NOXIOUS WEED RISK ASSESSMENT
AND WEED REPORT
RIM FIRE RECOVERY PROJECT
STANISLAUS NATIONAL FOREST
GROVELAND AND MI-WOK RANGER DISTRICTS

PREPARED BY: /s/ Katie VinZant DATE: August 13, 2014
Katie VinZant, Botanist

INTRODUCTION.

Forest Service Manual 2903(4) requires the Forest to "determine the risk of introducing, establishing, or spreading invasive species associated with any proposed action, as an integral component of project planning and analysis, and where necessary provide for alternatives or mitigation measures to reduce or eliminate that risk prior to project approval." The Stanislaus National Forest Land and Resource Management Plan (Forest Plan) as amended, and the Pacific Southwest Region Noxious Weed Management Strategy require that a noxious weed risk assessment be conducted to "determine risks for weed spread … associated with different types of proposed management activities" (USDA, USFS 2010).

Noxious weeds are defined in FSM 2905 and the Plant Protection Act of 2000 as "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." Under Executive Order 13112, the U.S. Department of Agriculture defines an invasive plant species as a plant that 1) non-native (or alien) to the ecosystem and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

The California Department of Food and Agriculture (CDFA) developed and maintains the State noxious weed list which the Stanislaus National Forest referenced in developing the Noxious Weeds and Non-native Invasive Pest Plants of Concern for the Forest (Appendix A). The weed ratings assigned by CDFA "reflect CDFA's view of the statewide importance of the pest, the likelihood that eradication or control efforts would be successful, and the present distribution of the pest within the state" (CDFA [n.d.]b). CDFA defines their noxious weed ratings as follows:

> *"A" - A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment. ... A-rated pests are subject to state (or [County Agricultural] commissioner when acting as a state agent) enforced action involving eradication, quarantine regulation, containment, rejection, or other holding action.*
> *"B" - An pest of known economic or environmental detriment and, if present in California, it is of limited distribution. ... At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.*
> *"C" - A pest of known economic or environmental detriment and, if present in California, it is usually widespread. … If found in the state, they are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner.*

Inventories for weeds in support of Forest Service projects are conducted using the Noxious Weeds and Non-native Invasive Pest Plants of Concern for the Forest list (Appendix A) as a guide. The list was generated from several sources including the Forest Plan (Table 3.6a, 2001 SNFPA Final Environmental Impact Statement (FEIS), V.2, Chpt 3, part 3.6, pages 310-311), the CDFA list of State-rated noxious weeds (CDFA [n.d.]a), new weed discoveries in the Forest, information provided by local County Agricultural Commissioners, occurrence records at CalFlora (a web-based botanical database), published technical references (Baldwin, et. al. 2012, Bossard, et.al. 2000, Whitson, et.al. 1996), and personal observations.

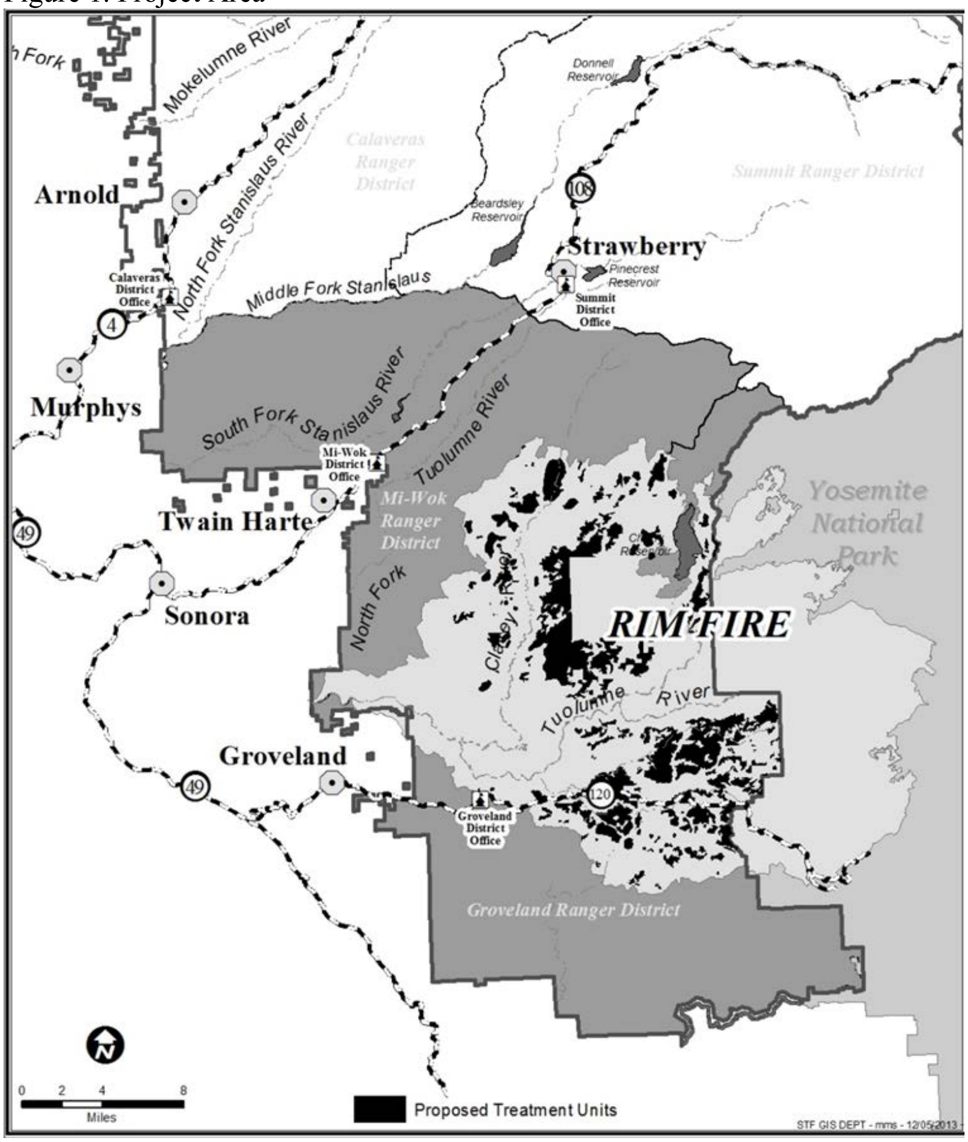
This noxious weed risk assessment evaluates the risk for weed introduction and spread by project activities in the Rim Fire Recovery project.

DESCRIPTION OF PROPOSED PROJECT.

Project Location.

The Rim Recovery project is located within and adjacent to the Rim Fire perimeter in the Stanislaus National Forest on portions of the Mi-Wok and Groveland Ranger Districts (Figure 1). Elevations within the project area range from 3,000 feet to 7,000 feet.

Figure 1. Project Area



Primary Purpose.

An event as large as the Rim Fire provides an opportunity to look at restoration at a landscape scale, considering the many features and structures that are desirable and sustainable for future forested conditions. The Forest Plan long-term management goals (USDA 2010, p. 5-15) [1] include goals to create a fire resilient forest where fire is an integral part of the system, not a landscape altering force. To sustain forests into the future, natural and prescribed fire will be an important tool to protect this area from another stand replacing event. To that end, Stanislaus National Forest Fire and Fuels managers together with Researchers from the Pacific Southwest Research Station (PSW) compiled a strategy for the Rim Fire area outlining conditions along with features on the landscape that could help reduce the size and severity of future fires. The goal is not to prevent fires within the forest, but to modify fire behavior to lower severity, and to bring these areas back to a more historic heterogeneous structure where fire complements and sustains the system instead of destroying it. The proposed structures include shaded fuel breaks along roads, large blocks of forest with lower densities adjacent to critical areas (i.e. private property and old forest emphasis areas), heterogeneous forest structure throughout the area (planting in clumps and variable spacing of trees), limited plantations on southern and southwestern slopes where natural fire return intervals are high and the tree growing ability is low, and prescribed and natural fire within these stands every 5 to 20 years. These features located across the landscape provide safe locations for firefighters to work from during wildfires and to utilize during prescribed burning activities. The fire and fuels strategy fits well with the overarching objective of sustainable old forests for wildlife and timber production. Several critical wildlife species lost habitat within the Rim Fire; and providing opportunities to return forests to this area is critical for sustainable populations and connectivity of habitat for wildlife movement and expansion.

Salvage logging is the first step in the process of long-term forest recovery. In order to provide critical structures within the new forests over time, snags and down logs will be left, but excess trees will be removed. Snags will provide short term benefits for many species of wildlife, and long-term down woody structure. Most of the stands that burned were over stocked due to decades of fire exclusion and now have far more dead trees within them than would have occurred naturally. In addition, the vast area of high severity burn is far larger than historic gap sizes would have been in the Sierra Nevada, setting up another severe fire scenario if not treated. If the dead material were left and burned again, severe soil damage (hydrophobic soils) could result and be far more damaging than the Rim Fire.

The Forest Service completed the Stanislaus National Forest Land and Resource Management Plan (Forest Plan) on October 28, 1991. The Stanislaus National Forest “Forest Plan Direction” (USDA 2010) presents the current Forest Plan management direction, based on the original Forest Plan, as amended. The Forest Plan includes Goals, Strategies and Objectives for this project (p. 5-7 and 11-15). The overall purposes of this project are to:

- Capture the economic value of hazard trees and dead trees which pays for their removal from the forest and potentially for other future restoration treatments.
- Provide for greater worker and public safety.
- Reduce fuels for future forest resiliency.
- Improve road infrastructure to ensure proper hydrologic function.

Proposed Action and Alternatives.

The Rim Recovery Project Environmental Impact Statement has four developed Alternatives:

Alternative 1: Proposed Action.
Alternative 2: No Action (no salvage activities under this analysis and decision).
Alternative 3
Alternative 4

For a complete description of all four Alternatives and their associated management requirements see the Rim Recovery EIS, Chapter 2. The management requirements pertaining to invasive plants are described below.

Management Requirements

Management requirements are designed to reduce the effects of the alternatives by; avoiding the impact altogether by not taking certain action or parts of an action, minimizing impacts by limiting the degree or magnitude of the action and its implementation, rectifying the impact by repairing, rehabilitating, or restoring the affected environment, and reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

Invasive Plant Management Requirements –

Alternative 1:

a. Where possible above 4,000 feet elevation, prior to use, manually treat dense infestations of weeds in areas utilized by project equipment/vehicles to prevent spread, if flowers or seeds are present on the plants.
b. Flag and avoid infestations of high priority noxious weeds during project activities. Manual methods such as hand thinning may take place within noxious weed sites if timed for before seed set.

Alternative 2:

None

Alternative 3 and Alternative 4:

a. Conduct a pre-project implementation invasive plant inventory of all project areas subject to project associated ground disturbance. This inventory, along with previous survey information, will be utilized to implement the management requirements (b-f) below.
b. Flag and avoid infestations of high and moderate priority weeds in all project locations subject to ground disturbance from either mechanical or foot traffic (e.g. project units, staging/landing areas, turnouts, roads). Units currently included are: B32, D04B, E01B, F11, F15, F16, F17, F23A, H11, H12X, K02, L02A, L02B, L02BX, L02D, L04, L201, L202, L202B, L203, L204, L205, L206, M02C, M05B, M05E, M201, M202A, M203, M204, N01, N01A, O03, Q07, Q13, Q14A, R01A, R04A, R04B, R12X, R16, R17X, R19A, R19B, R19D, S02, S03, T04B, T24, T25X,T27A, T27AX, T27B, U01D, V10, V13, V13X, V14B, V14C, X04, X06, X116, X118X ,X119X and Y01D (140 acres).
c. In areas needed for implementation of the proposed activities, manually treat new or expanding portions of post-Rim Fire infestations before seed dispersal. Manual treatment will entail the cutting, digging, or pulling of all flower heads and/or vegetative reproductive parts (i.e. rhizomatous root parts) (see Weed Risk Assessment for species specific treatments).
d. Where re-using landing and/or staging areas is necessary, the topsoil (top 6-8 inches) may be pushed into a wind-row and covered to prevent seed dispersal. Topsoil will be pushed back into place following project completion.
e. Conduct road maintenance activities in a manner which reduces the risk of weed spread, such as avoiding soil movement out of weed sites; grading toward weed infestations, not away; or utilizing manual methods.

Requirements Common to All Alternatives:

a. Implement the equipment cleaning requirements in the standard contract provisions for all contract operations and activities.
b. The Forest Service will designate the order, or progression, of unit completion to emphasize treating uninfested units before treating infested units to reduce the risk of weed spread from infested units into uninfested units. Clean equipment before moving from infested sites and prior to being transported from the project area.
c. Use certified weed-free mulches (woodstraw and rice straw are preferred) where available. Stage these materials in weed-free sites only.
d. Obtain construction materials, including crushed rock, drain rock, riprap and soil, from sources free of high and moderate priority weeds. If sources do contain these priority weeds either flag and avoid or move topsoil to a nearby location that will not be disturbed and cover.

METHODS

Site Surveys and Survey Limitations

Currently 75% of the proposed Project area (for all Alternatives) has had surveys for noxious weeds performed. This effects analysis is based on Forest Service survey data (GPS points and polygons) collected within and just outside (5 mile radius around) the fire perimeter since 2006. These pre- and post-fire weed surveys will provide data which will aid in the mitigation of impacts to weed species from Project activities under these Alternatives.

Database and Literature Review

The following Table 1 shows the California noxious weeds and non-native, invasive plant species known to occur within the Rim Fire area. While not all species were known to occur in proposed Rim Fire Recovery project units, quarries, staging/landing areas and roads before the fire, fire suppression efforts, soil movement and other disturbances may have led to the spread of seed or other reproductive parts into the project footprint. The known acreages of each species per Alternative can be found in Table 3 (under the Affected Environment heading). A listing of where these noxious weed species are currently located can be found under the Weed Species Accounts section (also under the Affected Environment heading).

Table 1. Noxious Weed and Invasive Plants Known from Within and Adjacent to the Project

Project priority ranking of each weed species found within and adjacent to the project area. The invasive characteristics, habitat degradation potential, state rating, prevalence across the fire area, and control factors of the invasive species were used in assigning these priorities. In addition, the risk of potential seed and reproductive part spread from project activities was also considered in assigning priority.

Weed Name	Status[1]	Project Priority	Comments
Barbed Goatgrass (*Aegilops triuncialis*)	CDFA B-Rated noxious weed	High	Isolated infestations.
Bachelor Button (*Centaurea cyanus*)	Invasive Plant[2]	Moderate	Isolated infestations.
Blackberry, cut-leaf (*Rubus laciniatus*)	Invasive Plant	Low	Common weed.
Blackberry, Himalayan (*Rubus armeniacus*)	Invasive Plant	Low	Common weed.
Black mustard (*Brassica nigra*)/ Shortpod mustard (*Hirschfeldia incana*)	Invasive Plant	Moderate	Few localized infestations, where common weed.
Blessed Milkthistle (*Silybum marianum*)	Invasive Plant	Moderate	Isolated infestations.
Bull thistle (*Cirsium vulgare*)	CDFA C-Rated noxious weed	High*	*High for dense infestations in or near wetlands, skid trails and landings. Low for scattered plants.
Canada thistle (*Cirsium arvense*)	CDFA B-Rated noxious weed	High	Isolated infestation.

Weed Name	Status[1]	Project Priority	Comments
Cheatgrass (*Bromus tectorum*)	Invasive Plant	Low	Common weed.
Dyers Woad (*Isatis tinctoria*)	CDFA B-Rated noxious weed	High	One isolated infestation.
Field bindweed (*Convolvulus arvensis*)	CDFA C-Rated noxious weed	Moderate	Isolated infestations.
French broom (*Genista monspessulana*)	CDFA C-Rated noxious weed	Moderate	Isolated infestations.
Hedgeparsley, (*Torilis arvensis*)	Invasive Plant	Low	Common weed.
Italian thistle (*Carduus pycnocephalus*)	CDFA C-Rated noxious weed	High	Isolated infestations.
Johnsongrass (*Sorghum halepense*)	CDFA C-Rated noxious weed	Moderate	Not known from burn area, but adjacent.
Klamathweed (*Hypericum perforatum*)	CDFA C-Rated noxious weed	Low	Common weed. Biocontrol insects present.
Medusahead Grass (*Taeniatherum caput-medusae*)	CDFA C-Rated noxious weed	High	Isolated infestations.
Perennial Sweetpea (*Lathyrus latifolius*)	Invasive plant	Moderate	Isolated infestations.
Puncturevine (*Tribulus terrestris*)	CDFA C-Rated noxious weed	High	Isolated infestations.
Scotch Broom (*Cytisus scoparius*)	CDFA C-Rated	Moderate	Isolated infestations.
Spanish Broom (*Spartium junceum*)	Invasive Plant	Moderate	Not known from burn area, but adjacent.
Spotted Knapweed (*Centaurea stoebe* ssp. *micranthos*)	CDFA A-Rated	High	Isolated infestations, most actively being treated.
Tocalote (*Centaurea melitensis*)	CDFA C-Rated noxious weed	High	Isolated infestations.
Tumble mustard (*Sisymbrium altissimum*)	Invasive Plant	Moderate	Few localized infestations, where common weed.
Woolly mullein (*Verbascum thapsus*)	Invasive Plant	Moderate**	Common weed. **Moderate for dense infestations, especially on landings or skid trails. Low for scattered plants.
Yellow star-thistle (*Centaurea solstitialis*)	CDFA C-Rated noxious weed	High	Isolated infestations.

[1]CDFA is the California Department of Food and Agriculture. CDFA pest ratings are defined at http://www.cdfa.ca.gov/phpps/ipc/encycloweedia/encycloweedia_hp.htm. Non-native, invasive plants have no CDFA pest rating.

AFFECTED ENVIRONMENT.

Climate

The Rim Fire area is within the Mediterranean climate zone designated Csa in the Koppen-Geiger Climate Classification System (Kottek et al 2006). This zone consists of warm, mostly dry summers and cool, wet winters. In degrees Fahrenheit, Rim Fire area average summer high temperatures are about 95 at the lowest elevations and 75 at the higher elevations. Average low winter temperatures are about 30 degrees at the lowest elevations and 20 degrees at the highest. Extreme high and low temperatures vary about 10-15 degrees from average. Precipitation increases in elevation, with a range of about 30 to 50 inches per year across the fire area. Annual variation in precipitation can vary up to about 50 to 150% of average depending on wet or dry years. About 80% of the annual precipitation occurs from November through March. Rain dominates areas below about 4,000 feet though occasional snow occurs in the coldest months. Between 4,000 and 5,000 feet rain and snow is mixed, and above 5,000 feet snow is more common across the landscape. Warm frontal storms can raise snow levels to 7,000 feet or higher.

This past year (2013) has been the driest year in recorded history (1849) for California (Henson 2014). As of January 10, 2014 the Sierra Mountain Range snowpack was estimated at 84% below average (CDWR 2014). Climate change is expected to continue to alter the historic climate patterns seen in the Sierras.

Geology

The Rim Fire landscape includes all three of the principal geologic types in the Sierra Nevada mountain range. Metamorphic rock occupies much of the lower elevations and the Sierra granitic batholith and relic volcanic flows generally occur at higher elevations.

Landforms within the Rim Fire are dramatic, punctuated by river canyons, glaciation, a lava cap, and large expanses of gentle to moderately steep slopes spread across much of the fire area.

Vegetation Communities

Hillslope vegetation in the Rim Fire area is dominated by broad expanses of coniferous forests above the deep river canyons of the Tuolumne and Clavey Rivers. These mid-elevation forests consist mostly of the Sierra Nevada mixed conifer association, which includes ponderosa, white fir, sugar pine, Douglas fir and incense cedar. As elevations increase within the fire area, the mixed conifer belt grades into Jeffrey pine and red fir-lodgepole pine stands in some locations. Grass-oak woodlands and mountain chaparral communities dominate river canyon vegetation, and oak stands often occupy drier sites at mid-elevations.

The other principal vegetation community in the fire area is in the riparian zone along its numerous waterways and in wetlands such as meadows, springs, fens, and ponds. This vegetation consists of a combination of riparian obligate plants (those associated with easily available water) and non-obligate trees and shrubs such as conifers and hardwoods. While these plants occupy a small portion of the landscape they provide a disproportionately large value for vegetative diversity and supports a wide range of aquatic, wildlife, recreational and aesthetic values. Principal obligate vegetation species in the Rim Fire area include dogwoods, maples, willows, cottonwoods and aspens, and non-obligates are the conifer species commensurate with the elevations at which they mostly occur.

Wildfire

When assessing the affected environment of the project for invasive plants after the Rim Fire, it is important to analyze the potential for vegetation type conversion, relative to departures from the historic fire return interval. In order to do this a query was done on the number and acreages of fires that have repeatedly burned the Rim Fire area since 1908. The vegetation types that burned in these historic fires were also analyzed. Once this data was compiled it was compared to the historic fire return intervals of presettlement reference vegetation types described by both the Fire Return Interval (NPS FRI) Index used by Yosemite National Park and a Fire Return Interval Departure (FRID) condition classification commonly used by the USFS (Safford and Schmidt 2011). Results of this analysis were used to determine the vegetation types and areas that may be more susceptible to type conversion and enhanced invasive species abundance and distribution.

For all lands within the burned area, NPS FRI Index indicates low to moderate departure from historic fire frequency for all presettlement vegetation types prior to the Rim Fire event. However, when presettlement reference vegetation types are assessed using FRID condition classes for the period from 1908 to 2013, 6% (all in mixed chaparral vegetation) of the burned area has burned more frequently and 71% (in yellow pine, mixed conifer and mixed evergreen forest vegetation) of the burned area has experienced extremely low fire frequency when compared to presettlement fire regimes. Both areas which burned too frequently and infrequently likely experienced more severe fire effects to soils and vegetation and therefore may take longer to recover (lack of seed source, altered soil quality, increased solarization, etc.). This slower native vegetation recovery makes these areas potentially vulnerable to invasion due to depressed native seed source and associated reduction in competition, altered soil properties, reduction in long-term nitrogen and carbon resources and current and predicted drought (Keeley et. al. 2011, Keeley and McGinnis 2007, Bossard et- al. 2000).

Table 2 below shows the comparison between alternatives for project acreages experiencing too much or too little fire according to FRID condition class. Similar to the results described above for the entire burn area the alternatives show that 85-90% of the project area has experienced too infrequent of a fire return interval; only 1-3% (although 900 acres is a substantial area) of the area has experienced fire which is too frequent. Based on these pre-Rim fire conditions, the majority of the project area (under all alternatives) indicate there is an increased potential for invasive type conversion in the post-fire environment. (for maps and tables showing these results see Appendix B).

Table 2. Summary of Acres and Proportion of Acres with Too Frequent and Too Infrequent Fire Return Intervals by Alternative

Alternative	Total acres (just units for alternatives)	% of area (acres) Median FRID Condition Class	
		Too frequent fire return (-2 to -3)	Too Infrequent fire return (+3)
Existing condition of entire Rim burned area	256,285	5.83 (14,941)	70.88 (181,655)
Alt. 1 Proposed Action	28,323	0.61 (172)	91.45 (25,901)
Alternative 3	30,399	3.12 (949)	85.42 (25,967)
Alternative 4	27,828	3.46 (963)	84.93 (26,634)

Weed Abundance in Project-

Twenty-six species of non-native and invasive plants are present or adjacent to the project area (Table 3). Ten species, including barbed goatgrass (*Aegilops triuncialis*), Italian thistle (*Carduus pycnocephalus*), tocalote (*Centaurea melitensis*), yellowstar thistle (*Centaurea solstitialis*), spotted knapweed (*Centaurea stoebe ssp. micranthos*), Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), dyer's woad (*Isatis tinctoria*), medusahead grass (*Taeniatherum caput-medusae*) and puncturevine (*Tribulus terrestris*) are considered high risk species from project activities. Eleven other species, including, bachelor buttons (*Centaurea cyanus*), field bindweed (*Convolvulous arvensis*), Scotch broom (*Cytisus scoparius*), French broom (*Genista monospessulana*), shortpod mustard (*Hirschfeldia incana*), perennial sweatpea (*Lathyrus latifolius*), milkthistle (*Silybum marianum*), tumblemustard (*Sisymbrium altissimum*), johnsongrass (*Sorghum halepense*), Spanish broom (*Spartium junceum*) and wooly mullein (*Verbascum thapsus*), are considered a moderate risk. The remaining five species are considered low risk. For a complete discussion of characteristics specific to each species, their known locations in the project, habitat impacts and recommended management tools, please see the Weed Species Accounts below.

Table 3. Weed Species Acreage in Rim Fire and Project Alternatives

Invasive Name	In Rim Fire (acres)	Alternative 1 (acres)	Alternative 3 (acres)	Alternative 4 (acres)
Barbed Goatgrass	4.69	1.37	1.37	1.37
Bachelor Button	Not mapped	Not mapped	Not mapped	Not mapped
Blackberry, cut-leaf	0.16	0.00	0.00	0.00
Blackberry, Himalayan	2.32	0.74	0.74	0.74
Black mustard /Shortpod mustard	Not mapped	Not mapped	Not mapped	Not mapped
Blessed Milkthistle	0.55	0.45	0.55	0.55
Bull thistle	137.38	99.35	100.23	100.10
Canada thistle	0.25	0.00	0.00	0.00
Cheatgrass	Not mapped	Not mapped	Not mapped	Not mapped
Dyers Woad	0.74	0.00	0.00	0.00
Field bindweed	0.72	0.00	0.00	0.00
French broom	.001	0.001	0.001	0.001
Hedgeparsley	0.02	0.00	0.00	0.00
Italian thistle	11.20	8.15	8.624	8.62
Klamathweed	0.84	0.16	0.19	0.19
Medusahead Grass	148.19	110.53	111.43	111.43
Perennial Sweetpea	0.30	0.00	0.00	0.00
Puncturevine	0.10	0.00	0.00	0.00
Scotch Broom	0.09	0.00	0.00	0.00
Johnsongrass	0.70	0.70	0.70	0.70
Spanish Broom	0.00	0.00	0.00	0.00
Spotted Knapweed	0.38	0.38	0.38	0.38
Tocalote	78.38	23.27	22.62	22.62
Tumble mustard	Not mapped	Not mapped	Not mapped	Not mapped
Woolly mullein	7.61	6.67	6.46	6.12
Yellow star-thistle	105.39	25.42	24.69	24.69
Total Acreage	**499.47**	**277.21**	**277.97**	**277.49**

Past managed and unmanaged actions involving ground disturbing activities such as timber harvests, fuel reduction, road and trail creation/maintenance, grazing, unauthorized OHV use and other dispersed recreation have impacted invasive plant infestations across the project area. The invasive species known to occur within the project area before the Rim Fire were introduced and spread primarily through transport on vehicles, in straw and hay, on earthmoving and mowing/weed-eating equipment, and on animals and in their manure associated with these activities. Weed seeds also spread quickly down streams and upwind along lakes and reservoirs. Livestock grazing also contributed to weed spread, due to transportation on their fur, decreased native grass and forb cover from preferential grazing over non-natives, un-palatability of many invasives, trampling and other soil disturbances (Olson 1999). Since the fire it is highly likely that these existing infestations created by the disturbances listed above were spread and/or introduced by suppression and BAER efforts which increased soil movement by air and water erosion.

Given the current data it appears that Medusahead grass, tocalote, yellow starthistle bull thistle and Italian thistle are by far the most common species within the project area (Table 3). To a lesser extent, several other invasive weed species occur, primarily along roads. It should be noted however, that it is highly likely that many of the lower priority invasives are mapped at a fraction of their actual occurrence acreage given their commonality.

Indeed, given that 75% of the project area has been surveyed for invasives it is highly likely that actual acreage is higher than shown in Table 3.

Invasive Species Presence within Different Project Action Areas

A compilation of the invasive plant acreages in each alternative for the specific project actions is found below in Table 4. This table indicates that the highest invasive infestation acreages are found within the salvage units and hazard tree removal areas. This is not surprising given that these project areas cover the largest overall acreages and would therefore, be the most likely to harbor weed infestations. Roadside maintenance, reconstruction and new construction project areas also have higher invasive infestation acreages. Roadsides consistently experience ground disturbance, creating areas of increased sunlight, decreased native competition and increased water runoff, all leading to excellent colonization sites for weeds.

Table 4. Invasive Plant Acreages in Each Alternative by Specific Project Action

Treatments	Invasive Plant Locations (acres)			
	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Salvage Units	110.4	0.0	155.4	154.1
Road Treatments	44.5	0.0	44.5	44.5
Roadside Hazard Tree	122.1	0.0	78.8	78.6
Quarry	0.5	0.0	0.5	0.5
Totals	**277.5**	**0.0**	**278.2**	**277.8**

A compilation of the invasive plant acreages in each alternative for the different types of activities occurring in the salvage unit and road work project actions is found below in Table 5 (for units) and Table 6 (for road work). Table 5 indicates that the highest invasive infestation acreages are by far found within the tractor removal salvage units (which compose the largest acreage). Table 6 indicates that the highest invasive infestation acreages are found within the road maintenance and reconstruction actions. Since maintenance and reconstruction areas cover the most mileage of all road actions, it is logical that most known weed acreages would show up under these actions. It is also likely that since maintenance and reconstruction are on existing roads previous invasive surveys are more likely to have occurred there than on new temporary or permanent road construction routes.

Table 5. Known Acreages of Invasives by Unit Salvage Removal Action Type for Each Alternative

Unit Action Type	Alt 1 Acreage of Known Weed Occurrences	Alt 2 Acreage of Known Weed Occurrences	Alt 3 Acreage of Known Weed Occurrences	Alt 4 Acreage of Known Weed Occurrences
Tractor	93.0	0	137.6	136.30
Skyline	6.0	0	6.5	6.5
Helicopter	11.3	0	11.3	11.3
TOTAL ACREAGE	**110.4**	**0**	**155.4**	**154.1**

Table 6. Known Acreages of Invasives by Road Work Action for Each Alternative

Road Work Action	Alt 1 Mileage (Acreage of Known Weed Occurrences)	Alt 2 Mileage	Alt 3 Mileage (Acreage of Known Weed Occurrences)	Alt 4 Mileage (Acreage of Known Weed Occurrences)
Maintenance	216.0 (20.3)	0	200.6 (14.3)	209.3 (14.4)
Reconstruction	320.3 (24.1)	0	324.0 (29.9)	315.0 (29.8)
Temporary Road (new construction)	4.1 (0)	0	9.5 (0)	8.4 (0)
Temporary Road (existing)	17.6 (0)	0	26.0 (0)	25.4 (0)
Temporary Use - Revert	7.3 (0)	0	5.4 (0)	5.4 (0)
Permanent Road (new)	5.4 (0)	0	1.0 (0)	0
TOTAL MILEAGE (WEED ACREAGE)	**570.6 (44.4)**	**0**	**566.6 (44.2)**	**563.4 (44.2)**

WEED SPECIES ACCOUNTS.

Barbed Goatgrass (*Aegilops triunicialis*)

Observed within Project: Along roads 1N11, 1N17, 1N24, 1N25, 1N25A, 1N25B, 1S49, 2N11 scheduled for project road maintenance in all alternatives.

Ecology

Aegilops triuncialis (barb goatgrass) is a winter germinating annual grass (family *Poaceae*) that grows in rangelands, grasslands, and oak woodlands. It is becoming a dominant grass in foothill grasslands of central California. This weed can directly injure livestock by lodging in their eyes or mouths, and is unpalatable to cattle. Goatgrass blooms May-August and has seeds that typically remain viable for two years (DiTomasio and Healy 2007).

Control

- Prevention: Removal of small, initial infestations is the best method to prevent the development of large monocultural stands that are typically difficult to eradicate. Also the prevention of continuous heavy grazing or high intensity short term grazing during the growing season will reduce the potential for increased infestation.
- Mechanical: As with most mechanical control methods, success is often achieved only after many sequential cuts that exhaust the plants' resources. Optimal timing for cutting is just after the commencement of flowering.
- Fire Management: Goatgrass seeds that are in the soil or on the ground typically survive fire and readily germinate in burned areas where canopy cover has been reduced (DiTomasio and Healy 2007).

Bachelor Buttons (*Centaurea cyanus*)

Observed within Project: Known from within the burn, in the Spinning Wheel area. No locations have associated GPS data.

Ecology

Bachelor buttons is a purple annual in the Sunflower Family (*Asteraceae)*. Typical infestations are escaped ornamentals that are usually found lower than 2000 meters in elevation, potentially in all vegetation types except deserts. Bachelor buttons blooms from July-September and has seeds that typically remain viable for less than three years (DiTomasio and Healy 2007).

Control

- Prevention: Removal of small, initial infestations is the best method to prevent the development of large monocultural stands that are typically difficult to eradicate. Also the prevention of continuous heavy grazing or high intensity short term grazing during the growing season will reduce the potential for increased infestation.
- Mechanical: Mowing at late bud to early bloom growth stage reduces seed production. However, poorly timed mowing (too early or late) can encourage growth and disperse seed. The species has a sturdy and long taproot, which can make removal by digging difficult. However handpulling 2-4 times per year or severing plants 2 inches below root crowns can control small infestations. Cut flower heads should be bagged, as they may still produce viable seed.
- Fire Management: Burning removes current growth but may enhance seed germination. seeds that are in the soil or on the ground typically survive fire and readily germinate in burned areas where canopy cover has been reduced (DiTomasio and Healy 2007).

Cut-leaf Blackberry (*Rubus laciniatus*) and Himalayan Blackberry (*Rubus armeniacus*)

Observed within Project: Along roads 1N01H, 1N02, 1N18, 1N27, 1N35, 1N35, 1N43, 1N48A, 1N49A, 2N11, 2N52 scheduled for project road maintenance in all alternatives.

Ecology

Himalayan blackberry and cut-leaf blackberry are perennial brambles in the rose family (Rosaceae). They form dense, impenetrable thickets in disturbed and wet sites such as creeks and river flats, along roadsides, in forest plantations, pastures and fence lines (Hoshovsky, 2000). They can spread as seeds vectored by wildlife or humans, or from sections of cane which sprawl out from the mother plant, touch the ground and grow roots. The fruit of these berry plants are highly sought after by wildlife and humans as food.

Control

- Prevention: There are no known land management practices that would discourage establishment of Himalayan blackberry that do not also discourage the establishment of favorable native bramble species. However, removal of small, initial infestations is the best method to prevent the development of large monocultural stands that are typically difficult to eradicate.
- Mechanical: Cutting stems can be an effective mode of removal, but as these species has several methods of vegetative reproduction, purely mechanical eradication means can be problematic. Stems should be cut with a chainsaw, scythe, or tractor-mounted mower followed by the removal of as much underground tissue as possible, which can be prohibitively labor-intensive in large infestations. While cutting does not stimulate lateral root sprouting, stems will re-grow from root crowns. Large, older root crowns are often difficult or impossible to remove completely. As plants can reproduce from cut branches, slash piles should be burned or removed. As with most mechanical control methods, success is often achieved only after several sequential cuts that exhaust the plants' resources. Optimal timing for cutting is just after the commencement of flowering.
- Fire Management: Burning can be an effective means to control large thickets, but as fires do not kill underground tissues, re-sprouts require follow-up mechanical or herbicidal control.

Black mustard (*Brassica nigra*), Shortpod mustard (*Hirschfeldia incana*) and Tumble mustard (*Sisymbrium altissimum*)

Observed within Project: Several un-mapped populations of each species are known from roadside locations in the Project area.

Ecology

Black, shortpod and tumble mustards are all winter annuals or biennials in the Mustard Family (*Brassicaceae*) (Calflora 2011). They easily grows in many soil types, including loose to compact soils, and on sand, disturbed roadsides, and in pastures and will grow in disturbed and undisturbed areas (Hickman 1993, Howard 2003). In California, they are known to occur at elevations below 8,200 feet and typically flower between March and June (Howard 2003). All three species can form dense patches or occur as scattered individual plants.

Control

- Prevention: Establishment of mustard can be minimized or prevented by minimizing soil disturbance and seed dispersal and keeping a high native species cover (Howard 2003).
- Mechanical: Manually removing rosettes or bolting plants in the fall or early spring can control small infestations (Howard 2003). Weed whipping can reduce some flower/seed production, but plants will often grow prostrate and continue to produce seeds if not pulled. Mowing can also stimulate multiple flower stalks being produced instead of one.
- Fire Management: Fire has not been demonstrated to be an effective control method for tumble mustard, and it may instead increase in abundance in the early postfire community if other species are slow to establish on the open ground (Howard 2003).

Blessed Milkthistle (*Silybum marianum*)

Observed within Survey Area: Mapped along roads 1N02 and 1N19 proposed for project maintenance under all alternatives, in Unit L204 under Alternatives 3 and 4.

Ecology

Milkthistle is a spiny pink-flowered biennial or short lived perennial thistle in the Sunflower Family that can be found in disturbed areas below 2,500 feet in elevation. Milkthistle reproduces from seed, which typically germinate in the first year, but can remain viable for nine years (DiTomasio and Healy 2007). Milkthistle often forms dense stands and can be abundant enough to displace native plants. Under stressed conditions (e.g. drought, trampling frost), the foliage of milkthistle can be toxic to livestock (DiTomaso and Healy 2007).

Control

- Prevention: The best preventative measure is removal of small infestations as soon as possible after they are located. If vehicles or equipment are operating in an infested area, they should be thoroughly cleaned afterward to prevent the spread of the infestation (Zouhar 2002). Also the prevention of continuous heavy grazing or high intensity short term grazing during the growing season and limiting other disturbances that create bare soil will reduce the potential for increased infestation.
- Mechanical: Milkthistle can be hand pulled prior to flowering. Use a pick to loosen hard soil and pull the taproot. Milkthistle can also be cut or mowed shortly before flowering (DiTomaso and Healy 2007). Cut the stem a minimum of one to two inches below the ground with a shovel. If mowing, cut close to the ground just before flowering. A follow up mowing one month later is often needed (Holloran et al. 2004). Stems can be left to decompose on-site, although flower heads should be removed. Cut flower heads should be bagged, as they may still produce viable seed (DiTomaso and Healy 2007).
- Fire Management: Burning has been shown to enhance seed germination and establishment (DiTomaso and Healy 2007).

Bull Thistle (*Cirsium vulgare*)

Observed within Survey Area: Along roads 1N18, 1N25B, 1N27B, 1N43B, 1N48A, 1N49, 1N49A, 1N77, 1S16Y, 1S70B, 1S75, 2N11, 2N11F, 2N31, 2N31YA, 2N52, 2N52A, 2N66, 3N83A, and FR7858 proposed for project maintenance under all alternatives, with the addition of 1N79B and 1S1806A in Alternative 1. Along road 1N12, 1N24, 1N36, 1N50, 1N61, 1N79, 1S01Y, 1S01YA, 1S03B, 1S13Y, 1S16Y, 1S69, 1S70, 1S71, 2N06, 2N11, 2N12, 2N48A, 2N85, 2S30, 2S35Y, 2S87 proposed for road reconstruction under all alternatives. In quarry site 33. Known from project units B32, D04B, E01B, F11, F15, F16, F17, F23A, H11, H12, L02B, L02BX, L202, L203A, M02C, N01A, O03, Q13, Q14A, R01A, R04A, R04B, R12, R16, R17, R19A, R19B, R19D, R36, S02, S03, T04B, T24, T25X, T27A, T27AX, U01D, V10, V13, V14B, V14C and V116 in all alternatives, with H12, R12, R17, R36 and V118 in Alternative 1 and H12X, L203, L204, R12X, R17X, X118X and Y01D in Alternatives 3 and 4.

Ecology

Bull thistle is a spiny pink-flowered biennial or short lived perennial thistle in the Sunflower Family that is widespread in California in coastal and montane habitats below 8,000 feet in elevation. It is common in moist grasslands, meadows and forests (Randall 2000). Bull thistle reproduces from seed with one large plant capable of producing "tens of thousands" of seeds (Randall, 2000). These seeds typically germinate in the first year, but can remain viable for three years or more and are capable of wind-dispersal for distances of more than a mile. Bull thistle rarely forms dense stands, but can be abundant enough to displace native plants including forage species important to native herbivores (Randall 2000). It is unpalatable to wildlife and livestock, probably due to its spines (DiTomasio and Healy 2007). In addition, Randall and Rejmanek (1993) found that bull thistle is very competitive against ponderosa pine seedlings in plantations.

Control

- Prevention: The best preventative measure is removal of small infestations as soon as possible after they are located. If vehicles or equipment are operating in an infested area, they should be thoroughly cleaned afterward to prevent the spread of the infestation (Zouhar 2002). Also the prevention of continuous heavy grazing or high intensity short term grazing during the growing season and limiting other disturbances that create bare soil will reduce the potential for increased infestation.
- Mechanical: Bull thistle can be hand pulled prior to flowering, by bending the stem and pulling. Use a pick to loosen hard soil and pull the taproot. Bull thistle can also be cut or mowed shortly before flowering (DiTomaso and Healy 2007). Cut the stem a minimum of one to two inches below the ground with a shovel. If mowing, cut close to the ground just before flowering. A follow up mowing one month later is often needed (Holloran et al. 2004). Stems can be left to decompose on-site, although flower heads should be removed. Cut flower heads should be bagged, as they may still produce viable seed (Bossard et al. 2000; DiTomaso and Healy 2007; Holloran et al. 2004).
- Fire Management: In some cases, bull thistle was reduced following burning. In other cases bull thistle was enhanced, probably due to the increased suitability of the habitat following burning (USFS, 2003).

Canada thistle (*Cirsium arvense*)

Observed within Survey Area: Not known from within project, however, it is known to occur within five miles of the project boundary and is considered to have a high chance of invading or colonizing disturbed project areas.

Ecology

Canada thistle is a spiny pale pink-flowered biennial thistle in the Sunflower Family that is adaptable to a wide range of habitats, but is most commonly found in disturbed areas as part of the initial post disturbance community along roadsides, streambanks, ditches, clearcuts and forest openings. Canada thistle may not establish immediately after logging and fire disturbances, but may be delayed for two or more seasons (Doyle et al. 1998). Canada thistle has a deep and wide-spreading root system with a slender taproot and far-creeping lateral roots. It often forms large patches, and individual clones may reach 115 feet in diameter (Donald 1994). Adventitious root buds that may form new adventitious shoots can develop along the root at any location, and at any time of the year with favorable growing conditions (Donald 1994). New plants can also form from root fragments as short as 0.2 inch (6 mm) (Nadeau et. Al 1989). Introduction into new areas is mostly by wind- or water-borne seed, or by seed in contaminated crop seed, hay or machinery (Donald 1994). A typical Canada thistle shoot may produce 32 to 69 flowerheads per shoot (1-5 per branch) on average, but can produce as many as 100 flowerheads in a season. Reports of average seed-set per flowerhead range from 21-93 (Morishita 1999).

Control

- Prevention: Canada thistle should be removed from lightly infested natural areas when first observed, since it is very tenacious and difficult to control once well-established (Nuzzo 1997). Priorities for controlling infestations must be developed when planning a Canada thistle management program, with actions ranging from prevention, to reduction and containment, to eradication. When establishing vegetation on a site, certified weed-free seed and mulch should be used for any erosion control material, and sites should be monitored several times a year, particularly in areas that are most susceptible to the spread of weeds, such as roadsides, staging areas and waterways.
- Mechanical: Effective long-term control of Canada thistle includes killing the roots and root buds, and preventing seed production and reinfestation by seedlings (Haderlie 1991). Because Canada thistle has root nutrient stores, it recovers readily from most types of stress, including control attempts. Therefore, control is optimized by stressing the plant enough to force it to use all of its root-stored nutrients. New seedlings must be killed within 2.5 weeks of emergence so they will not become perennial (Haderlie 1991). Canada thistle can be pulled and/ or cut several times during the growing season to weaken roots, however control may take several years and the treatment area must be monitored annually (Donald 1994).
- Fire Management: Studies have shown prescribed burning during the dormant season did not decrease biomass of Canada thistle and, therefore, may not be effective in eliminating it where it has become established. Fire has been shown, however, to reduce the relative abundance of Canada thistle, as well as the potential for spreading by seed. Canada thistle may be slowed or contained by prescribed burning under these conditions. (Young 1986).

Cheatgrass (*Bromus tectorum*)

Observed within Survey Area: Mapped populations are known to occur along most roadside locations in the Project area, quarry sites 30 and 61, and are anticipated to be in most Proposed and Alternative 3 Project units.

Ecology

Cheatgrass, also called downy brome, is an annual in the Grass Family. It is native to Eurasia (Wilken and Painter, 1993). It germinates in the early fall and over winters as a seedling (Mosley, et. al., 1999). Cheatgrass provides very little in terms of usable forage or cover for native wildlife species. The seeds are also not palatable to livestock. Each plant can produce up to about 300 seeds, which can remain dormant in the soil for two to three years (Young, 2000).

Cheatgrass has spread across millions of acres in the west, up to 8,000 feet in elevation, and is thought to have altered the natural fire frequency in many plant communities. It also has the ability to carry fire into areas that previously would not ordinarily burn (DiTomaso and Healy 2007). The continued spread and dominance of cheatgrass represents several potential impacts to native species. Cheatgrass can out-compete native plant species, including both common and rare species. It is capable of depleting soil moisture to 28 inches (Young, 2000). Because of its ability to deplete soil moisture, it interferes with the ability of perennial herbaceous plants, shrubs and pine seedlings to become established (Young, 2000). Cheatgrass can also change the character of the forest floor, covering it with a relatively dense growth of grass where none would have otherwise been present. This can also alter the soil components and productivity. Cheatgrass dries in early summer, leaving the forest floor covered with a dry flashy fuel that carries fire quickly.

Control

- Prevention: Proper stocking levels and the protection of soil resources are the best known land management practices preventing the establishment and spread of cool-season annual grasses in California. However, preventing the spread or eradicating these cheatgrass is difficult. The majority of grasslands within the state are now dominated by cheatgrass and other exotic annual grasses.
- Mechanical: Few mechanical methods are suitable or effective in annual *Bromus* control. Precisely timed mowing, after the grass has begun to flower, but before it has produced mature seeds (a period of about a week), can help reduce the amount of seed produced each year. In agricultural areas, intensive or deep tilling can help eradicate infestations.
- Fire Management: Burning tends to promote the establishment, growth, and spread of cheatgrass. Late season burns can significantly increase *Bromus* densities in subsequent years (DiTomaso and Healy 2007). Some practitioners have advocated burning sites after seed is set but before the plants shatter, which reduces the amount of viable seed. However, like other burn control methods, this appears to increase the site's susceptibility to subsequent invasions (DiTomaso and Healy 2007), and therefore is not recommended.

Dyer's Woad (*Isatis tinctoria*)

Observed within Survey Area: Not known within project, however, it is known to occur within the Rim fire perimeter and is considered to have a high potential to invade or colonize areas disturbed by construction or other ground-disturbing activities.

Ecology

Dyer's wood is a biennial, sometimes annual or short lived perennial, in the Mustard Family (*Brassicaceae*). The species is highly competitive and can grow in dense colonies capable of displacing native vegetation in elevations less than 2000 meters (DiTomasio and Healy 2007). Taproots of plants grow to average depth of one meter. Dyer's wood reproduces by seed and typically produces 400 fruits per plant. Seeds removed from fruits lack a dormancy period, meaning seed longevity is probably less than one to two years unless the fruit remains intact. Because dyer's woad germinates both in the fall and spring, overwinters as a rosette, initiates early spring growth, has deep taproots, and possesses summer dormancy mechanisms, it may escape many restrictions by which growth and spread of associated native species are regulated (Kassim 1987). Studies have also shown that Dyer's wood may also demonstrate an allelopathic potential, meaning it has the potential to chemically inhibit germination and root elongation of other species (Kassim 1987).

Control

- Prevention: Isolated infestations of Dyer's woad should be removed when first observed, since it is very tenacious and difficult to control once well-established. Also the prevention of continuous heavy grazing or high intensity short term grazing during the growing season will reduce the potential for increased infestation (McConnel et. al 1999). .
- Mechanical: Hand-pulling is one of the most important methods of dyer's woad containment. This approach is most effective when dyer's woad is in flower, because the distinct yellow flowers make it easy to locate and identify. Cutting or mowing dyer's woad does not usually kill the plant, but may be useful to prevent or delay flowering. Important considerations for physical control of dyer's woad are preventing seed set or dispersal and removing as much of the root as possible. Dyer's woad seeds mature within 4 to 6 weeks from the time of flowering, so it is essential that the plants be removed as soon as possible after flowering to prevent seed dispersal. Taproots of dyer's woad must be removed to at least two inches below the root crown to prevent sprouting (McConnel et. al 1999).
- Fire Management: No literature is available on the species response to fire, however given its ability to re-sprout after other types of disturbances it is presumed that it is likely to respond well to fire.

Field Bindweed (*Convolvulus arvensis*)

Observed within Survey Area: Not observed within the Project area. However, it is known to occur within the Rim fire perimeter and is considered to have a moderate potential to invade or colonize areas disturbed by construction or other ground-disturbing activities.

Ecology

Field bindweed is an herbaceous perennial in the Morning-glory (*Convulvulaceae*) Family. It is native to Europe. Field bindweed typically develops large, uncontrollable patches with root systems that can penetrate soil to a depth of three meters (DiTomasio and Healy 2007). It is typically found along roadsides or in heavily disturbed areas. Bindweed can reproduce both from seed and vegeatively, with seeds remaining viable for 20 years or more and root fragments less than 5cm having the ability to generate new plants (DiTomasio and Healy 2007).

Control

- Prevention: Isolated infestations of field bindweed should be removed when first observed, since it is difficult to control once well-established (Sheley et. al 1999).
- Mechanical: Removing aboveground parts of field bindweed by hoeing, cutting, pulling or mowing repeatedly to starve the roots is commonly suggested as a control method (Bell1990). Cutting off field bindweed plants about 3 inches below soil surface "for the whole season" (15-27 cultivations, every 8-10 days, through the spring, summer, and early fall (until frost), and another dozen cultivations the next year) has been successful. Even with these cutting and pulling methods, field bindweed seedlings may continue to emerge for many seasons, given its long seed dormancy. After 3 weeks, a new seedling has a root system large enough to regenerate stems if it is cut (Bell 1990). Six to 9 weeks of solarization has been shown to reduce the number of field bindweed seedlings, but regrowth from established field bindweed plants was only suppressed for 6 weeks after treatment (Elmore et. al. 1993).
- Fire Management: Field bindweed has the potential to invade an area following fire. Fire provides a suitable seedbed for field bindweed by removing shade and exposing mineral soil. Therefore, if field bindweed is present on or near the site prior to burning, there is potential for its establishment and spread as it will re-sprout from its deep root system or germinate from long-lived seeds in the seed bank (Evans and Young 1970).

French Broom (*Genista monspessulana*)

Observed within Survey Area: Not observed within the Project area. However, it is known to occur just outside the Project perimeters and is considered to have a moderate potential to invade or colonize areas disturbed by construction or other ground-disturbing activities.

Ecology

French broom is an evergreen shrub in the Pea Family (*Fabaceae*). It is native to the Mediterranean and the Azores Islands (CDFA [n.d.]a, Bossard 2000). French broom becomes reproductive after 2 to 3 years of growth (Bossard, 2000). Flowers bloom in spring, roughly March through May in inland areas (Zouhar, 2005). French broom reproduces by seed produced in seed pods which burst and eject seed away from the parent plant (CDFA [n.d.]a, Bossard, 2000, DiTomaso and Healy 2007). French broom seed can bank in the soil for up to 50 years (DiTomaso and Healy 2007). It is a drought tolerant species (CDFA [n.d.]a). Originally introduced into California as a landscaping plant, French broom has often escaped cultivation and is able to rapidly occupy wildlands (DiTomaso and Healy 2007). It can form dense, impenetrable thickets, crowding out native vegetation (Hoshovsky 1986a). Flowers, seeds and foliage are toxic to humans and livestock (Bossard 2000, DiTomaso and Healy 2007).

Control

- Prevention: Isolated infestations of French broom should be removed when first observed, since it is difficult to control once well-established (Sheley et. al 1999).
- Mechanical: Manual methods are best applied to smaller infestations while large infestations are best tackled with other techniques (Bossard 2000). Cutting plants to the ground at the end of the dry period can prevent resprouting until the next year (DiTomaso and Healy 2007). Pulling mature broom out of the ground using a shrub removing tool is very effective at removing mature plants and preventing resprouting (Bossard 2000). Seedlings can be removed by hand pulling or cutting and suppressed by thick layers of mulch (more than 4 inches) (Bossard 2000).
- Fire Management: Fire appears to stimulate germination. Plants can resprout from root crowns after burning (DiTomaso and Healy 2007, Zouhar 2005). Prescribed burning in the spring can remove mature broom plants; then later in a follow-up burn, resprouts and young plants can be killed if there are other fuels to carry the fire (Bossard 2000). However, burning under appropriate prescribed burning timing with high humidity and fuel moistures may inhibit acceptable consumption or killing of broom shrubs (Zouhar 2005).

Hedgeparsley (*Torilis arvensis*)

Observed within Project: Several un-mapped populations along mostly roadside locations are known from the project area.

Ecology

Hedgeparsley is an annual in the Carrot Family (*Apiaceae*) that can rapidly spread in a wide variety of habitats, growing in both disturbed and undisturbed areas (Constance, 1993). It can also grow in open or partly shaded sites. Hedgeparsley flowers from March-July and reproduces by seed that typically germinates the following spring (DiTomaso and Healy 2007).

Control

No information on how forest management activities such as prevention or burning might affect hedgeparsley was found in conducting literature and worldwide web searches. However, DiTomaso and Healy 2007 have noted that hand removal before fruits have developed can lead to successful control.

Italian Thistle (*Carduus pycnocephalus*)

Observed within Project: Along roads 1N01, 1N02, 1N13, 1N13A, 1N18, 1N19, 1N24, 1N24C, 1N34Y, 1S49, FR5606, FR7965 and FR99001 proposed for project maintenance under all alternatives. Along road 1N79 proposed for road reconstruction under Alternative 1. Known from project units L202, L203A, L206, V13 in Alternative 1 and L202, L203, L204, L205 and V13X in Alternatives 3 and 4.

Ecology

Italian thistle is a large biennial herb in the Sunflower Family (Asteraceae). It is native to the Mediterranean Region of the world. Italian thistle grows in meadows, pastures, roadsides and disturbed wildlands (Bossard and Lichti, 2000; and CDFA[2]). It can invade undisturbed sites and is most often found in full sun. Italian thistle displaces native plants, including forage plants. Most animals avoid eating it because of its stiff spines. A single plant can produce 20,000 seeds in one season (Bossard and Lichti, 2000). The seeds are mucilaginous which aids in dispersal of the plant (Bossard and Lichti, 2000). The seeds can be dispersed by wind, traveling as far as 325 feet in strong wind (Bossard and Lichti, 2000). Seeds are also spread by animals, vehicles, in contaminated hay, and in contaminated soil from infested quarries (Bossard and Lichti, 2000). Seeds of Italian thistle can persist in the soil seed bank for approximately eight years (Pitcher and Russo, 1988).

Control

- Prevention: Minimizing ground disturbance and the removal of native vegetation will prevent the establishment of Italian thistle as it requires these disturbances to thrive. This includes the prevention of heavy grazing, which can increase or spread infestations (DiTomaso and Healy 2007).
- Mechanical: Italian thistle can be hand pulled prior to flowering with success. Use a pick to loosen hard soil and pull the taproot. It can also be cut or mowed shortly before flowering (DiTomaso and Healy 2007). Cut the stem a minimum of one to two inches below the ground with a shovel. If mowing, cut close to the ground just before flowering. Cut flower heads should be bagged, as they may still produce viable seed.
- Fire Management: In some cases, Italian thistle was reduced following burning. In other cases bull thistle was enhanced, depending on a variety of factors including vegetation type, fire timing and intensity and seed bank composition (DiTomaso and Healy 2007).

Johnsongrass (*Sorghum halepense*)

Observed within Project: Found in Unit T04B in all Alternatives.

Ecology

Johnsongrass is a perennial, rhizomatous species in the Grass Family. It is considered to be one of the top ten most noxious weeds in the world, due to its extremely aggressive colonization abilities (DiTomaso and Healy 2007). Johnsongrass is native to the Mediterranean region and was introduced as a forage crop. Johnsongrass reproduces by both seed and vegetatively from roots. Root systems can grow up to 1.2 m deep and seeds can last up to 15 years in the soil (DiTomaso and Healy 2007). Under stressed conditions (e.g. drought, trampling frost), the foliage of johnsongrass can be toxic to livestock (DiTomaso and Healy 2007).

Control

- Prevention: The most efficient and effective method of managing johnsongrass is to prevent its invasion and spread, especially by ensuring the cleaning of machinery and confining of livestock that have been in infested areas (Sheley et. al. 1999). Preventing the establishment of johnsongrass is achieved by maintaining native communities and conducting aggressive surveying, monitoring, and any needed control measures several times each year.
- Mechanical: Johnsongrass cannot tolerate repeated, close to the roots mowing. However, ground disturbance will encourage growth from roots and new plants (DiTomaso and Healy 2007). Hand pulling johnsongrass usually leaves rhizome pieces behind in the soil, stimulating sprouting. It is not an effective control method unless all rhizomes are removed or new sprouts are controlled (Solecki 1997). Best results are obtained in early spring when soil in moist and rhizomes are least likely to break. Repeated solarization treatments can control small johnsongrass infestations (Bainbridge 1990).
- Fire Management: Spring burning does not effectively control johnsongrass because it is likely to encourage regrowth. Few studies using fire to control johnsongrass have been attempted, so small-scale trials and caution are advised when using fire on the species (Solecki 1997).

Klamathweed (*Hypericum perforatum*)

Observed within Project: Common throughout the project area, usually unmapped. Mapped along roads 1N44, 1S48 and 2S25 proposed for project maintenance and 1S13Y and 1S70 for road reconstruction under all alternatives. In units S01 and V13 in all alternatives.

Ecology

Klamathweed, also known as St. John's Wort, is a perennial herb in the St. John's Wort Family (*Hypericaceae*). Klamathweed is native to Europe (Talbot, 1993). It begins its seasonal growth in early spring and flowers from June to September (CDFA[6]). Klamathweed spreads by seed and by rhizomes (CDFA[6]). It grows in pastures, disturbed areas, roadsides, and forest clearings and has the capacity to displace native species (CDFA[6]). Klamathweed is toxic to most livestock, causing weight loss and sun burn (CDFA[6]; and Whitson, 1996). It has also been reported to cause contact photosensitivity resulting in second degree blisters on human eyelids and foreheads (WA State NWCB, 2003).

Control

- Prevention: Some aspects of prevention cleaning of machinery and vehicles prior to their movement from weed-infested to uninfested sites and revegetation of disturbed soils with site-appropriate plant species to inhibit St Johnswort entry. Upon discovery, pioneer St Johnswort plants should be eliminated (Piper 1999). Because St Johnswort infestations may become ubiquitous on overgrazed areas, adoption of grazing systems that increase or maintain cover of desirable plants and/or reduce the amount of St Johnswort seed produced is a worthwhile preventative tactic (Sampson 1930).
- Mechanical: Mowing can reduce seed production but promotes growth from rhizomes (CDFA[6]).
- Fire Management: Burning has been shown to promote Klamathweed seed germination and sprouting from roots (CDFA[6]).

Medusahead Grass (*Taeniatherum caput-medusae*)

Observed within Project: Along roads 1N01H, 1N01K, 1N02, 1N09Y, 1N11, 1N13, 1N13A, 1N13B, 1N18, 1N19, 1N26, 1N27, 1N34Y, 1N38, 1N39, 1N43, 1N48, 1N48A, 1N77, 1S30, 1S30B, 1S57, 1S62Y, 1S89, 2N11, FR1981 and FR4875 proposed for project maintenance under all alternatives, with the addition of 1N48B, 1N72 and 1S1806A in Alternative 1. Along road 1N09, 1N24, 1N32, 1N46, 1N79 and 1S25A proposed for road reconstruction under all alternatives, with the addition of 1S63Y in Alternative 1 and 184V422 in Alternative 3. Along 184V422 and FR4100 for temporary road construction in Alternative 1. In units K02, L02D, L04, L205. L206, M05B, Q07, V14C and V10 in all alternatives, with additional units L203 and L204 in Alternative 1 and L203B, L204A, M05B and V05A in Alternative 3 and 4.

Ecology

Medusahead grass is a winter annual species in the Grass Family. It is native to Spain, Portugal, southern France, Morocco and Algeria (Kan and Pollacck, 2000). Seeds germinate in the fall (Kan and Pollack, 2000) and over winter as seedlings. The roots of the seedlings continue to grow all winter and are able to tap deep soil moisture by spring. In the spring, Medusahead grass continues to grow and produce seeds after most other annual grass species have matured and completed their life cycles (Kan and Pollack, 2000). Seed is dispersed by wind, animals and human activities (Kan and Pollak, 2000). Medusahead displaces native and desirable non-native species. Because of its high silica content, Medusahead grass forms dense, deep mats of dead vegetation which decompose slowly. These dense mats then form barriers to the germination of other species (Kan and Pollack, 2000). Medusahead is unpalatable to cattle and wildlife except early in its growth (Kan and Pollack, 2000).

Control

- Prevention: A healthy stand of perennial vegetation appears to be the best barrier to medusahead invasion, as disturbed areas are especially susceptible (Dahl and Tisdale 1978). Medusahead invasions are most common on ranges or forestland in poor condition. Poor grazing management practices may accelerate the rate of spread, but proper management alone may not prevent invasion (Furbush 1953). Livestock avoid medusahead when more palatable forage is available, leading to an abundance of soil-stored medusahead seed (Murphy 1959). Proper stocking levels and the protection of soil resources are the best known land management practices preventing the establishment and spread of cool-season annual grasses in California.

- Mechanical: Spring plowing after most medusahead has germinated has given some control, with optimal results reaching 95% reduction. Besides removing germinating medusahead and preparing a seedbed for native species, cultivation may bury some medusahead seeds so deeply that they cannot emerge. Killing two successive crops of annual medusahead increases the chances of survival of seeded species, however, mechanical plowing is not feasible under many wildland conditions (Miller et al. 1999).
- Fire Management: Fire kills mature medusahead plant, however, immature plants may be only top-killed by early-season fire, and regenerate from their roots (Miller 1999). Fire also destroys many viable medusahead seeds, but sufficient numbers remain uninjured that reduction in plant density is usually temporary (Maret and Wilson 2000). Medusahead promotes further frequent fire by increasing fuel loads (Maret and Wilson 2000). Accumulated medusahead litter enables stand-replacement fires to occur in ecosystems that normally may have been fire-resistant (Young 1992).

Perennial Sweet Pea (*Lathyrus latifolius*)

Observed within Survey Area: Not known within project, however, it is known to occur within the Rim fire perimeter and is considered to have a moderate potential to invade or colonize areas disturbed by construction or other ground-disturbing activities.

Ecology

Perennial sweet pea is a perennial vine in the Pea Family. It is a garden ornamental that has escaped cultivation in many areas of California. Preferred habitat includes roadsides, riparian areas and other disturbed places up to 6,560 feet in elevation. The plants are often vigorous, deep rooted and can form dense colonies, excluding native vegetation. Reproduction is by both seed and rhizome-like roots. The plant is toxic to humans and livestock when ingested (DiTomaso and Healy 2007).

Control

- Prevention: The best preventative measure is removal of small infestations as soon as possible after they are located. If equipment is operating in an infested area, it should be thoroughly cleaned afterward to prevent the spread of the infestation.
- Mechanical: Perennial sweet pea can be controlled, but not eradicated by cultivation, close mowing, or manual removal of stems before plants can set seed (DiTomaso and Healy 2007).
- Fire Management: Burning can be an effective means to control large thickets, but as fires do not kill underground tissues, re-sprouts require continued follow-up mechanical control.

Puncturevine (*Tribulus terrestris*)

Observed within Project: Not known within project, however, it is known to occur within the Rim fire perimeter and is considered to have a high potential to invade or colonize areas disturbed by construction or other ground-disturbing activities.

Ecology

Puncturevine is an annual plant in the Caltrop Family (*Zygophyllaceae*). It is native to the Mediterranean regions of southern Europe. It germinates in late spring to early summer. The seeds are produced in woody burrs consisting of four to five nutlets, each having two to three long, sharp spines (CDFG[9]). The nutlets break loose and the spines become imbedded in vehicle tires, shoes and animal's feet. The nutlets eventually break away from the spines, leaving the seeds in a new location. Buried seed can bank in the soil for several years (CDFG[9]). Puncturevine is toxic to livestock (CDFG[9]). It grows in disturbed areas, especially road shoulders and pull outs.

Control

- Prevention: The best preventative measure is removal of small infestations as soon as possible after they are located. If equipment is operating in an infested area, it should be thoroughly cleaned afterward to prevent the spread of the infestation.
- Mechanical: Puncturevine is a prostrate plant. Due to its low stature, mowing is an ineffective means of controlling it (Wilen, 2006). Hand pulling is effective for small infestations (CDFA [n.d.]i). Tillage of young plants is also effective in controlling the plants but may bury seed pin the soil, potentially delaying germination for several years (CDFA [n.d.]i).
- Fire Management: Literature and web searches for puncture vine found no information available. However, puncturevine has been noted to germinate and proliferate post-fire.

Scotch Broom (*Cytisus scoparius*)

Observed within Project: Not known within project, however, it is known to occur within the Rim fire perimeter and is considered to have a moderate potential to invade or colonize areas disturbed by construction or other ground-disturbing activities.

Ecology

Scotch broom is a deciduous shrub in the Pea Family. It is native to Europe and North Africa (Bossard, 2000). It was planted throughout the Sierra foothills as a landscape shrub and has since escaped cultivation, capable of forming dense patches which crowd out native plants (Bossard, 2000; CDFA[1]). Scotch broom favors disturbed habitats such as roadsides but will grow in undisturbed areas including openings in forests (Bossard, 2000). Mature plants can produce three to twelve seeds per seed pod (McClintock, 1993), which are propelled away from the plant when the pod bursts open at maturity. A mature plant can produce more than 12,000 seeds in a year (Bossard, 2000). Seeds of Scotch broom can bank in the soil for as long as 30 years (CDFA[1]). The flowers, seeds and possibly foliage are toxic to humans and livestock (CDFA[1]).

Control

- Prevention: Minimization of soil disturbance, followed by immediate revegetation of any areas that must be disturbed through temporary impacts, along with equipment washing are the best ways to prevent infestation by Scotch broom. Once a large population is established, eradication is very difficult due to the large, long-lived seed bank that develops (DiTomaso and Healy 2007). However, careful removal of initial colonizers as described below can help prevent the formation of a colony.
- Mechanical: Remove individual plants in late winter to spring when the soil is moist and plants are most easily removed from the soil, using a weed wrench or similar tool to get as much taproot as possible. This is most efficient when removing the initial colonizers of an area to prevent a large infestation, but once a large infestation is present, spring hand pulling of successive generations is still thought to be the most effective method of control (Holloran et al. 2004). Untreated cut stems will re-sprout, and will require repeated cutting unless treated, although in medium to large shrubs, re-sprouting can be reduced by removing all of the bark from the cut stump down to ground level. Wherever mature plants are removed by pulling or cutting, seedlings will have to be treated for at least the following five to eight years to prevent a recurrence of the infestation (DiTomaso and Healy 2007).

- Fire Management: Burn-based control methods are not recommended for this species, due to the danger of fire spreading to tree canopies. In addition, burning can stimulate germination of seeds deeper than one inch in the soil seed bank as the result of heat scarification (Bossard, 2000).

Spanish Broom (*Spartium junceum*)

Observed within Project: Not observed within the Project area. However, it is known to occur just outside the Project perimeters and is considered to have a moderate potential to invade or colonize areas disturbed by construction or other ground-disturbing activities.

Ecology

Spanish broom is a yellow-flowered shrub in the Pea Family with many long, straight, dark green stems. It is widespread in drier coastal and interior regions of California up to 8,000 feet in elevation. The long-lived shrubs reproduce from abundantly produced seed, which remain viable for at least five years and potential up to 30-40 years (DiTomaso and Healy 2007). Spanish broom invades open sites on hot, dry hillsides, especially in chaparral areas. Spanish broom rapidly develops dense colonies that prevent establishment by native shrubs. These stands are considered a fire hazard and are of little value to wildlife (Nilsen 2000).

Control

- Prevention: Minimization of soil disturbance, followed by immediate revegetation of any areas that must be disturbed through temporary impacts, is the best way to prevent infestation by Spanish broom. Areas where ground disturbance impacts have occurred should be monitored until successfully revegetated to catch initial colonizers, which should be manually removed as described below. Once a large population is established, eradication is very difficult due to the large, long-lived seed bank that develops (DiTomaso and Healy 2007). However, careful removal of initial colonizers as described below can help prevent the formation of a colony.
- Mechanical: Remove individual plants in late winter to spring when the soil is moist and plants are most easily removed from the soil, using a weed wrench or similar tool to get as much taproot as possible. This is most efficient when removing the initial colonizers of an area to prevent a large infestation, but once a large infestation is present, spring hand pulling of successive generations is still thought to be the most effective method of control (Holloran et al. 2004). Untreated cut stems will re-sprout, and will require repeated cutting unless treated, although in medium to large shrubs, re-sprouting can be reduced by removing all of the bark from the cut stump down to ground level. Wherever mature plants are removed by pulling or cutting, seedlings will have to be treated for at least the following five to eight years to prevent a recurrence of the infestation.
- Fire Management: Burn-based control methods is not recommended for this species, due to the danger of fire spreading to tree canopies, however seedlings can be killed by flaming with a propane torch.

Spotted Knapweed (*Centaurea stoebe* ssp. *micranthos*)

Observed within Project: Along roads 1N24 and 1N49B proposed for road maintenance and 1S19 for road reconstruction for all project alternatives. Known from project unit Q14A in all alternatives.

Ecology

Spotted knapweed is a biennial or short-lived perennial shrub in the Sunflower Family. It is native to Europe. Some plants germinate after fall rains and over-winter as small rosettes of leaves. Others germinate in late spring. The rosettes can remain as such through the first year, but more often they grow stems and bloom, producing seed in the same year. Seed heads pop open at maturity, dispersing the seeds a short distance from the mother plant (CDFA[3]). The seeds can be vectored in the hair or feathers of wildlife, or by vehicles or road maintenance activities. In addition to producing seeds, spotted knapweed plants can reproduce vegetatively by lateral roots

(CDFA[3]). Plants can produce up to 40,000 seeds each (CDFA[3]). Spotted knapweed readily grows in disturbed sites. Locally it is usually found along roads.

Control

- Prevention: Prevention of spotted knapweed establishment is the most cost-effective control strategy (DiTomasio 2000). Prevention practices begin with the maintenance of healthy, desirable vegetation that is resistant to weed establishment. This includes minimizing soil disturbance in all activities and reestablishing desirable vegetation promptly whenever soil disturbance leaves areas of bare ground, with continued monitoring and immediate follow-up treatment of colonizing weeds, and/or revegetation with desirable species (DiTomasio 2000). Carefully monitor the intensity, frequency, and season of grass defoliation in grazing prescriptions so that grasses can tolerate grazing and resist weed invasion. The introduction of spotted knapweed seeds from infested areas to recently disturbed and/or uninfested areas can be limited by monitoring vehicle, livestock, and equipment movement. (USDA 2001).
- Mechanical: Mowing, hand-pulling, planting competitive species, and good range management may reduce the spread of spotted knapweed, but may not eliminate well established stands (Kelsey 1984). Tillage of soil can reportedly lead to the spread of spotted knapweed (DiTomasio 2000). This is especially likely in mature stands since tillage creates an ideal weed seed bed from which individuals in the seed bank may emerge. Consistent hand pulling can control spotted knapweed, although it is time and labor intensive. Entire plants must be removed before they produce seeds each year, and flowering plants should be removed from the site so no seeds are dispersed (Sheley 1998).
- Fire Management: Burning removes the top growth but the plants rapidly resprout from the crowns, possibly being stimulated to produce more seed than if not burned (CDFA[3]).

Tocalote (*Centaurea melitensis*)

Observed within Project: Along roads 1N01, 1N02, 1N11, 1N13, 1N18, 1N18A, 1N19, 1N24C, 1N34Y, 1N39, 1S23Y, 1S48, 1S49, 1S58F, 2N11, FR5606, FR8988 and FR99001 proposed for project maintenance under all alternatives. Along roads 1N96 and 1S80 proposed for road reconstruction under all alternatives. Known from project units L206, M201 and N01 in Alternative 1 and L204, L205, M201 and M203, M204 in Alternatives 3 and 4.

Ecology

Tocalote is a yellow-flowered winter annual in the Sunflower Family that is mostly found along roadsides and in other disturbed sites up to 7,170 feet in elevation in California. Tocalote is an aggressive invader and readily displaces native and desirable non-native plant species. The growth pattern of tocalote is somewhat similar to yellow star-thistle, but flowering occurs earlier in the year and the plant is smaller. Tocalote produces a rosette in the early part of the growing season, then bolts and flowers in late spring or early summer. Tocalote reproduces only from seed, and individual plants can produce as many as 6,000 seeds (DiTomaso and Gerlach 2000). Tocalote seed does not travel far by wind. It is dispersed primarily by human activities and animals (CDFA[4]).

Control

- Prevention: When working in areas infested with tocalote, equipment (including undercarriages) should be carefully cleaned before moving to a non-infested area. The collection and export of fill soils and erosion control material from infested areas should be avoided or minimized to the maximum extent practicable.
- Mechanical: Mowing can provide effective treatment of infested areas if mowed at the correct time, which is immediately after the earliest 2% to 5% of plants have begun to produce flower heads, usually in April or early May (DiTomaso and Healy 2007). Mowing too early may cause plants to become bushier and produce more flower heads. Treatments (including hand pulling) should continue for at least two to three years, after which spot eradication may be required indefinitely.

- Fire Management: Prescribed burning of tocalote can reduce populations if timed correctly, but to avoid heavy damage to native vegetation, burns should be timed to occur after other annual plants have dried but before tocalote seeds are produced. Due to its late spring-early summer flowering period, burning may be difficult to implement for tocalote. However, an experimental study showed that during three years of prescribed fires, non-native forb biomass increased 18,000% from pre-burn levels and was largely composed of tocalote, which went from non-existent in pre-burn plots to comprising 46.3% of total biomass three years later (Parsons and Stohlgren 1989), suggesting that fire management of tocalote may provide mixed results of success.

Woolly Mullein (*Verbascum thapsus*)

Observed within Project: Many mapped and un-mapped populations are scattered across the Project area. Also known from quarry sites 33 and 61.

Ecology

Woolly mullein, also called common mullein, is a tall biennial herb in the Figwort Family (*Scrophulariaceae*). Woolly mullein grows in open disturbed sites, moist meadows, creek drainages, roadsides, river banks, logged sites and burned areas (Pitcairn, 2000). It can invade undisturbed sites and displace native herbs and grasses (Pitcairn, 2000). Woolly mullein spends its first year as a basal rosette of very fuzzy leaves. In the second year of growth, it bolts, producing a long stalk of flowers by June. After producing seeds, the plant dies. Each plant can produce 100,000 to 240,000 seeds (Pitcairn, 2000). Most seeds fall close to the parent plant although some can be dispersed as far as 36 feet (Pitcairn, p. 2000). Seeds might remain viable in the soil for more than 100 years (Hoshovsky, 1986). Woolly mullein is unpalatable to cattle and sheep due to the dense hair on the leaves (Hoshovsky, 1986).

Control

- Prevention: Given the long-lived seed bank and wide range occupied by common mullein, transportation of soil or erosion control materials may introduce or encourage common mullein establishment. Increased levels and frequencies of disturbances may also increase the density of the common mullein seed bank (Korb et. al 1975).
- Mechanical: Plants severed through the root crown below the basal leaves do not re-sprout (Bossard et. al. 2000). Flowering stalks should be removed from the site to limit additions to the seed bank.
- Fire Management: Prescribed burning kills plants in both the rosette stage and the bolted or flowering stage (Pitcairn, 2000). However, given a seed source, mullein establishment on burned sites is nearly guaranteed since some seed survival on burned sites is likely (Hunter and Omi 2006).

Yellow Star-thistle (*Centaurea solstitialis*)

Observed within Project: Along roads 1N01, 1N17, 1N18, 1N25, 1N27, 1N27B, 1N31Y, 1N35, 1N43, 1N48, 1N48A, 1N48B, 1N67, 1S21Y, 1S23, 1S23D, 1S23Y, 1S26, 1S30, 1S57, 1S58, 1S66A, 1S80, 1S85, 1S98Y, 2N11, 2N11F, FR5606, FR8988 and FR99001 proposed for project maintenance under all alternatives. Along road 1N01E, 1N96, 1N96E, 1S03B, 1S08Y, 1S14 and 1S80 proposed for road reconstruction under all alternatives with the addition of 1N79 in Alternative 1. Along FR4100 for temporary road construction in Alternative 1. Known from project units L202, L203A, N01, V13, V14B, V14C, X04, X06, X119 and Y03 in Alternative 1 and L202, L203, M202A, N01, V13, V14B, V14C, X04, X06 and X119 in Alternatives 3 and 4.

Ecology

Yellow star-thistle is a deep-rooted winter annual forb in the Sunflower Family. Yellow star-thistle inhabits open hills, grasslands, open woodlands, fields, roadsides, and rangelands. This species is considered one of the most serious rangeland weeds in the state (Cal-IPC 2008). Yellow star-thistle is extremely invasive, and at present is spreading in mountainous regions below 7,500 feet in elevation (DiTomaso and Gerlach 2000). It reproduces from seed, and each plant is capable of producing up to 75,000 seeds. Seeds can remain viable in the soil for up to ten years (Callahan et al. 1993). One reason for yellow star-thistle's extreme invasiveness is its ability to grow vigorously late in the season, when most native plants are dormant. It is highly competitive with native plants, especially in grazed areas, and is capable of forming monocultures that maintain dominance over an area for many years.

Control

- Prevention: Ground disturbance or ill-timed mowing may increase infestation occurrence and severity. Much like tocalote, intense infestations may be avoided through responsible range management, including the appropriate stocking of susceptible rangelands. Vegetation should shade as much of the soil surface as possible to discourage yellow star-thistle growth (Zouhar 2002).
- Mechanical: Cutting can provide effective treatment of infested areas if mowed at the correct time, which is immediately after the earliest 2% to 5% of plants have begun to produce flower heads, usually in June (DiTomaso and Healy 2007). Cutting too early may cause plants to become bushier and produce more flower heads. Treatments should continue for at least two to three years, after which spot eradication may be required indefinitely. Cut immediately after the earliest 2% to 5% of plants have begun to produce flower heads (May/June). Additionally, hand-pulling may be used as a follow-up treatment for re-sprouting yellow star-thistle rosettes produced by root fragments remaining in the soil or for smaller infestations.
- Fire Management: Prescribed burning of yellow star-thistle can reduce populations if timed correctly, similar to mowing-based treatments. Burning should occur after other annual plants have dried but before yellow star-thistle seeds are produced (DiTomaso and Healy 2007). However, burning also creates favorable growing conditions for yellow star-thistle seed in the soil seed bank and must be followed by other treatments or burning in the next two years to have an impact on the numbers or size of an infestation (DiTomaso, 2001).

WEED STRATEGIES CONSIDERED BUT NOT DEVELOPED FOR THIS PROJECT.

A number of weed management strategies were considered for the Rim Fire Project. The reasons for not selecting these methods for further development in the proposed action or management requirements are detailed below.

1. Herbicide treatment for weed control or eradication.

   Properly timed and planned herbicide treatment is usually the most economical and effective method to control or eradicate weeds. There is normally a high level of environmental analysis with high levels of resource study and effects analysis needed to gain approval to use herbicides in the National Forests in California. Herbicide use in the proposed project would primarily be mitigation for the effects to weeds caused by the salvage, hazard tree removal and road work project activities. Since the purpose and need of the project is not weed eradication or control, the proposed project would bear the brunt of the environmental analysis expense and would also be subject to any appeals or litigation which might result from the herbicide treatment proposal. Herbicide treatment was, therefore, not developed for further study.

2. Mechanical Removal of Noxious Weeds

   Cultivation (disking) or repeated mowing can be used in agricultural or urban settings where the ground is reasonably flat, with some success in controlling but not eradicating weeds such as yellow star-thistle or tocalote. For some species, such as Medusahead, disking or mowing may actually exacerbate the infestation.

The nature of the soils in the project area would impede the use of cultivation in most of the units. The soils are quite rocky, creating hazards and barriers to cultivating and mowing equipment. In addition, the soils in some units are part of a highly specialized lahar ("lava cap") geological formation consisting of fairly shallow soils among the rocky andesitic tuff breccia. Cultivating these soils would irreparably damage the soil structure and the wildflowers and other specialized plants which grow there.

Cultivation would be mostly non-selective. All vegetation which comes into contact with the equipment would be damaged or killed. Native and desirable non-native species would not be retained where the treatments are applied. Due to all of these concerns mechanical removal of weeds was not developed further.

3. <u>Use livestock grazing to treat noxious weeds</u>.

Grazing animals are not particularly selective of the plants they eat. In other words, they do not select only weeds to consume. In fact, grasses, particularly native perennial grasses are preferred by cattle over forbs (broadleaved species) (Olson, 1999). With the grazing pressure on the perennial grasses, there is less competition for nutrients and moisture against the non-native annual grasses and broadleaved species, such as cheat grass, Medusahead grass and yellow star-thistle, leading to greater numbers and densities of these weedy species (Olson, 1999).

Intensive grazing can result in the equal reduction of all forage species including the desirable species preferred for recolonizing an infested site (DiTomaso, 2001). Goats strip the leaves and soft new growth on branches of trees as high up as they can reach. If left in a confined situation, cattle eat the soft new growth of conifers. These effects would not be acceptable in a burn area where the intent is to encourage native plant regeneration.

Livestock grazing requires some sort of fencing. Often in this type of management, electric ribbon or portable corral panels are used. This method is labor intensive in that a wrangler or shepard needs to monitor the animals on a daily basis to ensure that the site isn't being over-grazed or otherwise adversely affected. The fencing or panels have to be moved from one site to the next.

Just as the use of herbicides engenders a negative reaction for some people, grazing is also thought by some to be a highly controversial land management activity. The level of analysis needed to implement grazing as a follow-up weed treatment method in the project would be an unacceptable burden. When the additional cost for the analysis and the risk of appeals or litigation which could stop the proposed project are combined with all of the issues mentioned above, grazing livestock for weed control is not feasible for this proposed project.

4. <u>Use biological control to control noxious weeds</u>.

Biological control agents work over a long-term. It takes five or more years after initial release of the insects for their numbers to build sufficiently to make a noticeable difference in weed densities or numbers. Even established biocontrol insects are not capable of building sufficiently within one year to control a flush of weeds caused by a disturbance event or activity. In fact, a disturbance event, such as a prescribed burn, might impact the insects themselves, possibly reducing the numbers available to respond to a flush of weeds. The inability of the insects to respond quickly to a flush of weeds makes them undesirable as a mitigation weed treatment in the project.

EFFECTS OF THE PROPOSED PROJECT.

Alternative 1 (Proposed), Alternative 3 and Alternative 4

Direct and Indirect Effects

Within every alternative there are three major ways that project-related activities and impacts could contribute to an increase in invasive plants: (1) the creation of conditions that favor establishment of invasive plant (weed) species, such as soil disturbance, removal of native vegetation, breakup of cryptogamic crusts;[1] (2) spread of new and pre-existing weed infestations into newly disturbed areas via project tools, equipment, and personnel; and 3) the subsequent release of pre-existing weed seed banks from dormancy; or the quick build-up of new weed seed banks on disturbed soils.

Disturbance by heavy equipment can have long-term effects to soils and favor weed establishment if unmitigated. Heavy equipment can compact soils, reducing water infiltration and accelerating erosion. They can also displace soils and sheer off vegetative roots. If these effects are severe, a loss of soil productivity may occur. Numerous passes by equipment over vegetation often causes plant mortality or severe injury, thus exposing the soil organic layer and making it more susceptible to erosion. Loss of vegetative cover and the soil organic layer reduces the ability of the soil to hold moisture. Many weed species are more capable of utilizing less productive soils with less soil moisture. In addition, some weeds produce secondary chemical compounds that inhibit native plant germination and growth. These compounds also affect nutrient cycling rates by inhibiting soil microbial fauna activity (Sheley et.al.1999).

Maintenance, reconstruction and the creation of roads can also spread invasives. Grading disturbs soil and competing native vegetation in addition to dispersing soil, weed seeds and plant parts. Cleaning ditches, grading, installing overside drains and road construction moves soil and creates ideal weed seedbeds. Seeds from equipment can be deposited in stream crossings and washed downstream. This movement of weed seed/parts can happen at any time of the year since the seeds and parts are present in the soil at infested sites at all times of the year. Stockpiles of crushed aggregate can also be infested with weeds. Weeds are dispersed when that aggregate is moved to a new location. This translocation of weed seed is of particular concern when dispersal vectors (streamside, areas of high human use, fire staging and action areas, roads, etc.) are nearby.

Even those project sites in remote native communities may be expected to contain an existing weed seed bank. Seed banks are known to regularly contain a different suite of species than is represented by the standing vegetation due to succession, low reproduction rates of some perennials (by seed), and other factors (Thompson, 2000). In most cases it is rare to find species in the seed bank that are not represented to any degree in the above-ground vegetation; the exception being seeds from invasive, aggressive, disturbance-adapted, and early colonizing weeds (Thompson, 2000). For example, large cheatgrass seed banks are commonly found throughout western North America, often regardless of such factors as remoteness of the site, grazing, or fire history. Within intact communities however, these seeds are typically held in the above-ground vegetation or in crevices on cryptogamic

[1] Crypotogamic crusts are biological soil crust composed of living cyanobacteria, green algae, brown algae, fungi, lichens, and/or mosses.

crusts. Germination is therefore prevented until disturbance allows the cheatgrass seeds to come into contact with broken soil surfaces (Boudell et al., 2002).

Following establishment, new populations of weeds are often extremely difficult to eradicate and even if controlled or eradicated it may take several years or decades to re-establish the native soil structure and biota. If allowed to expand, dense infestations can occur that not only displace native plants and animals, but also threaten natural ecosystems by fragmenting sensitive plant and animal habitat (Scott and Pratini 1995). For example, when equipment disturbance activities introduce or release weeds, the vegetative pattern is changed, often providing more flammable fuels into the system. As the weeds spread and increase in volume, an increase in ladder fuels occurs. Weeds such as Scotch broom, Medusahead/barbed goatgrass grass, yellow starthistle and others, change the arrangement of vegetation, the amount of soil moisture at specific times of the year, the amount of fuel available to burn, and how fire behaves (Keeley et. al. 2011). These changes in fire behavior often mean that areas that previously would not ordinarily burn frequently or at high intensity are now doing so (DiTomaso and Healy 2007). This is especially a concern in dry lava cap areas where weed species compete with sensitive plants.

Cumulative Effects

Factors which are not planned and difficult to control (e.g., wildfire, dispersed recreation use, grazing, climate change) would likely have the greatest cumulative impact to native plant communities from the expansion of invasive plants for Alternatives 1, 3 and 4 of the project. Fully implementing any of these alternatives would add to this cumulative effect. For the purpose of this analysis, cumulative effects of past activities or natural events are represented within the existing conditions.

Appendix B of the Rim Recovery Project Environmental Impact Statement (EIS) provides a list and description of present and reasonably foreseeable projects, including private lands within the Rim Fire perimeter. All of these present and future activities will contribute to effects on invasive plant proliferation. Within the project area, hazardous fuels reduction and hazard tree removal are anticipated to occur within the next few years on approximately 16,107 acres of NFS, 816 acres on NPS and 18,407 acres on private lands (see Appendix B of EIS). These projects are the primary activity that will alter forest vegetation and impact invasive plants; most of the weed risk assessments for these projects show the risk to be moderate if management requirements are followed. Recreation management, road and trail work and decommissioning of unauthorized routes account for approximately 96 miles of additional potentially ground disturbing activities (anticipated to occur in the foreseeable future). Livestock grazing within the project area (13 allotments) may also proliferate weeds. All of these activities (in addition to other recreation activities such as dispersed camping) were ranked as low to moderate risk.

These present and future projects are cumulative in nature in that some of them overlap spatially with the project areas, but all of them impact the ability of the Forest Service to feasibly and adequately manage invasive plant proliferation. With all the different projects occurring across the forest (BAER treatments, hazard tree removal, fuel treatments, etc), several of which are thousands of acres in size, in addition to the large size of the Rim Fire itself, it becomes very difficult to physically visit all the affected areas, let alone perform time consuming hand removal of invasives in an adequate manner. Because of overlapping implementation timeframes of this project and above mentioned projects, it is also difficult to acquire the trained personnel necessary for mitigating (survey/treatment) project impacts.

Alternative 2 (No Action)

Direct and Indirect Effects

Under this alternative, areas which currently have invasive plants would continue to support these species, providing seed sources for dispersal into adjacent areas. However, the no-action alternative would eliminate the high likelihood of directly and indirectly spreading weeds from salvage, hazard tree removal and road construction activities (in Alternatives 1, 3 and 4). The reduction in invasive plant spread would equate to lower risk for vegetation type conversion to non-natives and better habitat and hydrologic function throughout the project area.

On the other hand, there is the potential that the no action alternative will indirectly increase invasive plant proliferation. If fuel reduction activities in overstocked timber areas are not completed, it is possible that during the next wildfire event, vegetation and soil burn intensity and severity may be exacerbated. As discussed above, these more intense or severe fires may be beneficial to weed proliferation in that the native vegetation recovery may be slowed, releasing invasive species from greater competition. However, when comparing the potential effects of the different project activities, invasive plant proliferation impacts associated with the action alternatives are of greater scope and magnitude than the impacts of no action.

<u>Cumulative Effects</u>

As stated above within the cumulative effects section (for Alternatives 1, 3 and 4), all the activities and factors listed in Appendix B of the EIS may cumulatively affect the proliferation of invasive plant species. Factors that are not planned and difficult to control (e.g., wildfire, dispersed recreation use, grazing, climate change) would likely pose the greatest risk of proliferating invasive plants. The no action alternative however, would not add to these cumulative impacts.

Summary of Effects Analysis across All Alternatives

The risk of creating new or expanding populations throughout the project area differs depending on a variety of factors, regardless of the risks associated with spreading existing weed populations through travel routes or on project equipment. These risks are affected by factors including the following:

- *<u>Species-specific dispersal traits of weeds.</u>* Weed species with seeds dispersed by wind (Italian thistle), by tumbleweed (shortpod mustard), water (tamarisk), or by animals (Medusahead grass) can potentially spread weed propagules miles from their original sources. Most seeds are not moved far from the parent plant, but a small proportion of seeds can be found large distances away. Even propagules with low innate dispersal abilities, such as stem fragments of giant reed or castor bean seeds that fall close to the plant, can be carried far after initial dispersal by streams or surface runoff. However, species without wind, water, or animal-mediated dispersal are less likely to disperse propagules far from the original source.
- *<u>Habitat being disturbed.</u>* While many weed species are generalists that can potentially colonize a fairly wide range of vegetation types, it is true that some habitats, particularly those with ample nutrients and soil moisture or those that have been recently disturbed, are more susceptible to invasion. Additionally, the suite of weed species that one would expect to colonize a site is dependent to some degree on the habitat where the disturbance occurred.
- *<u>Regional patterns in weed occurrence and propagule pressure.</u>* The project occurs across a transitional area with regards to microclimate, elevation, and vegetation communities. The most commonly observed weeds differed within these areas, possibly due to species-specific habitat preferences.
- *<u>Type of ground disturbance.</u>* The type of disturbance creates conditions favoring release and establishment of different weed species. For example, tree removal is expected to favor the establishment of weed species that do best in full sun, such as yellow starthistle; burning is expected to favor the establishment of fire-adapted weed species such as French broom; and soil disturbance is expected to favor the establishment of early-colonizing weed species, such as mustards or tocalote, that respond favorably to disturbed, denuded soils.

These factors were used to consider the risks associated with the establishment of new weed infestations due to project activities. In addition to these four factors, the results of the risk assessment were focused on risks associated with 1) the release of pre-existing but currently dormant weed seed banks at disturbed sites, 2) the rapid build-up of transient weed seed banks at disturbed sites, and/or 3) the creation of conditions favoring weed establishment at disturbed sites. The risks are labeled "high, moderate and low," and are defined as follows:

High: Chances of weed species infesting new areas range between 76-100%.

Moderate: Chances of weed species infesting new areas range between 31-75%.

Low: Chances of weed species infesting new areas range between 1-30%.

Each of the project alternatives are expected in general to be in the high risk category (76-100% chance) for the potential establishment of new populations of the invasive species listed as being high and moderate priority in Table 1. This high risk ranking was chosen after careful consideration of the four factors and the three major risks listed in the paragraph above. In other words, for each of the three major risks 1) release of seed bank, 2) build-up of weed seed, and 3) creation of conditions, the ranking was determined to be in the high category for each of the project alternatives. Those portions of the zones that are outside of the historic fire burn return interval (i.e. burning more or less frequently) are expected to have an even higher risk (still in high risk category) of experiencing vegetation type conversion in the project areas.

Management requirements for Alternative 1 (proposed action) will help reduce the risk of spreading weeds from known dense infestations over 4,000ft and high priority invasive infestations, but not enough to warrant a lowering of the risk ranking from high to moderate.

Management requirements for Alternatives 3 and 4 (e.g., implementing equipment cleaning; designating the unit completion order to work in un-infested units before infested ones; using certified weed free mulches and rock/soil sources; pre-project surveys, manual treatment and avoidance of high and moderate priority weeds.; and removal of weedy topsoil at landing/staging areas) will help to reduce the risk of establishing new populations of (high and moderate priority) invasive species from a high to a moderate ranking (31-75% chance of new infestation). However, these design features will more than likely not reduce the high risk ranking for the spread of common invasives, which are typically some of the biggest contributors to vegetation type conversion and habitat degradation. The project design features will not alleviate the risk for these invasives because under Alternatives 3 and 4, they are not required to be avoided or removed.

All the alternatives, with the exception of the no action alternative (Alternative 2), have roughly the same affected environment and acreage of invasive plant species across similar project actions (salvage removal units, hazard tree removal and roadside work) (Tables 4, 5, 6). The direct, indirect and cumulative effects are also expected to be very similar. In terms of the risk of spreading invasive species, the main difference between the alternatives lays in the details of the management requirements. As discussed in the paragraphs above, Alternatives 3 and 4 have a lower risk of invasive weed spread and proliferation than Alternative 1. While the difference between Alternative 3 and 4 for invasive plant impacts is very slight, Alternative 4 does have a lower acreage of known weed infestations, salvage removal units and road work (especially new construction and reconstruction). Alternative 4 also has the highest amount of project acreage that is within the historic fire return interval, potentially making it slightly less susceptible to weed invasion. Of all the alternatives, Alternative 2 has the lowest direct, indirect and cumulative impacts for invasive plant introduction and proliferation, given the lack of associated ground disturbance and movement of equipment/personnel.

<u>RISK ANALYSIS</u>.

NOXIOUS WEEDS KNOWN OUTSIDE PROJECT BOUNDARIES.

Within several miles of the Rim Recovery Project boundary, there are areas known to be infested with bachelor buttons, Johnsongrass and Spanish broom. In addition, during the suppression of the Rim Fire equipment and vehicles from all over the United States were brought into the project area. It is highly likely that the equipment and vehicles brought reproductive plant parts of different invasive species in their wheel wells, tires/tracks and undercarriages that was then translocated to the project area. A weed washing station was not utilized during the initial attack response stage of the fire, nor for several days afterwards. It is also possible that adequate washing procedures were not followed by all personnel.

Risk: High without management requirements incorporated, Moderate with requirements for all action and no action alternatives. This is due to the large number of heavy equipment and vehicles (likely over 300) moving across the project area, often off of roads, during Rim Fire suppression activities.

HABITAT VULNERABILITY.

Depending on the alternative, the entire project area totals around 50,000 acres. The project area occurs in the footprint of the Rim Fire of 2013, which was disturbed not only by the wildfire itself, but suppression activities (e.g. dozerlines, safety zones, camps, safety areas, etc). Prior to the fire much of the area was generally fairly dense with forested or chaparral vegetative canopy cover. In much of the burned area, the fire has removed the forest canopy cover and ground vegetation as well as decreased the litter and organic matter. Studies have found that canopy cover is an important factor in the establishment of non-native plant species, with areas that retain higher cover having the lowest risk of weed invasion (Rejmanek 1989). Reduction of canopy cover has created a more open habitat allowing species adapted to higher light environments, such as star thistle, tocalote and dyer's woad, to spread into and to become established in new areas. Removal of ground vegetation has decreased the barriers to weed seed spread by wind and other vectors. Weed species that are easily spread by wind such as thistles and grasses, can move into new areas. In addition, removal of litter and organic matter during the fire increases bare mineral soil that often triggers many invasive species to germinate (Zouhar 2008). Potential increases in water and nutrient may allow these plants to produce greater volumes of seed and increase the rate of spread over the next few years. (Zouhar 2008).

In areas of high fire severity the potential risk from the spread of noxious weeds is increased. One study found that there was a greater abundance of nonnative species following high severity fire than after low severity fire (Keeley et al. 2003). This is probably due to the increased amount of open canopy, disturbed soil and reduction in barriers to weed spread. Potential spread is also correlated to the abundance of existing weed richness and abundance (Zouhar 2008). Since much of this project occurs along roadsides and other habitats with a history of past disturbance and a large number of existing infestations, there is the greater potential for spread.

Risk: High for all alternatives. Management requirements do not address these impacts.

NON-PROJECT WEED VECTORS.

Weed vectors that currently are in the project area and surrounding vicinity include: OHV trails, roads, powerline right of ways, private lands, Forest management activities, wildlife, recreationists including horse riders, and Forest Service workers. Livestock grazing is also a vector for weed dispersal.

Past disturbance and adjacency to transportation systems can increase the vulnerability of habitats to noxious weed introduction and spread. Roads are a common method for new weed species to be spread into natural areas. Roads provide greater access to the adjacent habitat increasing its use for recreation or other activities that create disturbance. Roadside habitats may also have a longer history of anthropomorphic disturbance and past introduction of non-native species. As a result roadside habitats often contain more noxious weeds and are more susceptible to weed spread than areas farther from roads (Zouhar 2008). Lands adjacent to private may also be more vulnerable to weeds. Because there is often limited management for invasive species on private property, weeds can spread from private to adjacent public land. Power line maintenance also creates areas of open, habitat that is vulnerable to noxious weed establishment. Overall, the areas that are included in the Rim Recovery project are vulnerable to noxious weed spread as a result of past disturbance and increased adjacency to existing weed populations. Due to the extent of the combined impacts from all of these above listed weed sources and vectors there is a great potential for weed spread.

Risk: High for all alternatives. Management requirements do not address these impacts.

HABITAT ALTERATION EXPECTED AS RESULT OF PROJECT.

Habitat alteration has already occurred within the project area as a result of the 2013 Rim fire. The additional activities proposed in the project have varying levels of risk for creating further habitat alteration. For a detailed description of all proposed project activities refer to the Rim Recovery EIS, Chapter 2.

<u>Salvage Logging:</u> This activity will be accomplished by three types of equipment and their associated methods: helicopter, skyline and ground. The majority of the salvage acreage will be treated by tractors in the ground based method, with helicopter and skyline acreage making up approximately 15% of the total salvage area. Ground based salvage is expected to result in a high to moderate level of habitat alteration as the heavy equipment employed will be tracking and skidding over the majority of the units. This will uproot and/or crush resprouting native vegetation and disturb soil in the already impacted burned landscape. Skyline and helicopter operations are expected to result in a lower level of habitat alteration as there will be no heavy equipment tracking in the units. However, in all salvage units the majority of the canopy cover will be removed, opening the areas up to increased sunlight and solarization. As discussed above, invasive plant species thrive in these conditions of increased light, heat, soil disturbance and removal of native species competition. *Risk: High for ground based salvage, moderate for skyline, low for helicopter.*

<u>Fuel Treatments (biomass removal, mastication, drop and lop, machine piling and burning, jackpot burning)</u>: Biomass removal, mastication and machine piling and burning all entail the use of heavy equipment to remove or pile dead trees and brush. These activities will have the same impacts as described above under salvage logging with heavy equipment. Drop and lop and jackpot burning have far fewer impacts to habitat as the work is accomplished by hand and does not create as much soil or vegetation disturbance. However, as described above, all these fuel treatment methods reduce the canopy cover and open areas up to increased weed invasion. *Risk: High for biomass removal, mastication and machine piling, low for drop and lop and jackpot burning.*

<u>Roadside Hazard Tree Removal</u>: This project activity is very similar to ground based salvage logging as roadside hazard trees will be removed via heavy equipment along skid routes. Trees will not be skidded along great distances as established roads will be within 200-300 feet, meaning ground disturbance and native plant removal should be more minimal, unless the concentration of hazard trees is high. However, since invasive plant infestations tend to be the most prolific along roadsides (where canopy is more open, disturbance impacts are more consistent and frequent and vectors are abundant) the threat of habitat alteration in the areas disturbed by hazard tree removal is high to moderate (depending on the concentration of hazard trees and the overlap with weed infestations). *Risk: High to moderate.*

Landings/Staging Areas: The ground disturbance from re-opening old landings/staging areas or constructing new landings/staging can create additional suitable habitat where introduced noxious weed seed can become established. Overall, based on estimates of landing size and frequency, landings would represent less than 5% of the total project area, which is small relative to the total area within the project. *Risk: Moderate*

Road Maintenance, Reconstruction and New Construction: Road maintenance involves the least amount of new ground disturbance, with heavy equipment almost entirely operating in existing roadbeds. Reconstruction involves more disturbance as some vegetation along edges or in the middle of roads will be removed and soil compacted. New road construction will require the most habitat alteration as areas will be converted to roadbed. The risk of weed invasion into these areas corresponds to these varying levels of ground disturbance. *Risk: High for new construction, moderate for reconstruction, low for maintenance.*

Rock Quarry Sites: Of the seven quarry sites proposed for use in the project, three are known to have low and/or moderate priority invasive plant populations. The three invasive species that occur in the sites are all more commonly spread across the Stanislaus National Forest. While movement of rock and material from these quarries may also transport invasive seed, these low/moderate invasives carry less risk for habitat alteration throughout the project area. *Risk: Moderate*

Overall Risk: Beyond the already high habitat alteration risk from invasive plant spread caused by the Rim Fire, project activities are expected to have a combined high risk of habitat alteration. If implemented correctly management requirements are expected to lower the habitat alteration risk due to invasive spread to Moderate for Alternatives 3 and 4, but not for Alternative 1, which does not have requirements that mitigate as many project disturbances. For the no action alternative the risk from habitat alteration from project activities is none as project activities will not occur.

INCREASED VECTORS AS A RESULT OF PROJECT IMPLEMENTATION.

Due to the large numbers of weed infestations within the project, weed seed is expected to be vectored among infested project units by the salvage equipment, by vehicles/equipment traveling along infested roads, or by workers in their clothes and boots. Removing vegetation canopy cover would open areas to more use by OHV users, range cattle and wildlife, thereby increasing the possibility of weeds being vectored to uninfested areas.

Risk: High without management requirements incorporated for all alternatives. Moderate with requirements for Alternatives 3 and 4 and High for Alternative 1. For the no action alternative the risk from increased vectors from project activities is none as project activities will not occur.

ANTICIPATED RESPONSE OF NOXIOUS WEEDS TO PROPOSED ACTIONS.

Implementing Management Requirements as part of the proposed action of the Rim Recovery project reduces the risk of introducing new noxious weeds and spreading existing infestations as the result of most project activities from an overall High down to a Moderate Risk for Alternatives 3 and 4. Careful application of the management requirements with regard to pretreating existing population and careful equipment washing and avoiding existing weed locations can successfully minimize the risk from this project. However, the requirements alone cannot eliminate the risk of weed spread in this project, nor reduce the risk to low given the habitat vulnerability within the project area due to the impacts of the Rim Fire. For Alternative 1 the overall risk ranking would remain at a High level, due to the lack of more protective or mitigating management requirements.

Implementing the Rim Recovery project *without* implementing all of the management requirements in Alternatives 3 and 4 would impart a high risk of introducing new infestations of noxious weeds, depending on where the equipment, vehicles or workers had been previously. If the land where the equipment and operators previously worked was infested with noxious weeds, moving the equipment to the project site without first cleaning the equipment would most likely result in new infestations in the project area. Moving equipment and personnel through existing weed infestation would also most likely result in the spread of weeds within the project area.

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APPENDIX A

Noxious Weeds and Non-native Invasive Pest Plants
Of Concern
Stanislaus National Forest

Russian knapweed,	*Acroptilon repens*	perennial
jointed goat grass,	*Aegilops cylindrica*	annual grass
barbed goat grass,	*Aegilops triuncialis*	annual grass
tree of heaven,	*Ailanthus altissima*	deciduous tree
capeweed,	*Arctotheca calendula*	annual
prostrate capeweed,	*Arctotheca prostrata*	perennial herb
giant reed,	*Arundo donax*	perennial grass-wet drainages, ponds
black mustard,	*Brassica nigra*	perennial
cheat grass,	*Bromus tectorum*	annual grass
plumeless thistle,	*Carduus acanthoides* ssp. *acanthoides*	biennial
Italian thistle,	*Carduus pycnocephalus* ssp. *pycnocephalus*	annual
slenderflower thistle,	*Carduus tenuiflorus*	annual
smooth distaff thistle,	*Carthamus creticus*	annual
woolly distaff thistle,	*Carthamus lanatus*	annual
purple star-thistle,	*Centaurea calcitrapa*	annual to perennial
diffuse knapweed,	*Centaurea diffusa*	annual to perennial
Iberian star-thistle,	*Centaurea iberica*	annual to biennial (perennial?)
tocalote,	*Centaurea melitensis*	annual
yellow star-thistle,	*Centaurea solstitialis*	annual
spotted knapweed,	*Centaurea stoebe* ssp. *micranthos*	perennial
squarrose knapweed,	*Centaurea virgata* ssp. *squarrosa*	perennial
rush skeletonweed,	*Chondrilla juncea*	perennial
Canada thistle,	*Cirsium arvense*	perennial
bull thistle,	*Cirsium vulgare*	biennial
field bindweed,	*Convolvulus arvensis*	perennial vine
jubata grass,	*Cortaderia jubata*	perennial grass
pampas grass,	*Cortaderia selloana*	perennial grass
Bermuda grass,	*Cynodon dactylon*	perennial
Scotch broom,	*Cytisus scoparius*	deciduous shrub
foxglove,	*Digitalis purpurea*	biennial herb
stinkwort	*Dittrichia graveolens*	annual herb
longbeak stork's bill,	**Erodium botrys*	annual herb
shortfruit stork's bill,	**Erodium brachycarpum*	annual herb
redstem filaree,	**Erodium cicutarium*	annual herb
greenstem filaree,	**Erodium moschatum*	annual herb
Medusahead grass,	*Elymus caput-medusae*	annual grass
quackgrass,	*Elymus repens*	perennial grass
oblong spurge,	*Euphorbia oblongata*	perennial
leafy spurge,	*Euphorbia virgata*	perennial
fennel,	*Foeniculum vulgare*	perennial
French broom,	*Genista monspessulana*	deciduous shrub
shortpod mustard	*Hirschfeldia incana*	annual herb
hydrilla,	*Hydrilla verticillata*	aquatic herb

Klamathweed,	*Hypericum perforatum ssp. perforatum*	perennial
dyers woad,	*Isatis tinctoria*	perennial
perennial sweetpea,	*Lathyrus latifolius*	perennial
whitetop,	*Lepidium appelianum*	perennial
lens-podded hoary cress,	*Lepidium chalepense*	perennial
heart-podded hoary cress,	*Lepidium draba*	perennial
perennial pepperweed,	*Lepidium latifolium*	perennial, wet sites
oxeye daisy,	*Leucanthemum vulgare*	perennial
Dalmation toadflax,	*Linaria dalmatica* ssp. *dalmatica*	perennial
purple loosestrife,	*Lythrum salicaria*	perennial
parrot feather watermilfoil,	*Myriophyllum aquaticum*	aquatic herb
Eurasian milfoil,	*Myriophyllum spicatum*	aquatic herb
black locust,	*Robinia pseudoacacia*	deciduous
Himalayan blackberry,	*Rubus armeniacus*	perennial vine
cutleaf blackberry,	*Rubus laciniatus*	perennial vine
Russian thistle, tumbleweed,	*Salsola tragus*	annual
bouncing bet, soapwort,	*Saponaria officinalis*	perennial
milk thistle,	*Silybum marianum*	annual or biennial
tumble mustard,	*Sisymbrium altissimum*	annual
white horse-nettle,	*Solanum elaeagnifolium*	perennial
Johnson grass,	*Sorghum halepense*	perennial, large grass
Spanish broom,	*Spartium junceum*	deciduous shrub
puncturevine,	*Tribulus terrestris*	annual, prostrate herb
gorse,	*Ulex europaeus*	thorny perennial shrub
woolly mullein,	*Verbascum thapsus*	perennial, lg fuzzy leaves

*these species are primarily a concern on lava caps but can also be indicators of adverse impacts in some ecosystems. Report when found on lava caps or when they form monocultures or near monocultures.

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Table 1– Proposed Action – *Fire history and condition class of presettlement reference vegetation types by proposed logging system.*

Presettlement Vegetation Type	Salvage System	NPS FRI Index	% proposed action acres									
			# of fires since 1908								Median FRID Condition Class	
			0	1	2	3	4	5	6	7	Too frequent (-2 to -3)	Infrequent (+3)
Chaparral and serotinous conifers	Helicopter	Low	0	0.12	0.02	0	0.01	0	0	0	0.03	0
		Mod	0.01	0	0	0	0	0	0	0	0	
	Skyline	Low	0	0.02	0	0	0.00	0	0	0	0	0
	Tractor	Low	0	0.21	0.19	0.30	0.07	0.01	0	0	0.58	0
		Mod	0.40	0	0	0	0	0	0	0	0	
Dry mixed conifer	Helicopter	Low	0	1.88	0.55	0.12	0.29	0	0	0	0	2.43
		Mod	2.67	1.77	0	0	0	0	0	0		4.44
	Skyline	Low	0	0.76	0.10	0.02	0	0	0	0	0	0.86
		Mod	1.30	0.40	0.40	0	0	0	0	0		2.10
	Tractor	Low	0	7.75	1.70	1.79	0.46	0.03	0	0	0	9.45
		Mod	32.43	7.36	1.72	0.22	0	0	0	0		41.50
	Tractor/Skyline	Low	0	<0.01	0	0	0	0	0	0	0	<0.01
		Mod	0.03	0	0	0	0	0	0	0		0.03
Lodgepole pine	Helicopter	Low	0.22	<0.01	0	0	0	0	0	0	0	0
	Tractor	Low	0.56	0.31	0.11	0.04	0	0	0	0	0	0
Mixed evergreen	Helicopter	Low	0.05	0.01	0.12	0.06	0	0	0	0	0	0.04
		Mod	0.23	0	0	0	0	0	0	0		0.23
	Skyline	Low	0.01	0.03	0	0	0	0	0	0	0	0.01
		Mod	0.07	0	0	0	0	0	0	0		0.07
	Tractor	Low	0	0.19	0.14	0.05	0	0	0	0	0	0.19
		Mod	0.42	0.14	0.02	0	0	0	0	0		0.56
	Tractor/Skyline	Mod	<0.01	0	0	0	0	0	0	0	0	<0.01
Moist mixed conifer	Helicopter	Low	0	0.03	0.07	0	0	0	0	0	0	0.03
		Mod	0.49	0.11	0	0	0	0	0	0		0.60
	Skyline	Low	0	0.01	0	0	0	0	0	0	0	0.01
		Mod	0.42	0	0	0	0	0	0	0		0.42
	Tractor	Low	0	0.26	0.07	0.04	0.02	0	0	0	0	0.26
		Mod	3.03	0.13	<0.01	0	0	0	0	0		3.15
Montane chaparral	Helicopter	Low	0	0.03	0	0.01	0.05	0	0	0	0	0.03
		Mod	0.03	0	0	0	0	0	0	0		0
	Skyline	Low	0	0.02	0	0	0	0	0	0	0	0.01
		Mod	0.01	0	0.01	0	0	0	0	0		0
	Tractor	Low	0	1.02	0.12	0	0.01	0	0	0	0	0.03

		Mod	0.31	0.05	0.01	0	0	0	0	0		0
Oak woodland	Tractor	Low	0	0	0	0	0	0	0	0	0	0.07
		Mod	0.06	0	0.02	0	0	0	0	0		0
Yellow pine	Helicopter	Low	0	0.36	0.05	0.02	0.04	0	0	0	0	0.43
		Mod	0.80	0.07	0	0	0	0	0	0		0.88
	Skyline	Low	0	0.18	0.02	0	0	0	0	0	0	0.20
		Mod	0.59	0	0.01	0	0	0	0	0		0.60
	Tractor	Low	0	4.75	1.58	1.23	0	0	0	0	0	7.56
		Mod	10.90	2.66	1.39	0.20	0	0	0	0		15.15
	Tractor/Skyline	Mod	0.02	0	0	0	0	0	0	0	0	0.02

PROPOSED ACTION INTERPRETATION: For units proposed for treatment with the proposed action, NPS FRI Index indicates low to moderate departure from historic fire frequency for all presettlement vegetation types prior to the Rim Fire event (third column from left). However, when presettlement reference vegetation types are assessed for the period from 1908 to 2013 for these units, 0.61% of the treatment area has burned more frequently (sum of second to last column on right) and 91.45% of the treatment area has experienced extremely low fire frequency(sum of last column on right) when compared to presettlement fire regimes. Approximately 68% of the area proposed for tractor logging systems was characterized by dry forest types with high to extreme departure from presettlement fire regimes (sum of red text in last column on right). Lack of frequent, low severity fires in these dry forest types likely resulted in dense stands that experienced severe fire effects over the majority of this area (68%) from the Rim fire event.

Table 2– Alternative 3 – *Fire history and condition class of presettlement reference vegetation types by proposed logging system.*

Presettlement Vegetation Type	Logging System	NPS FRI Index	% alternative 3 acres									
			# of fires since 1908								Median FRID Condition Class	
			0	1	2	3	4	5	6	7	Too frequent (-2 to -3)	Infrequent (+3)
Chaparral and serotinous conifers	Helicopter	Low	0	0.11	0.02	0	0.01	0	0	0	0.03	0
		Mod	0.04	0	0	0	0	0	0	0	0	
	Skyline	Low	0	0.02	0	0	0	0	0	0	0	0
		Mod	<0.01	0	0	0	0	0	0	0		
	Tractor	Low	0	0.25	0.29	2.07	0.47	0.01	0	0	3.09	0
		Mod	0.30	0.00	0	0	0	0	0	0	0	
Dry mixed conifer	Helicopter	Low	0	1.51	0.53	0.11	0.27	0	0	0	0	2.04
		Mod	2.88	1.05	0.21	0	0	0	0	0		4.15
	Skyline	Low	0	0.93	0.09	0	0	0	0	0	0	1.02
		Mod	1.02	0.35	0.03	0	0	0	0	0		1.4
	Tractor	Low	0	7.10	1.46	2.40	1.07	0.03	0	0	0	8.55
		Mod	28.84	6.27	1.54	0.21	0	0	0	0		36.86
	Tractor/Skyline	Low	0	<0.01	0	0	0	0	0	0	0	<0.01
		Mod	0.03	0.00	0	0	0	0	0	0		0.03
Lodgepole pine	Helicopter	Low	0.20	0.00	0	0	0	0	0	0	0	0
	Tractor	Low	0.52	0.30	0.16	0.38	0	0	0	0	0	0

Mixed evergreen	Helicopter	Low	0	0.04	0.04	0.11	0.06	0	0	0	0	0.04
		Mod	0.17	0	0	0	0	0	0	0		0.17
	Skyline	Low	0	0.01	0.00	0	0	0	0	0	0	0.01
		Mod	0.06	0	0	0	0	0	0	0		0.06
	Tractor	Low	0	0.27	0.25	0.20	0.05	0	0	0	0	0.27
		Mod	0.40	0.18	0.06	0	0	0	0	0		0.58
	Tractor/Skyline	Mod	<0.01	0	0	0	0	0	0	0	0	<0.01
Moist mixed conifer	Helicopter	Low	0	0.02	0.10	0	0	0	0	0	0	0.02
		Mod	0.57	0.11	0	0	0	0	0	0		0.68
	Skyline	Low	0	0.01	0	0	0	0	0	0	0	<0.01
		Mod	0.33	0	0	0	0	0	0	0		0.33
	Tractor	Low	0	0.24	0.04	0.05	0.02	0	0	0	0	0.24
		Mod	2.59	0.11	0.00	0	0	0	0	0		2.7
Montane chaparral	Helicopter	Low	0	0.04	0	0.01	0.05	0	0	0	0	0
		Mod	0.02	0.02	0.01	0	0	0	0	0		0.2
	Skyline	Low	0	0.04	0.00	0	0	0	0	0	0	0
		Mod	0.02	0	0	0	0	0	0	0		0.02
	Tractor	Low	0	0.93	0.11	0.18	0.07	0.02	0	0	0	0
		Mod	0.26	0.03	0.01	0	0	0	0	0		0.25
Oak woodland	Tractor	Low	0	0	0.00	0.05	0	0	0	0	0	0.07
		Mod	0.07	<0.01	0.09	0	0	0	0	0		
Red fir	Tractor	Low	<0.01	0	0	0	0	0	0	0	0	<0.01
Yellow pine	Helicopter	Low	0	0.38	0.04	0.02	0.03	0	0	0	0	0.44
		Mod	1.10	0.02	0.01	0	0	0	0	0		1.14
	Skyline	Low	0	0.17	0.02	0	0	0	0	0	0	0.19
		Mod	0.50	0	0	0	0	0	0	0		0.5
	Tractor	Low	0	5.02	1.68	3.74	0.82	0.01	0	0	0	10.44
		Mod	9.69	2.49	1.34	0.18	0	0	0	0		13.7
	Tractor/Skyline	Mod	0.02	0	0	0	0	0	0	0	0	0.02

ALTERNATIVE 3 INTERPRETATION: For units proposed for treatment with alternative 3, NPS FRI Index indicates low to moderate departure from historic fire frequency for all presettlement vegetation types prior to the Rim Fire event (third column from left). However, when presettlement reference vegetation types are assessed for the period from 1908 to 2013 for these units, 3.12% of the treatment area has burned more frequently (sum of second to last column on right) and 85.42% of the treatment area has experienced extremely low fire frequency(sum of last column on right) when compared to presettlement fire regimes. Approximately 70% of the area proposed for tractor logging systems was characterized by dry forest types with high to extreme departure from presettlement fire regimes (sum of red text in last column on right). Lack of frequent, low severity fires in these dry forest types likely resulted in dense stands that experienced severe fire effects over the majority of this area (70%) from the Rim fire event. In contrast, approximately 3% of acres proposed for tractor logging burned with higher frequency than historical records suggest prior to the Rim fire event. These acres are at risk of type conversion, severe reduction in native seedbank, slow post-fire native vegetation recovers, increased noxious weed invasion, low plant vigor and poor wildlife habitat recovery.

Table 3 – Alternative 4 – *Fire history and condition class of presettlement reference vegetation types by proposed logging system.*

Presettlement Vegetation Type	Logging System	NPS FRI Index	% alternative 4 acres									
			# of fires since 1908								Median FRID Condition Class	
			0	1	2	3	4	5	6	7	Too frequent (-2 to -3)	Infrequent (+3)
Chaparral and serotinous conifers	Helicopter	Low	0	0.12	0.02	0	0.01	0	0	0	0.04	0
		Mod	0.05	0	0	0	0	0	0	0	0	
	Skyline	Low	0	0.02	0	0	0	0	0	0	0	0
		Mod	<0.01	0	0	0	0	0	0	0		
	Tractor	Low	0	0.27	0.32	2.26	0.51	0	0	0	3.09	0
		Mod	0.33	0.00	0	0	0	0	0	0	0.33	
Dry mixed conifer	Helicopter	Low	0	1.59	0.58	0.12	0.30	0	0	0	0	2.17
		Mod	2.66	0.37	0.23	0	0	0	0	0		3.26
	Skyline	Low	0	0.96	0.10	0	0	0	0	0	0	1.06
		Mod	1.09	0.38	0.04	0	0	0	0	0		1.51
	Tractor	Low	0	6.29	1.28	2.52	1.15	0	0	0	0	7.57
		Mod	27.38	6.61	1.69	0.23	0	0	0	0		35.68
	Tractor/Skyline	Low	0	<0.01	0	0	0	0	0	0	0	<0.01
		Mod	0.03	0	0	0	0	0	0	0		0.03
Lodgepole pine	Helicopter	Low	0.22	0.00	0	0	0	0	0	0	0	0
	Tractor	Low	0.57	0.33	0.18	0.42	0	0	0	0	0	0
Mixed evergreen	Helicopter	Low	0	0.05	0.04	0.12	0.07	0	0	0	0	0.04
		Mod	0.18	0	0	0	0	0	0	0		0.18
	Skyline	Low	0	0.01	0.00	0	0	0	0	0	0	0.01
		Mod	0.07	0	0	0	0	0	0	0		0.07
	Tractor	Low	0	0.27	0.26	0.22	0.05	0	0	0	0	0.27
		Mod	0.44	0.19	0.07	0	0	0	0	0		0.63
	Tractor/Skyline	Mod	<0.01	0	0	0	0	0	0	0	0	<0.01
Moist mixed conifer	Helicopter	Low	0	0.03	0.10	0	0	0	0	0	0	0.03
		Mod	0.53	0.01	0	0	0	0	0	0		0.54
	Skyline	Low	0	0.01	0	0	0	0	0	0	0	0.01
		Mod	0.36	0	0	0	0	0	0	0		0.36
	Tractor	Low	0	0.24	0.04	0.06	0.02	0	0	0	0	0.24
		Mod	2.66	0.02	0.00	0	0	0	0	0		2.68
Montane chaparral	Helicopter	Low	0	0.03	0	0.01	0.05	0	0	0	0	0
		Mod	0.01	0.02	0.01	0	0	0	0	0		0.01
	Skyline	Low	0	0.02	0.00	0	0	0	0	0	0	0
		Mod	0.02	0	0	0	0	0	0	0		0.02
	Tractor	Low	0	0.90	0.12	0.20	0.08	0	0	0	0	0
		Mod	0.27	0.03	0.01	0	0	0	0	0		0.27
Oak woodland	Tractor	Low	0	0	0.00	0.06	0	0	0	0	0	0
		Mod	0.07	0.00	0.09	0	0	0	0	0		0.08

Red fir	Tractor	Low	0.01	0	0	0	0	0	0	0	0	0.01
Yellow pine	Helicopter	Low	0	0.37	0.05	0.02	0.04	0	0	0	0	0.44
		Mod	1.20	0.02	0.01	0	0	0	0	0		1.23
	Skyline	Low	0	0.18	0.02	0	0	0	0	0	0	0.21
		Mod	0.55	0	0	0	0	0	0	0		0.55
	Tractor	Low	0	5.14	1.77	4.06	0.89	0	0	0	0	10.97
		Mod	10.55	2.57	1.46	0.20	0	0	0	0	0	14.78
	Tractor/Skyline	Mod	0.02	0	0	0	0	0	0	0		0.02

ALTERNATIVE 4 INTERPRETATION: For units proposed for treatment with alternative 4, NPS FRI Index indicates low to moderate departure from historic fire frequency for all presettlement vegetation types prior to the Rim Fire event (third column from left). However, when presettlement reference vegetation types are assessed for the period from 1908 to 2013 for these units, 3.46% of the treatment area has burned more frequently (sum of second to last column on right) and 84.93% of the treatment area has experienced extremely low fire frequency(sum of last column on right) when compared to presettlement fire regimes. Approximately 73% of the area proposed for tractor logging systems was characterized by dry forest types with high to extreme departure from presettlement fire regimes (sum of red text in last column on right). Lack of frequent, low severity fires in these dry forest types likely resulted in dense stands that experienced severe fire effects over the majority of this area (70%) from the Rim fire event. In contrast, approximately 3% of acres proposed for tractor logging burned with higher frequency than historical records suggest prior to the Rim fire event. These acres are at risk of type conversion, severe reduction in native seedbank, slow post-fire native vegetation recovers, increased noxious weed invasion, low plant vigor and poor wildlife habitat recovery.