Response: *Refer to AL1 and AL3 response.*

FF3. Comment (Commenter 5): We contend that the Forest Service relies on outdated information (McDonald and Oliver 1983 and others) regarding planting densities for reforestation. Two reasons are offered to support this contention: 1) Past authors did not consider the increased use of fire to manage reforested areas and the risks associated with dense plantations; and 2) The authors did not consider climate change impacts and climate warming and extended fire seasons. The likelihood of more fire and larger fires places increased risk to the uniform, homogenous structure associated with dense plantations.

Response: *Refer to response of alternative considered but eliminated (AL3).*

Herbicides

HB1. Comment (Commenter 4): Selection of herbicides:

a. Has the interaction of multiple herbicides over an area been tested or studied? Do they form compounds that would have harmful effects not anticipated when they are used separately? Where is the analysis of how these herbicides interact and breakdown when mixed?

b. Is there any research on the impact of these herbicides, either separately or in combination, on bee populations? Other species?

c. Has the Forest Service looked at the recently developed organic herbicides now being used commercially in the agricultural world? Would any of these work on the target species? What is the cost differential?

d. If these options have been investigated, can the Forest Service provide citations to relevant studies to support the selection of this mix of herbicides proposed in the EIS?

Response: *The FEIS has been updated to include a discussion on Synergistic effects of combining herbicides (FEIS p.146). 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). In general it anticipated that the effects of combining chemicals proposed for use would be additive and not antagonistic or synergistic.*

*As stated in the FEIS on page 143, "Cumulative effects can be caused by the interaction of different chemicals with a common metabolite or a common toxic action. With the exception of triclopyr and chlorpyrifos, none of the other herbicides have been demonstrated to share a common metabolite with other pesticides." The effects of the common metabolite TCP (*3,5,6-trichloro-2-pyridinol) *are discussed in the FEIS on pages 142-145, as well as in SERA Risk assessment for Triclopyr.*

Toxicity data for the proposed herbicides was not available for any bumble bee species, but toxicity testing and analysis was conducted on honey bees, and was used in this analysis as a close surrogate for both behavior and biology to give an indication of potential for impacts to western bumble bees (FEIS pp.200-201). This analysis was based on the SERA analysis, which concluded that effects to terrestrial invertebrates (honey bees were the species studied) are most likely to associate with the changes in habitat and food availability rather than direct toxic effects. The cumulative effect of the habitat alteration, of which the herbicide treatments would contribute, would be a reduction in the amount of foraging and nesting habitat for bumble bees into the future (FEIS pp.202-203). Direct toxicity impacts were analyzed for other species analyzed in the terrestrial BE/BA and no direct impacts would be expected to these species, but habitat changes resulting from the reforestation activities, of which herbicide used is a contributor, would favor late seral forest species, and reduce habitat quality and quantity for early seral MIS species.(FEIS p.188).

HB2. **Comment (Commenter 4):** Regarding the radial spraying of herbicides around whitethorn, manzanita, and deer brush:

a. The Proposed Action recommends additional follow-up ground application within an 8-foot radius of trees. Alternative 3 recommends a 5-foot radius. Please provide the literature that demonstrates a 5-foot radial treatment will be an effective means of release for the planting strategy proposed.
b. Is release/follow up treatment proposed as a one-time treatment post planting? Please clarify between the alternatives the number of release/follow-up treatments, and how they differ.

Response: *A 5-foot radius has been shown to be the minimum effective release in studies involving manual release. However as noted in MacDonald and Fiddler (2010), "a common theme among the three representative study areas was that larger plots, treated most often, yielded a statistical advantage in conifer growth over those in the control"*

As described in MacDonald and Fiddler (2010):

"Because roots of competing plant species rapidly extend into cleared areas and capture valuable site resources, the treated area must be large enough (preferably a 5-ft radius) for the conifer seedling to establish its root system unencumbered for at least the first year and usually for the first 3 years. Early treatment of competing vegetation is extremely important and the most cost effective."

MacDonald and Fiddler (2010) also state "A general rule of thumb is that competition is too much when the foliar cover of undesirable plants exceeds 10 to 20 percent on poor sites and 20 to 30 percent on good sites."

In Alternative 3, a 5 foot radius is anticipated to get conifer survival on newly site prepped and planted areas, however as noted in the FEIS page 126, "In site prepped and planted areas, shrub competition in the stands are likely to exceed 30% within two to three years and to continue to cause increased moisture stress resulting in reduced growth for conifer seedlings." Due to the wide spacing of trees, relatively small area treated, and the presence of highly competitive sprouting woody brush, it is anticipated that a 5 foot radius will not meet longer term objectives for tree growth and vegetation control for fire and fuels objectives.

There is a schedule of proposed treatments in the social and economic analysis section of the FEIS (FEIS pgs. 170-172).

HB3. Comment (Commenter 5): We are opposed to the use of herbicides coupled with dense tree planting for a multitude of reasons, all of which were provided in detail in our scoping letter of 2014. And although these issues are listed in the DEIS (pp. iii, 9), they are not explicitly addressed anywhere else in the document.

For example, the lack of data we cited in 2014 for certain toxicological endpoints and ecological impacts from the herbicides proposed for use have not been addressed in the DEIS, either in the document or its supporting references. Nor were the monitoring protocols disclosed that will be used to assess ecological impacts to biodiversity from the massive amounts of herbicide proposed for use in the project. These issues are summarized in our scoping letter, and repeated here:

The DEIS must provide the following in the analysis of herbicide impacts:

- Disclosure of the environmental impacts of the chemicals as they are applied in the field (as a formulation or mixture). The analyses provided in the DEIS reference the active ingredients only, and not the full mixtures.
- Disclosure with specificity, the environmental impacts of the degradants and secondary metabolites of the chemicals
- Include data for endocrine disruption at environmentally relevant (dilute) exposures as a toxicological endpoint, as this is the range in which effects have been observed
- Analyze the ecological effects to ecosystems from use of herbicides to manipulate vegetation, supported by citation and footnote, and not conjecture. The analysis must not be limited to toxicological effects analysis.
- Document the monitoring protocols and criteria, and data proof that herbicides are necessary to achieve the desired goals for project area.

Response: *The FEIS has been updated to include a discussion on Synergistic effects of combining herbicides (FEIS p.146). See response to HB1 above. In general, even if hazard quotients of herbicides were directly added to those of surfactants, the result would be hazard quotients still less than 1 for most scenarios. In other words risk of negative effects would be negligible or within an acceptable range.*

Metabolites are also addressed in response to HB1 as well as in numerous references provided in the FEIS section on Human Health (FEIS pp.132-149).

Effects on the endocrine system are explicitly discussed in each SERA risk assessment for the chemicals proposed for use as well as the Risk Assessment for NPE completed by Bakke, 2003.

These documents are specifically referenced in the FEIS and relied upon as the analysis of the effects for this project.

Effects to non-human resources from the use of herbicides can be found throughout the various sections in Chapter 3 of the FEIS (FEIS p.39). Effects on resources such as terrestrial and aquatic wildlife, botany and soils constitute the analysis on effects to the ecosystem and ecology from project activities.

As discussed in the Forest Vegetation section of the FEIS (FEIS pp.107-131), several criteria were evaluated to determine the need for herbicide use in the project area. Among these existing conditions that have been determined to make alternative treatments infeasible or not effective are the presence of bearclover/grass, high volume of woody brush including highly competitive species, and wild fire risk. Unit data were obtained from the stand records, fixed plot plantation surveys, and walk through exams in 2013 through 2015. Foliar cover of competing vegetation was based on ocular estimation taken from fixed plot or walk thru exams.

HB4. **Comment (Commenter 5):** Further, the DEIS does not demonstrate that herbicide use is necessary to achieve the purpose and need, and can be used only as a “last resort” when other methods have clearly failed, as required by the regional 1989 Vegetation Management for Reforestation EIS, ROD, p. 9. Clearly, there are other methods that have not been explored to obtain the goals stated for the area in the Purpose and Need. We have described just such an alternative, utilizing prescribed fire as the main management tool, in our scoping letter, p. 20-22, and in the discussion below. Such an alternative would result in considerable cost savings compared to the herbicide alternatives. These cost comparisons must be included in the final EIS.

Response: *See response to HB1 above for criteria used to document the need for herbicide use. As noted in Affected Environment of Forest Vegetation section of the FEIS (FEIS p.109), “competing vegetation has been manually grubbed or manually cut in many cases, numerous times.” In other words alternate methods have been used in the project area but have been shown ineffective at meeting the purpose and need as described for this project.*

In addition, an alternative considered but not in detail addresses the use of prescribed fire and can be found in the FEIS (FEIS pp.24-31). See also responses to AL1 and AL3.

HB5. **Comment (Commenter 1):** Power Fire Reforestation Project DEIS at pages 13, 14, 17, 20, 25, 42, 44, 56, 57, 58, 63, 97, and 105 tells the public you will apply a herbicide that contains glyphosate to vegetation in the Eldorado National Forest.

… Even casual exposure to glyphosate could kill and maim terrestrial wildlife, birds and will kill aquatic life with water concentrations of just a few parts per million.

… Many carefully designed studies link glyphosate to horrendous bodily harm. How will you be at ease with yourself over the rest of your life knowing you planted the cancer seed where families (including children) will camp or hike? Even haz-mat suits will not protect the people spraying the poison.

… Do you know the USDA has been cozy with the herbicide and pesticide manufacturers for decades? The glyphosate attachment to these comments will enlighten you.

… you propose to subject your forest visitors to a potent cancer-causing chemical (glyphosate) in spite of the massive amount of independent science conclusions explaining the dangers of exposure to this chemical. You prefer to rely on a single fraudulent study promoted by Monsanto (SERA). Please read the **Glyphosate 1 attachment** and you will learn the USDA has been a lap-dog for Monsanto for decades.

Request for changes to be made to the final EIS:

If it does not clearly indicate herbicides that contain glyphosate will not be used anywhere, at any time, for any reason I suggest you find a good attorney. You see, my letters to the editor to the Sacramento Bee will describe several articles above. …My letters will suggest the public contact you and ask why.

Failure to tell the public this chemical will **not** be applied to your forest leaves the door open for glyphosate application. This violates:

18 U.S.C. § 1001(c) because the Responsible Official relied on a single (emphasis added) research conclusion that glyphosate is safe made by a lab with possible ties to Monsanto (Syracuse Environmental Research Associates--SERA) knowing the research conducted by hundreds of independent scientists reveals glyphosate exposure may cause birth defects, miscarriages, premature births, cancer - non-Hodgkin's lymphoma and hairy cell leukemia, DNA damage, autism, irreparable kidney and liver damage, infertility, learning disabilities, ADHD and other neurological disorders (especially in children), mitochondrial damage, cell asphyxia, endocrine disruption, bipolar disorder, skin tumors, thyroid damage, decrease in the sperm count and chromosomal damage

40 CFR 1501.2 (b), 40 CFR 1502.16(a) and (b), and 40 CFR 1508.8(b) because Chapter 3 omits important environmental effect disclosures related to glyphosate research (i.e. glyphosate exposure is statistically correlated to birth defects, miscarriages, premature births, cancer - non-Hodgkin's lymphoma and hairy cell leukemia, DNA damage, autism, irreparable kidney and liver damage, infertility, learning disabilities, ADHD and other neurological disorders (especially in children), mitochondrial damage, cell asphyxia, endocrine disruption, bipolar disorder, skin tumors, thyroid damage, decrease in the sperm count and chromosomal damage cancer)

40 CFR §1508.27(b)(2) because the intensity discussion fails to discuss the degree to which the proposed action affects public health or safety.

The Apr. 21, 1997 **Executive Order No. 13045** because the Responsible Official does not ensure that this project will not disproportionately expose children to environmental health risks and safety risks.

40 CFR §1508.27(b)(2) because you will not discuss the degree to which the proposed action affects public health or safety in the FOIA intensity section.

Response: *The articles included in the Glyphosate 1 attachment have been reviewed and are addressed in Attachment 1: Artley Glyphosate 1_2017_Citations and Response included in the project file.*

The USFS human health and ecological risk assessment for glyphosate (SERA 2011), includes a lengthy discussion of the carcinogenic potential of glyphosate (Section 3.1.10) which was *incorporated into the Power Fire Reforestation Project by reference. The project specific risk assessment characterizes risk to the general public, including scenarios involving children to identify risks associated with the project to inform the decision, and to identify where design criteria may be warranted to minimize risk.*

Recently, the International Agency for Research on Cancer (IARC) Monograph Working Group determined that glyphosate should be classified as "probably carcinogenic to humans" (Guyton et al 2015). This recent decision was based on a review of existing studies and not on new research. The issue is a particular group of cancers called non-Hodgkin's lymphomas. The Guyton 2015 paper is only a summary of a longer paper that is in-press at this time.

In 1991, US EPA concluded that glyphosate should be classified as a Group E (evidence of non-carcinogenicity for humans) based on a lack of convincing carcinogenicity evidence and considering the criteria in EPA Guidelines for classifying a carcinogen. In a few months, US EPA will be releasing for public comment their preliminary human health risk assessment for glyphosate as part of their program to reevaluate all pesticides periodically (link to US EPA's glyphosate reevaluation docket - https://www.regulations.gov/docket?D=EPA-HQ-OPP-2009-0361).

The USFS human health and ecological risk assessment for glyphosate (USFS 2011), includes a lengthy discussion of the mutagenic and carcinogenic potential of glyphosate including non-Hodgkin's lymphoma (Section 3.1.10). Many of the key references used in Guyton (2015) and another recent, but more in-depth review (Schinasi and Leon, 2014) are discussed in the glyphosate risk assessment. The USFS risk assessment for Glyphosate is included in the project file which states:

> *"The nature of the available epidemiology data on glyphosate is addressed in the U.S. EPA/OPP (2002) assessment:*
>
> *This type of epidemiologic evaluation does not establish a definitive link to cancer. Furthermore, this information has limitations because it is based solely on unverified recollection of exposure to glyphosate-based herbicides.*
>
> *Based on an evaluation of the available animal studies as well as epidemiology studies, U.S. EPA/OPP (2002, p. 60943) classifies the carcinogenic potential of glyphosate as Group E, No Evidence of Carcinogenicity. Given the marginal mutagenic activity of glyphosate (Section 3.1.10.1), the failure of several chronic feeding studies to demonstrate a dose-response relationship for carcinogenicity, and the limitations in the available epidemiology studies on glyphosate, the Group E classification in U.S. EPA/OPP (1993a, 2002) appears to be reasonable."*

It has been USFS practice to defer to US EPA unless there is a compelling reason to do otherwise. At this point, there is not yet a compelling reason to adopt the IARC's classification since all the technical details are not yet available from IARC and since US EPA's and our analyses would indicate a different conclusion. As stated, a new risk assessment from US EPA is expected later this year which will undoubtedly consider the IARC's classification. If the US EPA accepts the IARC recommendation, then the USFS would consider an update to the *glyphosate RA and for purposes of existing NEPA documents, such a reclassification would be considered ‘new information’.*

Studies linking glyphosate to cancer, neurological diseases, and birth defects generally are for rates, formulations, or uses that are dissimilar to this project. Some of the websites refer to cellular level studies that are not applicable to real world exposure risks. Research conducted on whole organisms (e.g. rats, quail, etc.) using plausible exposure routes (e.g. dietary, direct spray) with glyphosate provide the best available science regarding risk from Forest Service applications. Whole organism studies have been conducted, have been reviewed by EPA, are included in FS risk assessments, and form the basis of our conclusions. The risk assessments and other information in this FEIS constitute best available science.

Guyton, Kathryn Z., et al. 2015. Carcinogenicity of tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate. Lancet Oncology. Published online March 20, 2015. http://www.thelancet.com/pdfs/journals/lanonc/PIIS1470-2045%2815%2970134-8.pdf. Accessed online on 7/15/17.

Purpose and Need

PN1. Comment (Commenter 5): Failure to meet Purpose and Need

DEIS p.6, The Purpose and Need to re-establish a fire resilient forest will not be met by the proposed action. Your claim that the fire return interval of 11-26 years is part of a low severity fire regime is actually a low-and-moderate severity system (Sugihara et al. 2006). The Forest Service will be suppressing fire within these proposed planted areas until time for a first commercial entry. The plantations will be dense, overstocked and very fire prone. Silvicultural practices in the Sierra Nevada show a history of tightly grown stands, a practice done to attain a commercially viable stem (an even-tapered bole) at roughly 25 years. This approach places all reforested areas at high risk to fire loss. (See Issue 3, DEIS p. iii).

It is arbitrary to ignore the fire and climate related loss of plantations on the ENF and elsewhere in the Sierra Nevada and continue to do the same thing over-and-over again and expect a different result, particularly with climate-fire trends showing increased risk in the future (Hurteau et al. 2014; Laing et al. 2017; Miller and Safford 2017; Schoennagel et al. 2017)

Response: *The FEIS has been clarified to reflect low to mixed severity fire regime (FEIS, p.8). The supposition that the plantations will be dense, overstocked, and fire prone is not supported. Unlike past reforestation practices, planting patterns and densities proposed in this project are tailored to reflect ecological processes, and a range of planting densities and treatments were analyzed in detail for this project. A wide range of prescriptions, including three distinct planting designs under Alternative 1 and five planting designs under Alternative 3 varying by slope position and desired future condition are proposed (see pages 14-17). Density and spacing between trees and groups would vary with the topography and landscape position. This planting density also took into account expected seedling mortality as well as oak buffers to ensure adequate conifer stocking to achieve desired future conditions.*

Contrary to the contention that all plantations are fire prone, of the 154,530 NFS acres burned by the Rim Fire, less than 20,000 acres were known plantations. Only 22% of these plantations *experienced high severity fire (Rim Fire Reforestation EIS, p. 255). Furthermore, based on past practices, it is reasonable to assume that the Forest Service will thin plantations in the future In areas planted within the Power Fire that had adequate survival and stocking, pre-commercial thinning has already occurred on approximately 1,500 acres.*

Reforestation

RF1. Comment (Commenter 5): Natural Regeneration and Providing a Seed Source using a "Early Cluster Planting Strategy."

Using and managing natural regeneration coupled with fire is also the most economical reforestation approach. We request a short (year 1-5) and longer (5-30 year) economic analysis to accompany the approach we describe here (i.e., "fire-natural regeneration-cluster plant-when needed") compared to other approaches.

In areas unlikely to have natural regeneration we propose using a cluster planting strategy to provide a seed source (i.e., actively plant clusters of seedlings) to allow natural regeneration to occur across the broader unplanted and seed source deficient landscape. Subjectively, we define areas unlikely to experience natural regeneration as those areas unlikely to have natural conifer regeneration within the next 20+ years. The best approach to a "cluster planting strategy" will require experimentation. However, the concept does not include planting at or over desired stocking levels across the landscape or the use of a pre-commercial or commercial thin to create heterogeneity. The following are founding principles of a cluster planting strategy::

a. Provide a seed source in seed deficient areas.
b. Only plant where natural regeneration is unlikely to occur within the next 20 years.
c. Plant in patterns that do not thwart fire use to manage site conditions into the future and do not result in even-aged forest conditions.
d. Define all areas greater than 1000 feet from a seed source as "unlikely to have natural conifer regeneration in next 20 years."
e. Implement cluster planting strategy: 1) in areas greater than 1,000 feet from a seed source; and 2) if there is no successful regeneration in areas greater than 500 feet of a seed source after 5 years.
f. In areas defined by item "e," plant 2-10 acre blocks on sites likely to support forest in the foreseeable future based on climate change models. Planted blocks should be of variable shape and key off of ecological conditions such as cold pool pockets and other features that support survival. The is an ecological condition guideline, not a tree spacing guideline.
g. Do not plant more than 20 percent of contiguous seed deficient polygons.
h. Planted blocks (Founder stands) are heavily managed for fire resilience with 25'-50' buffers of limited vegetation to secure successful survival.
i. 10-20 years after the initial wildfire prescribed fire and wildfire managed for resource benefits and forest recovery are used to maintain a functional natural system where the process (regular fire) governs vegetation recovery, creates heterogeneity, and maintains resiliency.

Response: *The planting densities proposed and analyzed in both Alternative 1 and 3 were based on multiple sources of information as well as the professional judgement of the*

Silviculturist. For both the action alternatives planting densities are generally lower than have been used in historical studies. For example, Oliver 1984 studied plantations that were established at 4 by 4 foot spacing and 6 by 8 foot spacing. Even after pre-commercial thinning in the study the widest tree spacing was 14 feet apart. In contrast, the majority of the planting in Alternative 1 would place clumps of trees at approximately 21 feet apart (FEIS p.14-17).

RF2. Comment (Commenter 5): In general, we are not supportive of any of the alternatives, but we find some aspects of Alternative 3 to be less objectionable because of the reduced density of tree planting and the reduced volume and extent of herbicide use. However, the DEIS suggests that Alternative 1 will be more effective at producing old-growth forest. We do not see or find any facts, data, or supporting evidence for this contention. NEPA requires the agency to "make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement" (40 CFR 1502.24).

If the plantation model as proposed in Alternative 1, the same method used by the Forest Service for decades, is effective at producing old-growth forests that are resilient to fire, we would see this achieved somewhere in California. Instead, what we see are more plantations burning up in larger than ever fires (Rim, King for example), plantations dying *en masse* from drought and bark beetle infestations (see pictures, Penny Pines Balderston plantation, above), and a continued trajectory of loss of old-forest ecosystems. We also see a continued decline in species diversity, loss of viability of rare, threatened, and endangered species, and increased fire hazard, as has been identified in the scientific literature for decades. If you can do so, please identify a plantation somewhere in California that is producing old-forest habitat and is documented to be fire resilient.

Response: *As described in the Forest Vegetation section of the FEIS (FEIS pp.107-131), projections of tree growth into the future were made using growth models. SYSTUM-1 small tree growth simulator (Richie and Powers 1993) was used to predict future growth and development of trees, forest attributes, and competing vegetation on a similar site to the Power Fire located on the Eldorado NF. SYSTUM-1 scenarios completed for the alternatives were mixed conifer types and mixed conifer/oak types. Projections beyond age 50 were made using the Forest Vegetation Simulator (FVS) (Western Sierra Nevada Variant) to estimate the age where average stand diameters reached 12 and 24 inches, and the age where canopy closure reached 40 and 60 percent. Results are shown in Table 3FV.4 (FEIS, p.119). Input was taken from the 50 year averages for diameter and height from the Raincoat road site, Windmiller site, Mt. Shasta study, and SYSTUM-1. Site index was set at Forest Survey Site Class 3 – 120-164 cubic feet per acre per year at culmination of mean annual increment, an average site for the project area.*

There is no dispute that early seral forest conditions, including plantations, are at risk from fire and that young plantations have been lost in wildfires, however of the 154,530 NFS acres burned by the Rim Fire, less than 20,000 acres were known plantations. Only 22% of these plantations experienced high severity fire (Rim Fire Reforestation EIS, p. 255). Furthermore, it is reasonable to assume that the Forest Service will thin plantations in the future. In areas planted within the Power Fire that had adequate survival and stocking, pre-commercial thinning has already occurred on approximately 1,500 acres.

The purpose and need for this project recognizes that the current plantations are at high risk of fire-related mortality due to their small size. Competing vegetation also greatly affects tree growth rates. Control of competing vegetation would increase conifer growth rates. Increased growth would accelerate the development of key habitat and old forest characteristics and reduce the risk of loss to wildland fire (SNFPA ROD, page 49). The most effective way to protect plantations and restore fire to the landscape in the shortest time is to increase the canopy base height and reduce ladder fuels by controlling competing shrubs, grasses, and forbs to encourage tree growth.

Contrary to the commenter's assertion that species diversity declines in plantations, Bohlman et al (2016) found native plant species richness following the Fred's Fire, Pilliken Fire, and Cleveland Fire on the Eldorado National Forest was significantly higher in planted areas where shrub cover was lower and planted trees successfully established than in untreated sites. Lower plant species richness was associated with higher shrub cover. In addition to planting and shrub removal, 96% of the treated plots in the two older fires also experienced some level of pre-commercial thinning, a common practice for planted stands exceeding 20 years of age. Their study on these three wildfires suggests that while retaining some shrub cover for post-fire habitat may be desirable, some level of shrub reduction does favor native plant richness and overall herbaceous cover.

50 year old plantations established after the Ice House fire on the Eldorado National Forest and managed with herbicides, and thinning, have survived fires and currently have trees over 24" dbh as shown in the photo below.

RF3. Comment (Commenter 2): Successful regeneration for the long term will be difficult within the Power Fire perimeter. I have a couple of questions that aren't explicitly covered in the DEIS that I think should be:

1) It's unclear whether or not the "clumpy" planting strategy can be successful. Providing more space for shrubs to immediately occupy the site will only lead to the shrubs dominating the clumps of seedlings.

2) There's no economics provided for the different tasks that will be necessary to end up with trees in the ground. Because of the amount of mastication, I would expect that total reforestation costs could easily exceed $2,000/acre. There's also no disclosure of where the money is coming from to pay for the project.

Response: *Both Alternative 1 and Alternative 3 use forms of "cluster" or "clumpy" planting. Generally, Alternative 3 proposes more trees in a given clump with clumps spaced further apart. It is acknowledged in the FEIS on pages 112-131 that the relationship between planting arrangements and release methods will result in brush cover that will not meet stated objectives for seedling growth or fire and fuels reduction. However, even with clumped planting, if enough area is treated effectively around seedlings, vegetation competition could be brought to an acceptable level.*

A detailed economic analysis with costs by treatment is included in the FEIS pages 169-171. Average cost/acre for Alternative 1 are $1,099 (FEIS pp.169-170) and for Alternative 3 are $1,346 (FEIS p.171).

Sources of funding for reforestation include Power Fire Settlement funding, grants, agreements, and appropriations. Once a decision is made for this project, funding will be sought for implementation of associated tasks.

Sensitive Plants

SP1. Comment (Commenter 5): In general, the language used to describe the design criteria proposed for sensitive plant populations appear to represent a departure from Forest Service policy and the operative requirements found in the forest plan, Forest Service handbook, and Forest Service manual. For one thing, there can be no discretionary sacrifice of known sensitive plant populations because they happen to intersect with a planned plantation unit. "*Calochortus clavatus* var. *avius* populations may occur at the direction of a Forest Service Botanist" (p. 42, an incomplete sentence). Is the intention to permit adverse impacts to known populations of this species? If so, this is expressly not allowed under the guiding forest plan.

Response: *An incomplete sentence on page 42 of the DEIS was edited to say: "Hand thinning of overgrown Calochortus clavatus var. avius populations may occur at the direction of a Forest Service botanist when the botanist has determined thinning would be beneficial to the population."(FEIS p. 23).*

The Botanical Design Criteria states that no reforestation activities would occur in Sensitive plant populations or unsurveyed potential habitat (FEIS pgs. 23-24). Under the proposed action and alternatives, plantations would not be established within Sensitive plant occurrences so there will be no effect to known sensitive plant populations (FEIS pp.110- 111). The Design Criteria would allow for hand-thinning in select Calochortus clavatus var. avius populations at the direction of a Forest Service Botanist. This would only occur in areas overgrown with *native shrubs if the Botanist determines it is necessary to improve habitat for the Sensitive species. Hand thinning for other purposes would not occur in Sensitive plant habitat.*

The relevant laws, regulations, and policy, as well as Forest Plan direction relevant to sensitive plant species is described in Chapter 3 of the FEIS under Botanical Resources and the Botany BE (FEIS pp. 61-69, Botany BE pp. 4-6). Forest Service Manual direction regarding the management of sensitive plant species states that the Forest Service should avoid or minimize impacts to species whose viability has been identified as a concern… If impacts cannot be avoided then the Forest must analyze the significance of the potential adverse effects on the population or its habitat within the area of concern and on the species as a whole. Impacts may be allowed but the decision must not result in a trend toward federal listing (FSM 2670.32). Effects analysis/professional experience (FEIS p.61-69) indicate the impacts to sensitive species from the proposed project will be minimal, it is worth clarifying that the statement that "discretionary sacrifice of known sensitive plant population" would be a departure from the Forest Plan or Forest Service Policy is inaccurate.

SP2. **Comment (Commenter 5):** *Calochortus clavatus var. avius* is of concern because this rare species is in decline throughout its range primarily due to even-aged forestry, grazing, off-road vehicle traffic, and fire suppression. The Power Fire has increased suitable habitat for this species, but reforestation activities--site prep, planting, and herbicide use—will offset these improvements.

The Sierra Nevada Forest Plan Amendment directs the agency to minimize or eliminate direct and indirect impacts from management activities on threatened, endangered, proposed and sensitive plants ("TEPS") **unless** the activity is designed to maintain or improve plant populations (SNFPA Standards & Guidelines, Vol. 1, p. 366). This standard was affirmed on November 18, 2004 by the Chief of the Forest Service during his review of the SNFPA appeals decision made by the Regional Forester.

Since many TEPS plants are dependent upon fire for their long-term viability, any actions that destroy potential TEPS habitat in the post-fire environment, or that will result in permanent elimination of post-fire habitat (such as reforestation), would not follow this direction. The post-fire habitat must be evaluated with the assumption that new TEPS plants not previously known to occur in the area have now made their appearance. Long dormant seeds could easily be triggered to germinate after the fire and by now, have almost certainly established new populations.

Response: *Much of the project area was surveyed immediately following the fire (FEIS, p. 62). These surveys were properly timed (early spring/summer) and had the greatest chance of detecting new sensitive plants before early seral vegetation became established limiting the ability of surveys to detect species like Calochortus clavatus var. avius in the post fire landscape. Since 2005 additional surveys have been conducted in the project area for various projects and have documented additional sensitive species. While no survey effort can completely rule out the possibility of undetected populations, the survey coverage was consistent with standard efforts and adequate for the proposed project to evaluate potential impacts to Sensitive plant species dependent upon fire for long-term viability. The Botanical analysis acknowledges that some impacts to unknown Sensitive plant occurrences could occur* *from reforestation activities but impacts to known populations should be adequately prevented by design criteria (FEIS pgs 23 and.62).*

SP3. Comment (Commenter 5): The EIS makes no reference to surveys conducted explicitly in preparation for this EIS and its implementation, and the analysis appears to rely on historical records. Failing to survey the project area for plants and animals prior to EIS analysis is a departure from long term Forest Service policy and the requirements found in the forest plan, FSH (2609.25) and FSM (2670).

Response: *The Botanical BE does reference surveys (p. 14 Botanical BE) including ones that were completed in preparation for the EIS. However, the list of surveys in the BE was not complete and has been updated based on public comments. Much of the Power fire project area was surveyed for Sensitive plant species in the spring and summer of 2005 following the fire. These original surveys documented all species noted by crews within the targeted survey areas. Additional project specific surveys also occurred in 2012, and 2013 specifically targeting potential habitat for newly added sensitive plant species that were not covered during the original botanical surveys. These surveys were properly timed to detect the targeted species but were not floristic in nature, focusing only on identifying targeted Sensitive plant species (FEIS pp.61-65).*

SP4. Comment (Commenter 5): Fire suppression has contributed to widespread declining numbers of species that require fire for regeneration and maintenance. The prevalence of uniform, densely planted tree plantations managed with regular herbicide applications, and which will require active fire suppression, also contributes to loss of habitat for species that require regular fire. This is a cumulative impact that was not addressed in the DEIS.

Response: *The supposition that the plantations will be uniform, dense, and fire prone is not supported. Unlike past reforestation practices, planting patterns and densities proposed in this project are tailored to reflect ecological processes, and a range of planting densities and treatments were analyzed in detail for this project. A wide range of prescriptions, including three distinct planting designs under Alternative 1 and five planting designs under Alternative 3 varying by slope position and desired future condition are proposed. Density and spacing between trees and groups would vary with the topography and landscape position.*

The contention that plantations contribute to loss of habitat is similarly unsupported. Bohlman et al (2016) found native plant species richness following the Fred's Fire, Pilliken Fire, and Cleveland Fire on the Eldorado National Forest was significantly higher in planted areas where shrub cover was lower and planted trees successfully established than in untreated sites. Lower plant species richness was associated with higher shrub cover. In addition to planting and shrub removal, 96% of the treated plots in the two older fires also experienced some level of pre-commercial thinning, a common practice for planted stands exceeding 20 years of age. Their study on these three wildfires suggests that while retaining some shrub cover for post-fire habitat may be desirable, some level of shrub reduction does favor native plant richness and overall herbaceous cover.

SP5. **Comment (Commenter 5):** No reference was made in the botany BE to completion of any floristic surveys. A floristic survey is one in which all plant species seen are identified and reported in the documentation of the survey. This is the only means to ensure that rare species will not be missed. Surveying should take place in the spring and early summer.

Response: *See response to comment SP3.*

SP6. **Comment (Commenter 5):** The ENF must design the proposal to **maintain or improve** sensitive plant habitat and known populations for long-term viability as required by the forest plan.

Response: *Forest Plan standards and guidelines applicable to botanical species is described in the FEIS (pp. 61-65) and in the Botany BE (pp. 5-6). "In the Eldorado National Forest LRMP (USDA FS 1989), under Management Practice 49, the General Direction is to "provide for protection and habitat needs of sensitive plants so that Forest activities would not jeopardize the continued existence of such species". It is reiterated several times in the LRMP that "sensitive plants will be managed to insure that species do not become threatened or endangered because of Forest Service actions" (Botany BE, pg. 5).*

The proposed action and alternatives were designed to maintain or improve sensitive plant habitat and known populations for long-term viability. Design criteria to minimize the potential for impacts to sensitive plants were incorporated into the proposed action and alternatives (FEIS p. 22-23). Properly timed surveys were conducted throughout much of the project area, all known sensitive plant populations would be flagged and avoided during project implementation, and potential habitat will also be flagged and avoided during reforestation activities unless areas has been surveyed for Sensitive plants. Additionally manual removal of competing vegetation may occur in select Calochortus clavatus var. avius populations that have become overgrown with native vegetation with the intention of temporarily improving habitat condition for the species.

The Botanical analysis acknowledges that some impacts to unknown Sensitive plant occurrences could occur from reforestation activities but impacts to known populations should be adequately prevented with implementation of Design Criteria. (FEIS pp. 22-23)

SP7. **Comment (Commenter 5):** For species associated with fire such as *Calochortus clavatus* var. *avius*, prescribed fire in known, occupied sensitive plant habitats within the project area will probably never be conducted if the rare plants are isolated in a sea of conifer plantations. This is an outcome that is directly related to the proposal, but was not analyzed in the DEIS. A fresh look should be taken to ensure the long-term viability of these populations using regular prescribed fire, beginning now and included as part of the proposed action in the planning for this project EIS.

Response: *See response comment above for SP6, AL1 and AL3.*

SP8. **Comment (Commenter 5):** T he DEIS and Botany BE discussed the impacts of site preparation and herbicide use in known sensitive plant populations, but the conclusions made are not congruent with existing forest direction for maintaining and improving sensitive plant habitat. The Botany BE states: "Given the lack of data needed to take a proactive management approach to these sensitive plant species, the best available interim management approach is to minimize impacts to known occurrences while allowing expansion into suitable unoccupied habitat" (Botany BE p. 15). Obviously, allowing a plantation installation within a sensitive plant population is not "allowing expansion into suitable unoccupied habitat." The EIS needs to fully disclose upfront the fact that plantations are not suitable habitat for any single known TEPS species that occurs or might occur in the Power Fire project area.

Response: *Design Criteria included in the project state that known Sensitive plants and unsurveyed potential habitat will be avoided during project implementation (FEIS p.22-23). The Forest does not intend to establish plantations within Sensitive plant populations or potential habitat. The effects section of the FEIS (p.70) and botanical BE (pp.24-28) describe the potential adverse impacts of establishing and maintaining plantations for Sensitive plant species. Because plantations are not suitable habitat for ENF Sensitive plant species, design criteria excluding the establishment of plantations in known Sensitive plant populations and unsurveyed potential habitat were included in the project.*

SP9. **Comment (Commenter 5):** In addition, grazing livestock in known populations of *C. clavatus* var. *avius* should be eliminated. The DEIS reports that the use of herbicides and other types of clearing will increase access to the project area by grazing livestock (p. 61). Cumulative effects such as these resulting from the Power Fire Reforestation Project that have the potential to negatively impact this species, as described in the DEIS, will be in violation of the governing forest plan, as well as requirements of NEPA at CFR 1502.16 (h).

Response: *Eliminating potential impacts from grazing following project implementation is outside the scope of the FEIS. There are currently no impacts noted for any of the Sensitive plant species known in the project area from cattle, but if future impacts from cattle grazing are detected, mitigation measures described in the Bear River Allotment Management plan would be followed including, changes in livestock management such as herding practices, modifying salting or watering locations, or placement of barriers and fencing to restrict livestock access to sensitive plant sites (Bear River Grazing Allotment Management Plan Purpose and Need and Proposed Action, dated December 11, 2015). It is expected that future corrective actions under the Bear Allotment would sufficiently avoid or minimize impacts to species whose viability has been identified as a concern (FSM 2670.32) within the project area.*

Forest plan direction that pertains to botanical resources is described in the FEIS (pp. 62-63) and the Botany BE (pp. 5-6). Under 40 CFR 1502.16(h), the environmental consequences section shall include discussions of, "Means to mitigate adverse environmental impacts (if not fully covered under §1502.14(f)). Design criteria were incorporated into the proposed action and alternatives to minimize the potential for effects and avoid significant effects to sensitive plant species (FEIS pgs. 23 and 74).

SP10. Comment (Commenter 5): The agency lacks sufficient data to conclude that there will not be significant impacts to *Calochortus clavatus* var. *avius*, or the means to mitigate them, as required under 40 CFR 1502.1, 1502.16 (h), and 1502.24.

Response: *The Botanical Resources section in Chapter 3 of the FEIS and the Botany Biological Evaluation/Assessment (BE) describes the methodology, effects analysis, and summary of effects leading to the conclusion that there will be no significant effect to Forest Service sensitive plant species, including, Calochortus clavatus* var. *avius (FEIS, pgs. 61-69, and Botany BE pgs. 13-36).*

Under 40 CFR 1502.1, The purpose of an EIS "….It shall provide full and fair discussion of significant environmental impacts and shall inform decision makers and the public of reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment…." Under 40 CFR 1502.16(h), the environmental consequences section shall include discussions of, "Means to mitigate adverse environmental impacts (if not fully covered under §1502.14(f)). The Botanical Resources section in Chapter 3 of the FEIS (pgs. 61-69) and Botany BE (pages 15-37) discloses the environmental impacts to Forest Service sensitive plant species, including Calochortus clavatus var. *avius and provides the rationale for the conclusion that the potential for effects to Forest Service sensitive plant species is minimal and not considered significant under any of the alternatives. Design criteria were incorporated into the proposed action and alternatives to minimize the potential for effects and avoid significant effects to sensitive plant species (FEIS pgs. 23 and 69).*

Under 40 CFR 1502.24, "Agencies shall insure the professional integrity, including scientific integrity, of the discussions and analyses in the EIS. They shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement…" The methodology used for botanical resources can be found in the FEIS (pgs. 61-69 and 74) and Botany BE (pgs. 13-24) and describes the analysis assumptions, survey and life history information, and the spatial and temporal boundary for analyzing the effects to the sensitive plant species that have known occurrences or potential habitat in the project area.

Society, Culture and Economy

SC1. Comment (Commenter 4): We find the economic and social analysis to be short on detail. We would like to see clear analysis showing projections for increased local jobs, local benefits, and levels of expenditure and remuneration – values that ACCG seeks for the community we serve. We believe that the regional Forest Service office may have the expertise and resources to assist with developing this analysis. We suggest that the number of family-wage jobs is more important than the number of jobs generated. We suggest that the District request assistance from the Region in conducting a full economic analysis as the Region has the socio-economic expertise.

Response: *The FEIS has solicited input from the Regional Office staff. Anticipated employment and a discussion of employment benefits has been added to the FEIS (pgs 167-172). The jobs generated for this type of project are typically forestry laborers and crew supervisors. Jobs typically will be seasonal rather than permanent, and work is expected to continue for the approximately five years of implementation.*

Vegetation

VG1. Comment (Commenter 5): The DEIS states (p 97): "There will be no direct effects to approximately 10,140 acres in the analysis area where activities are not proposed. These are primarily snag patches left unharvested (160 acres), portions of pre-existing plantations that survived the Power Fire (75 acres), and areas that burned at low intensity during the Power fire (260 acres within the project units and 500 acres outside of project units)."

These numbers add up to 995 acres, not 10,140 acres. What is the status of the other 9,145 acres that you state "are not proposed for treatment." Is this all native forest that burned, but has not been clearcut or salvage logged, nor converted to uniform plantations? Is it complex early seral forest, in other words, are legacy components intact and the acres undergoing natural succession? If so, this area should be included for management under the Conservation Alternative we proposed in our 2014 scoping letter, and further described below. Naturally regenerating forests are among the rarest types of ecosystems in western forests (see our comments in scoping), and if this is the status of the 10,140 acres, it should be stated up front. This is important to understanding the cumulative impact of the project across the entire 17,005 acres of the Power Fire.

Response: *The breakdown of the 10,140 acres in the silviculture report was inaccurate and included in error and has been removed from the revised report and FEIS. See the new section on pp.1-4 of the FEIS.*

VG2. Comment (Commenter 5): <u>Plantations and Biodiversity</u> We again ask that you refer to the recent reforestation report titled 2012 Inventory and Monitoring of Current Vegetation Conditions, Forest Stand Structure and Regeneration of Conifers and Hardwoods within the Fred's Fire Boundary (Bohlman 2012).

In Ms. Bohlman's effort to determine potential seed source distances for natural regeneration she offers a caution regarding plantation forestry and the loss of biodiversity, "Plantations can drastically alter biodiversity levels and the presence of spatial heterogeneity that would otherwise naturally develop during forest establishment," citing to Carnus at al. 2016.

The same holds true for plantation establishment during a changing climate, "Attempting to return landscapes to a given historical state is unlikely to create either resilience under current and future conditions or socially desirable outcomes" (Franklin and Johnson 2012).

We reiterate, there is another path available that is largely consistent with the recommendations in the Power Fire Ecological Framework (Estes and Gross 2015) which includes an ecological site-driven reforestation strategy relying on far less traditional over-stocking, chemical use, more fire--earlier on--and a thoughtful use of the Power Fire Settlement Fund in a way that enhances ecological integrity, creates jobs, saves money and returns large-scale fire use in this landscape. The current proposed action seeks to force forest evolution out of early seral conditions and into homogenous, fire prone plantations on the unproven theory that these stands will achieve old forest condition sooner. Given the likelihood of increased fire activity due to climate warming and increasing high severity fire patches, it's not realistic to think that the proposed action will achieve anything other than another opportunity to repeat the same broken cycle.

A better, creative approach is needed for the Power Fire Landscape (and anywhere else in the Sierra Nevada) given the climate and fire projections, and given improved ecological understanding via GTR-220 heterogeneity/topography approaches, one which is driven by site conditions and opportunities for developing "founder stands" which are heavily tended and coincide with early establishment of a natural fire frequency. It is also time to recognize the long history of past failures (Rim fire, King Fire, Southern Sierra Tree Mortality) must lead to a change in restoration approaches.

Response: *Refer to responses AL1, AL3, AL5, FF1. The Power Fire Ecological Framework (Estes and Gross) was used to develop the reforestation strategy of Alternative 3. Alternative 3 represents a departure from "traditional" silviculture practices by planting fewer trees per acre in varying arrangements as well as relying much more on radial chemical release methods.*

Wildlife

WL1. Comment (Commenter 5): The idea that the proposed action's plantation strategy will "produce spotted owl habitat more quickly" (DEIS, p. 6) than other approaches is profoundly speculative given the current reality of climate change, increasing high severity fire trends and water deficit conditions in the Sierra Nevada (Hurteau et al. 2014; Laing et al. 2017; Miller and Safford 2017; Schoennagel et al. 2017). The DEIS citation to the 2004 Framework ROD p.6, is ecologically obsolete in that it ignores the last 13 years of large fire history and the number of acres of plantations lost in fires on the Eldorado NF such as the Cleveland Fire (1992); Fred's Fire (2004); King Fire (2014). We know of no location where this transition from homogenous plantations to ecologically complex, old growth forest has actually occurred.

Response: *The proposed action was designed through an interdisciplinary team process, and one of the goals identified early on within the Power Fire area has been to replace some of the lost CA spotted owl foraging habitat (i.e. forested habitat with 50% canopy closure, and average stand diameter of 12" dbh or greater, faster than would be achieved through natural stand development.*

As was discussed in the wildlife analysis for the proposed action: "Planting arrangements A and B would not be expected to develop high quality habitat as the desired tree stocking would not result in closed canopied, multi-storied stand. Planting arrangement C similarly would not be expected to develop into suitable habitat, except at the highest end of the desired stocking level of 90-100 trees per acre. Only a portion of this arrangement is likely to achieve that stocking. For this analysis 40% of the acreage (245 acres) is assumed to provide some level of suitable habitat in the future. Most of Planting arrangements D and E (275 acres combined) should provide long term foraging habitat, and arrangement E is the most likely to develop spotted owl and goshawk nesting habitat character and maintain it over time. (FEIS p. 187)."

These planting arrangements, and the effects analysis were developed through lengthy discussions between interdisciplinary team members, and relied heavily on the expertise of the project silviculturist and wildlife biologist. As was acknowledged in the FEIS (p.14-18), not all of the planting arrangements were expected to, or designed to, replace long term habitat losses *that occurred during the Power Fire. But planting arrangements D and E were thought to be the best strategy to put the stands on the desired trajectory.*

WL2. Comment (Commenter 5): Mule deer: The MIS analysis for mule deer is incomplete, as it only discloses impacts to oak discussed in the context of activities planned in 35 acres of oak habitat. There is no disclosure of the amount of deer habitat within the project area, the results of current population monitoring, and trends for the deer herd(s) in the project area. There is no discussion of impacts to deer from mechanical and herbicide release on approximately 4,000 acres of the project area. It is not possible to evaluate impacts to mule deer from the proposal in the absence of these fundamental data. Further, the use of prescribed fire as we propose in the Ecological Integrity Alternative (see scoping letter) would greatly enhance deer forage. This needs to be evaluated in the EIS.

Response: *Mule deer are analyzed in the project MIS Report. Management Indicator Species (MIS) for the Eldorado NF 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 1 of the report. The MIS species selection, and habitat to be analyzed for the species is described in the report, and the 35 acres of habitat (montane hardwood or montane hardwood conifer CWHR types) that met these specifications was analyzed for project impacts in the MIS report, including proposed thinning, oak pruning and chemical and hand releases. Habitat status and trend, population status and trend are discussed for this species, and the impact of the project on bioregional-scale mule deer trends was analyzed for the action alternatives. (FEIS pp 206, MIS Report pp 20-23)*

As relates to the use of prescribed fire as an alternative treatment, see alternatives considered but eliminated from detailed study (FEIS, pp. 24-30).

WL3. Comment (Commenter 5): Mountain quail: The analysis is deficient for the same reason, data are provided for mountain quail at the Sierra Nevada regional scale, with no information provided relative to the Power Fire area. Lack of survey data suggests that no valid conclusions can be made about impacts to mountain quail from the project, other than to say the net effect will be harmful, since destruction of the shrubs and other hardwood species in the early seral ecosystems now found in the Power Fire area, and targeted for conversion to uniform plantations with no understory, is obviously a negative impact for mountain quail, mule deer, fox sparrow, and any other species that is dependent upon healthy, post-fire early seral forest habitat. Again, analysis of the Ecological Integrity Alternative we have proposed is a requirement to meet goals for viability for these species and to fulfill NEPA's requirements for a range of alternatives:

NEPA requires agencies to "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." Surfrider Foundation v. Dalton, 989 F. Supp. 1309, 1325 (S.D. Cal. 1998), aff'd., 196 F.3d 1057 (9th Circuit 1999) (quoting 42 U.S.C. § 4332 (2)(E)). The courts have ruled that setting up a "No Action" alternative as a straw man does not meet the requirements for alternatives assessment under NEPA. Oregon Natural Desert Association v. Singleton (D.Or. 1998) 47 F. Supp. 2d 1182).

Response: *As was discussed above for mule deer, impacts from the project for mountain quail (and fox sparrow) are disclosed in the FEIS (pgs. 206-208 and 204-205) and the project MIS report (MIS Report, pp 23-25 and 18-20), and includes a discussion of effects to the species distribution and habitat and trends.*

Avian monitoring in the Fred's and Power Fire area conducted by Point Blue Conservation Science found that reforestation had a positive effect on early successional bird species ($P < 0.001$), indicating that even when taking salvage logging into account, planting trees may have resulted in increased abundance of some early successional birds (Fogg et al. 2015). Patterns were similar for species richness. The report suggests that planting trees where natural regeneration was poor may offer more habitat structure for nesting and foraging.

In regards to the requirements for alternatives, under the CEQ regulations, the agency is required to, "Study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources as provided by section 102(2)(E) of the Act. 40 CFR 1502.1(c))" "Reasonable alternatives to the proposed action should fulfill the purpose and need and address unresolved conflicts related to the proposed action." (FSH 1909.15, Chapter 10, section 14). The Forest Service developed three alternatives that were analyzed in detail, including the No Action and Proposed Action alternatives, in response to issues raised by the public (FEIS pp.13-23). Alternative 3 employs a radial spray approach to herbicide application and varying the planting density to emulate the spatial heterogeneity of forest conditions that would have been created by topography's influence on fire frequency and intensity (FEIS pp.17-19). Alternative 3 differs from the Proposed Action primarily in planting arrangements, planting density (trees per acre), and type and methods of release (FEIS p.19). Two alternatives were considered in response to public comments, but were eliminated from detailed study, including a No Herbicide Alternative and Prescribed Fire, Natural Regeneration, Limited Cluster Planting Alternative, as described in the FEIS on pages 24-31).