Rough Fire BAER Botany Report
North Zone (Sierra NF)

Resource Specialty: Botany (includes native vegetation; Threatened, Endangered, and Sensitive (TES) plants; invasive non-native weeds)

Fire Name: Rough Fire North Zone (Sierra NF)
Month and Year: August/September 2015
Authors Name and Home Unit Name: Kendal Young, Stanislaus NF; Fletcher Linton, Sequoia NF
Reviewed by: Joanna Clines, Sierra NF

I. Potential Values at Risk

A. Critical Values

a. Native Vegetation Recovery and Diversity: In areas of the Rough Fire North Zone (Sierra NF) that burned at high intensity and areas disturbed by suppression activities, the capacity for the native vegetation to provide rapid cover of the soil has certainly been diminished. These areas are at risk of invasive non-native weed incursion, which would reduce the rate of native vegetation recovery and compromise diversity.

The elevation in the Rough Fire area runs from 1,000 feet on the Kings River above Pine Flat Reservoir, to over 10,000 feet on Spanish Mountain in the John Muir Wilderness. As such, this area contains a wide diversity of vegetative communities (Table 1). The unknowing introduction of invasive noxious weeds into areas disturbed by wildfire, fire suppression, and suppression rehabilitation has the potential to establish persistent weed populations. These persistent populations could affect the structure and function of plant communities within the burn area, including ability to support wildlife. Forest Service direction is to minimize the establishment of non-native invasive species to prevent unacceptable degradation of the burned area. Consequently, assessment of dozer lines, safety zones, and roads is necessary to detect the spread and introduction of weeds in the first year after fire. Assessing the establishment of weeds and treating small outlying populations before they expand, is well demonstrated to prevent weeds from becoming serious threats to the recovery of native plants and animals.

Kings River buckwheat (*Eriogonum nudum* var. *regirivum*) is a Forest Service Sensitive plant that grows within the Rough Fire Northern Zone perimeter along the Kings River. All five occurrences of this limestone endemic perennial herb are in the lower Kings Canyon area, and four of them are on National Forest system lands. These open habitats could be affected by invasive weed propagules getting established in proximal areas of fire suppression ground disturbance.

Kings River Buckwheat; Photo by Chris Winchell and Jamie Tuitele-Lewis

Howell's umbrellawort. Photo by Sam Young and Anne Russell

Muir's tarplant. Photo by Keir Morse, http://calphotos.berkeley.edu

Muir's tarplant (*Carlquistia muirii*) occurs in the upper portion of the fire perimeter. This perennial rhizomatous herb occurs on granitic outcrops and associated gravel soils. This higher elevation area was also impacted by soil disturbing fire suppression activities and was relatively free from invasive plants before the fire.

Howell's umbrellawort (*Tauschia howelli*) was known only from Siskiyou County in northwest California, Jackson County in southern Oregon, and Sierra County in the Sierra Nevada prior to 2007. It was discovered on Patterson Mountain in the Kings River drainage (Fresno County). This species is very habitat specific, and occurs in openings within subalpine and upper montane coniferous forest with *Abies*, decomposed metamorphic or granitic soils on ridge tops and upper slopes. Soils are highly erodible from both natural events and man-made disturbances. The occurrence in the Rough Fire North Zone is at 8,000 ft, growing in metamorphic soils on a ridgetop in red fir forest.

Aromatic canyon gooseberry in the Rough Fire North Zone. Photo by Mike Nolen

The aromatic canyon gooseberry (*Ribes menziesii* var. *ixoderme*) is an endemic shrub to California in chaparral plant communities of the southern Sierra Nevada. It is considered a rare species by the California Native Plant Society and has recently been added as a Forest Service Sensitive species for the Sierra National Forest (J. Clines, Forest Botanist, Pers. Comm.). Appendix A pro vides a list of Forest Service Sensitive species on the Sierra National Forest, and highlights species that may occur in the fire area.

b. **<u>Threatened and Endangered Plant Species:</u>** No federally listed plants occur within the Rough North Zone Fire area. The only federally listed plant occurring on the Sierra NF is Mariposa pussypaws (*Calyptridium pulchellum*). The nearest occurrence is more than 30 miles to the

northwest of the fire perimeter. This small annual plant grows below 3,600 feet on rock outcrops and gravelly or sandy soil in foothill woodland and foothill chaparral. The Rough North Zone fire has no suitable habitat for Mariposa pussypaws, and this species has never been found during surveys for other projects in the fire area.

B. Resource Condition Assessment

(a) Resource Setting

The Rough Fire started on July 31, 2015. It was ignited on the north side of Kings Canyon on Deer Ridge near the Monarch wilderness by a lighting storm. The fire burned on the High Sierra Ranger District of the Sierra National Forest in Fresno County, California for almost three weeks. It then crossed the south fork of the Kings River to the Giant Sequoia National Monument of the Sequoia NF.

The 30,850 acres of the Rough Fire within the Sierra National Forest fall on the west slope of the Sierra Nevada between 1000 and 10,000 feet elevation. Hierarchical systems using ecological principles for classifying land have been developed for geographical scales ranging from global to local (Cleland et al. 1997). Such a system is the USDA Forest Service National Hierarchical Framework of Ecological Units (Miles and Goudey 1997). Of the Ecological Sections mapped for California, the Rough North Zone Fire area is mostly within the Sierra Nevada Ecological Section (M261E), with smaller portions in Section M261F (Sierra Nevada Foothills). M261E encompasses the montane zone through the alpine zone. Climate is one of wet, cold winters with 20-80 inches of precipitation falling mostly as snow above 6,000 feet; and dry, warm summers. In lower elevations of the Rough North Zone fire precipitation averages 20-40 inches, mostly falling as rain in the winter.

Vegetation types in the Rough Fire North Zone burn perimeter are predominantly mixed conifer dominated by pine (27%) and canyon live oak (22%) (Table 1). The vegetation of the burned area is very heterogeneous, and difficult to map precisely. Depending on the slope aspect and gradient, plant communities varies from blue oak savanna, foothill chaparral and live oak woodland at the lower elevations to ponderosa pine, mixed conifer forest, montane meadows, and red fir forest at the upper elevations (Figure 1). Various riparian plant communities are found along rivers, streams, and within and around meadows.

Chaparral: The chaparral at the lower elevations of the Rough Fire North Zone area is characteristic of eastern Fresno County: a mixed chaparral dominated by manzanita species, *(Arctostaphylos viscida* ssp. *mariposa*.); interior live oak (*Quercus wislizenii*); canyon live oak (*Quercus chrysolepis*); buckbrush (*Ceanothus cuneatus*); and poison oak (*Toxicodendron diversiloba*). Ponderosa pine is scattered throughout the chaparral, especially in the drainages.

Table 1. Acres of vegetation types in the Rough Fire North Zone perimeter.

Vegetation Type	Acres	Percent
Non-forest	502	1.6%
Grassland and Meadows	3,256	10.6%
Mixed Chaparral	5,132	16.6%
Black Oak	936	3.0%
Canyon Live Oak	6,653	21.6%
Blue Oak	2,506	8.1%
Ponderosa Pine	1,468	4.8%
Mixed Conifer	8,332	27.0%
Red Fir	2,067	6.7%
Approximate Total	**30,850**	

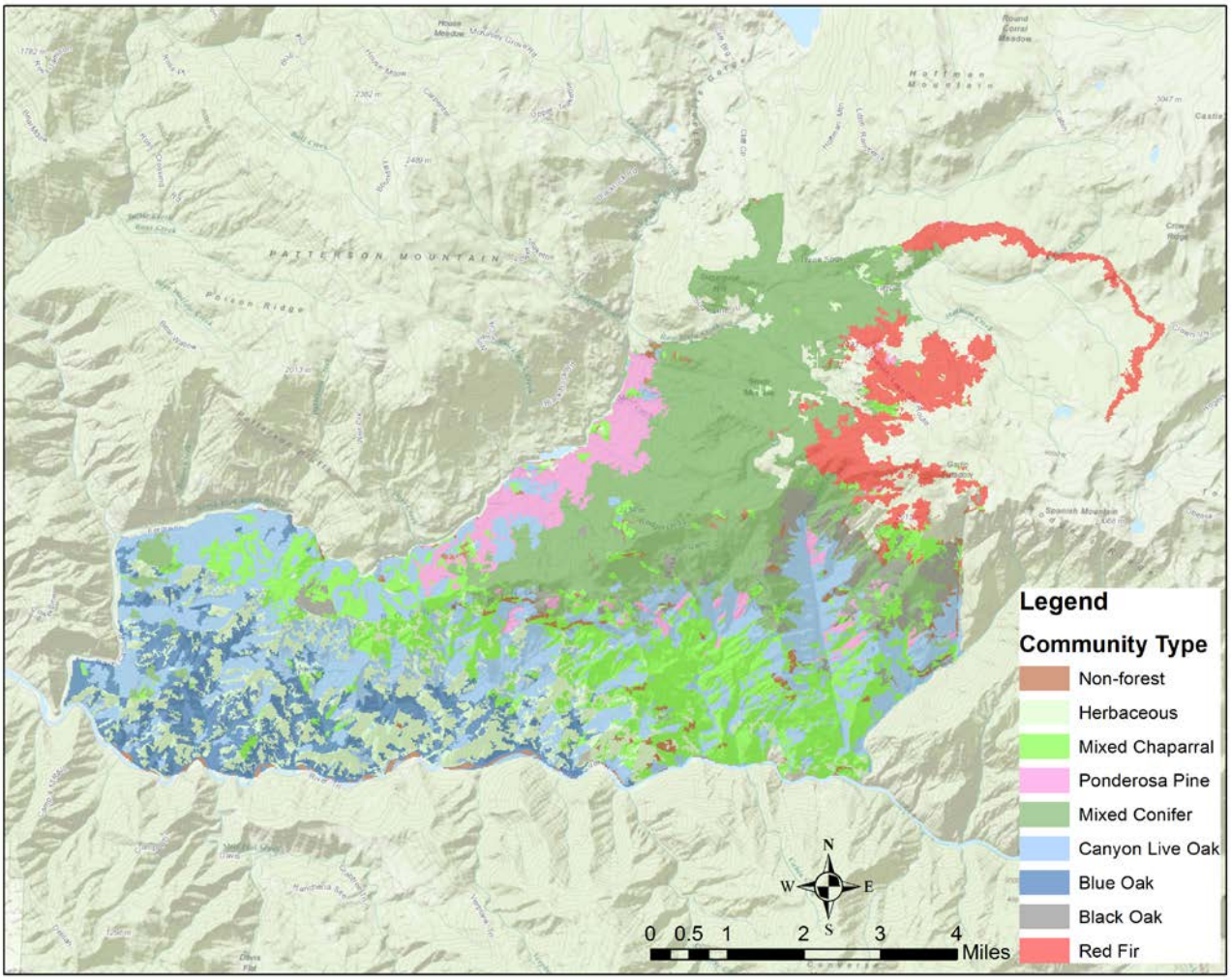

Figure 1. Vegetation communities in the Rough Fire North Zone.

Ponderosa Pine Forest: Ponderosa pine (*Pinus ponderosa)*, is a fire-adapted species that evolved with frequent fire. Seeds of ponderosa pine require mineral soil for successful germination, thus benefit from ground fires, which clear the soil of debris (Barbour, 1988). Chaparral shrub seedlings and herb species of *Lupinus*, *Acmispon*, *Claytonia*, *Clarkia*, *Phacelia*, and *Gayophytum* (to name a few genera) are expected to provide good ground cover by the first or second year postfire. Within areas of high burn intensity if the soil seed bank was consumed, it is to be expected that a considerable amount of bare ground will remain the first year, but will fill in gradually from adjacent areas over years 2-5.

Mixed Confer Forest: A high proportion of the coniferous forest of the burned area is mixed conifer forest dominated by ponderosa pine, white fir (*Abies concolor*), incense cedar (*Calocedrus decurrens*), and sugar pine (*Pinus lambertiana*). Hardwood associates such as black oak (*Quercus kelloggii)* and canyon live oak occur in groves or scattered within the conifers. Typical understory plants are mountain whitethorn (*Ceanothus cordulatus)*, bear clover (*Chamabaetia foliolosa*), Mariposa manzanita, and canyon live oak.

Red Fir Forest: Red fir (*Abies magnifica*), Jeffrey pine (*Pinus jeffreyi*), and lodgepole pine *(Pinus contorta ssp. murrayana*) are the primary species that define the upper montane zone. Common associates of red fir include white fir (*Abies concolor*) at lower elevations and mountain hemlock (*Tsuga mertensiana*) and Western white pine (*P. monicola*) at higher elevations.

Riparian and Meadow Habitat: Creeks and rivers within the fire are bordered by riparian woodland dominated by white alder (*Alnus rhombifolia*), Oregon ash (*Fraxinus latifolia*), and willows (*Salix* spp.), native blackberry (*Rubus ursinus*), and the non-native invasive Himalayan blackberry (*Rubus armeniacus*). Herbaceous native riparian plants include sedges (*Carex* spp.), rushes (*Juncus* spp.), grasses, scarlet monkey flower (*Mimulus cardinalis*), California fuschia (*Epilobium canum* var. *latifolium*), and umbrella plant (*Darmeria peltata*). Montane meadows are dominated by low-growing herbaceous perennial vegetation such as sedges (*Carex* spp.) grasses (family Poaceae), and rushes (*Juncus* spp.).

Invasive Non-native Species: The burn area is relatively free of known invasive non-native weeds; however, the distribution of invasive non-native species is poorly mapped in or adjacent to the burn area. Bull thistle (*Cirsium vulgare*) occurs sporadically in disturbed areas and meadows primarily in the montane zone. Tocalote (*Centaurea melitensis*) and Italian thistle (*Carduus pycnocephalus*) occur in the foothill zone of the burn area, and are scattered throughout disturbed sites and up on hillslopes. Himalayan blackberry (*Rubus armeniacus*) is present along streams, next to reservoirs and in other areas with high soil moisture. Milk thistle (*Silybum marianum*) is present in foothill vegetation types in the Rough Fire area, especially in severely disturbed sites with adequate soil moisture. Spanish broom (*Spartium junceum*) occurs in the North Fork Kings River around Balch Camp, and possibly downstream in the Middle Fork. Scotch broom (*Cytisus scoparius*) and French broom (*Genista monspessulana*) may be present as well. Woolly mullein (*Verbascum thapsus*) is scattered from the foothills through the upper montane zone across the Forest and likely in the Rough Fire area. Other invasive non-native plants that are likely present based on nearby areas of the Sierra National Forest include velvet grass (*Holcus lanatus*), medusahead (*Elymus caput-medusae*), oxeye daisy (*Leucanthemum vulgare*), and foxglove (*Digitalis purpurea*.) (Pers. Comm. Joanna Clines, Forest Botanist).

(b) Findings of the On-The-Ground Survey

Washing of incoming heavy equipment, engines, and many line-going vehicles to prevent weed introduction was established along the Dinkey Creek Road near the Rough Fire ICP on August 25 (See Rough Fire Resource Advisors Report), after the fire had grown to over 50,000 acres and most of the fire lines were in place (Appendix B). <u>The delayed delivery of the weed wash station greatly increases the risk of invasive weed propagule introduction</u> into the fire area and forested environments near contingency lines. In addition, suppression equipment and crews may have traversed through, and built fire line through, areas of invasive plant infestations during fire suppression efforts, primarily Italian thistle (Figure 2). Bull thistle occurs at scattered locations, and tocalote occurs within the fire perimeter and could have been transported into the higher elevations of the burned area from the foothill zone where it currently exists.

A three-blade wide dozer line cleared a population of aromatic canyon gooseberry along a contingency fire line. Resource Advisors noted robust healthy plants in a few locations, including immediately adjacent to the road below the ridgeline dozer tracks mentioned above. At least one of the known locations was possibly destroyed by a dozer line, whether or not the shrubs resprout will determine the outcome. In addition, a dozer line was established through one subpopulation of the Forest Service Sensitive Howell's umbrellawort while installing Division C contingency fire line, near Forest Road 11S15. The suppression related disturbances are documented in the Resource Advisor's report and should be monitored by the Forest Botanist. Tule Meadow Camp (adjacent to Tule Meadow) was used as a staging area for several weeks prior to weed washing. As such, a variety of invasive non-native species may have been introduced into this meadow, a wet montane meadow containing a fen and the FS Sensitive plant Bolander's clover (*Trifolium bolanderi*).

Figure 2. Fire suppression activity on the Rough Fire North Zone that increases the risk of invasive plant incursion. Photo indicates a dozer line starting in an Italian thistle area. Plant photo by Alfred Brousseau, St. Mary's College (http://www.nps.gov/seki/learn/nature/badcapy.htm). Dozer line photo by Kendal Young.

Rapid assessment surveys of botanical resources within the burn area were conducted by Kendal Young and Fletcher Linton on August 3-6, 2015. Surveys concentrated on areas disturbed by fire suppression activities, areas of known invasive weeds, and Forest Service sensitive plant occurrences. Examples of dozer work and heavy equipment concentrations increase the risk of invasive species incursion into fire area are provided in Appendix C.

Table 2 indicates the number of acres burned at low, moderate, or high intensity for each dominant vegetation type, estimated from the burn intensity map (See Soils Report for burn severity details). Approximately, 1,840 acres (6.0%) burned at a high intensity, 8,250 acres (27%) burned at moderate intensity and 15,793 acres (51%) burned at low intensity. Patches of unburned vegetation exist throughout the area (Appendix D).

Table 2. Vegetation Types in Relation to Burn Intensity.

	Soil Burn Severity			
Vegetation Type	**Unburned/Very Low**	**Low**	**Moderate**	**High**
Grassland and Meadows	915.0	2,210.5	128.3	1.9
Mixed Chaparral	254.9	2,277.7	2,283.1	316.1
Black Oak	29.6	488.2	325.2	92.5
Canyon Live Oak	651.3	3,307.0	2,158.7	535.7
Blue Oak	727.9	1,676.6	101.3	0.3
Ponderosa Pine	105.3	857.1	432.1	73.9
Mixed Conifer	1,016.8	4,004.6	2,531.7	778.5
Red Fir	1,098.6	692.5	238.1	37.8
Approximate Total	4,979.6	15,792.7	8,249.5	1,839.6

There are approximately 53.4 miles of Forest Service roads in or near the Rough Fire North Zone perimeter, representing approximately 4.1 miles of Maintenance Level (ML) 3 roads, 39.8 miles of ML 2 roads, and 9.4 miles of ML 1 roads. Approximately 21.7 miles of roads were used as a fire line. Overall, there are 4.8 miles of hand line and 36.0 miles of dozer line (Table 3, Figure 3) in the burn perimeter. Approximately 9.6 miles of dozer line occurs on private land, thus is not considered in this analysis. Acres were estimated by multiplying the length of a feature by an estimated width (24 feet for dozer lines and roads, and 8 feet for hand lines). Area of drop points was averaged by applying a 24 feet buffer. This distance is low for most drop points, but drop points were typically on roads or other disturbed sites that accounted for most of the disturbance acres. As such, this area estimate should account for any additional disturbance associated with drop points. Safety Zones and Spike Camps were digitized from Digital Ortho Quads. Drop points that were not a concern for the spread of invasive points were not included in the analysis.

Table 3. Miles and acres of fire line and other sites disturbed during suppression for the Rough Fire North Zone.

	In Burn Perimeter	
Fire Line Type	**Miles**	**Acres**
Hand Fire Line	4.8	9.2
Dozer Line	36.0	215.3
Roads used for Fire Line	21.7	121.0
Drop Points, Safety Zones, Spike Camps		31.2
Total	62.5	376.7

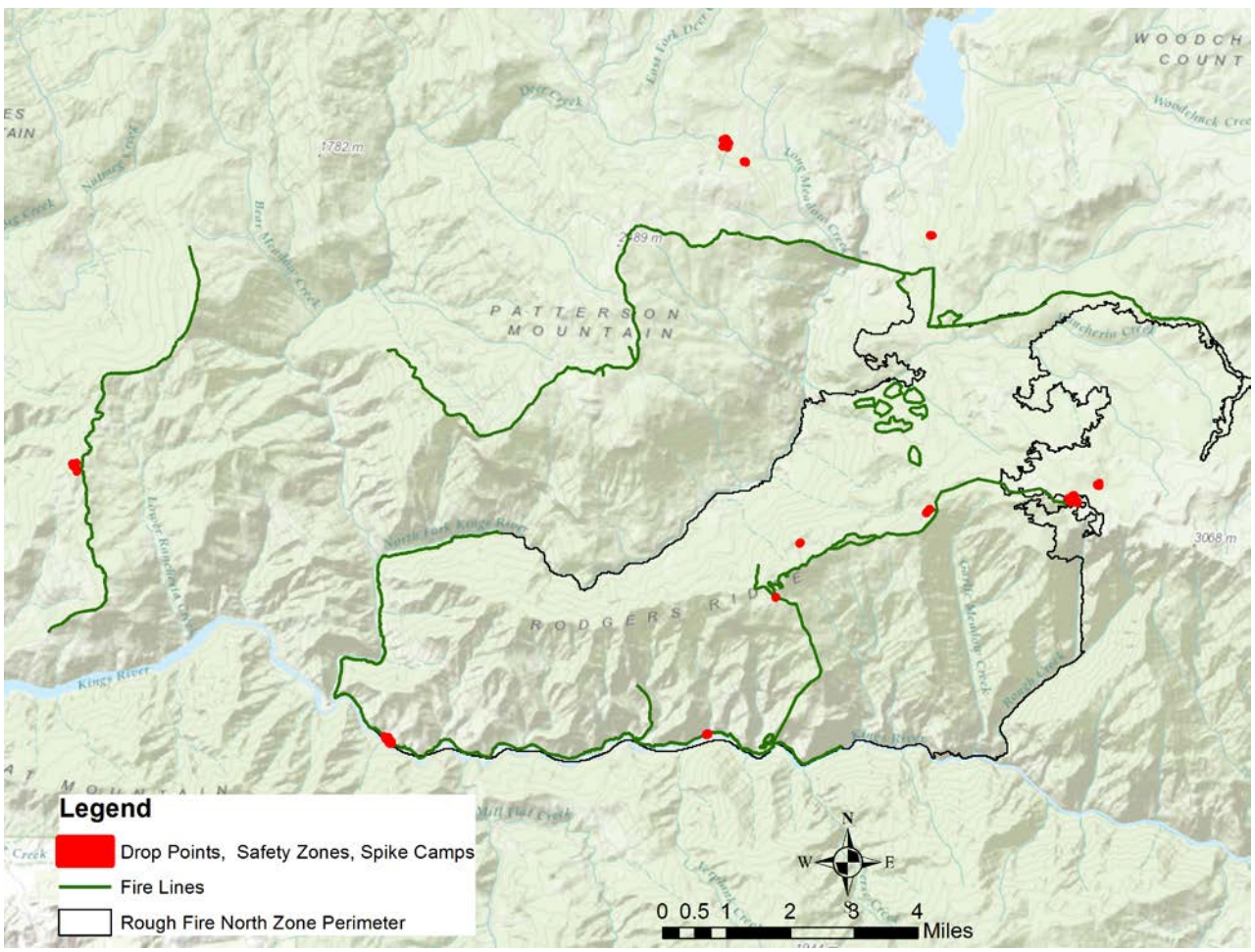

Figure 3. Fire lines, drop points, safety zones, and spike camps considered for invasive species treatments.

Vegetative recovery after fire in foothill and lower montane chaparral occurs rapidly, although some bare areas are not filled in until the second or third year. Chaparral is made up of plants with a variety of fire-adapted features. Many shrubs will begin sprouting within weeks of being consumed by fire, others are killed by fire but have an extensive bank of seeds that are stimulated to germinate by heat or smoke from burned wood. The first growing season after fire is a crucial time for these species since significant sexual reproduction only occurs at this time (Keeley and Keeley, 1988).

Herbaceous plants proliferate after chaparral fire. A flush of fire-following annual herbs will germinate the first wet season after fire from seeds that have accumulated in the soil and duff over decades (Keeley and Keeley, 1988). Based on observations in nearby burned areas (e.g, Powerhouse Fire and Balch Fire of 1989), at least the following species are expected to appear: whispering bells (*Emmenanthe penduliflora),* golden eardrops (*Ehrendorfia chrysantha*), skullcap (*Scutellaria tuberosa*), and many species of monkey flower (*Mimulus bolanderi, M. torreyi, M. congdonii, M. guttatus*). After most Sierra National Forest wildfires in the montane and foothill zones, miner's lettuce (*Claytonia parviflora* ssp.*parviflora, Claytonia rubra)* contributes significant ground cover during the first two years, in addition to abundant flowers that provide nectar for pollinators.

In the Rough Fire North Zone area, some of the main species that will resprout are interior live oak (*Quercus wislizenii),* canyon live oak (*Q. chrysolepis*), redbud (*Cercis occidentalis*), coffeeberry (*Frangula rubra*), California buckeye (*Aesculus californica*), poison oak (*Toxicodendron diversiloba),* deerbrush (*Ceanothus integerrimus*, greenleaf manzanita (*Arctostaphylos patula*) and yerba santa (*Eriodyction californica).* Many of these species also produce seedlings after fire. Species that do not sprout but rely completely on seedling production are Mariposa manzanita, buckbrush (*Ceanothus cuneatus),* and chaparral whitethorn (*C. leucodermis).*

(c) Consequences of the Fire on Values at Risk

The value at risk related to Botany for the Rough Fire North Zone is native vegetation recovery and diversity. Invasive plants impede the recovery of native plant assemblages through their direct and indirect effects on soil chemistry and ecosystem function. For example, non-native invasive plants may modify the soil environment through root exudates that kill native plants, affect soil structure, and mobilize and/or chelate nutrients (Weidenhamer and Callaway 2010). The long-term impact of invasive species presence can include modified soil nutrient pools, and altered nutrient cycles that impede native vegetation recovery and diversity; in addition to permanent replacement of native plants relied upon by pollinators and wildlife.

Prevention and early detection of non-native invasive plants are the principal strategies to successful management. Eradication efforts are most successful for infestations < 2.5 acres in size (Rejmanek and Pitcairn, 2002). Once infestations are > 250 acres, eradication efforts are largely unsuccessful, costly, and unsustainable (Rejmanek and Pitcairn 2002). Non-native plants can significantly alter the local flora and yield economic consequences estimated at greater than $120 billion dollars per year nationwide (Pimentel, et al. 2005). Further, the U.S. Congress, Office of Technology Assessment (1993), stated that the environmental and economic benefits of supporting prevention and early detection initiatives significantly outweigh any incurred costs, with the median benefit-to-cost ratio being 17:1 in favor of being proactive.

Risk-assessment procedures can assist in prioritizing areas for conservation efforts or prioritizing limited budgets. Risk assessment for invasive species is the process of obtaining quantitative or qualitative measures of risk levels by incorporating a broad array of information describing factors that may influence the distribution of invasive species (Young et al. 2013).

Areas at risk of poor native vegetation recovery and diversity in the Rough Fire North Zone were estimated by evaluating suitable invasive weed environments (areas of fire disturbance, including fire lines, drop points, and recently burned areas), vectors and pathways (roads, trails, fire lines), source invasive weed populations, and native vegetation recovery potential. These risk factors were combined into the BAER Risk Assessment matrix (Table 4) to determine high risk areas for invasive plant incursion. These are also the areas at highest risk for impaired native vegetation reestablishment.

Table 4. BAER Risk Assessment

Probability of Damage or Loss	**Magnitude of Consequences**		
	Major	Moderate	Minor
	RISK		
Very Likely	**Very High**	**Very High**	**Low**
Likely	**Very High**	**High**	**Low**
Possible	**High**	**Intermediate**	**Low**
Unlikely	**Intermediate**	**Low**	**Very Low**

Very High Risk - Priority 1 Areas: The probably of damage or loss (probability of plant incursion) was considered "Very Likely" if the area met the following criteria:

1) Areas of fire suppression activity (fire lines (mechanical), drop points, safety zones, or equipment concentration points) (suitable environments, vectors, and pathways).
2) Native vegetation recovery rates would be compromised by invasive non-native species.

High Risk - Priority 2 Areas: The probably of damage or loss was considered "Likely" if the area met the following criteria:

1) High or moderate fire burn severity within 200 feet of fire lines (mechanical) or equipment concentration points (suitable habitat with vector and pathway).
2) Known invasive weed occurrences on or near pathways, even in low severity habitat.
3) Native vegetation recovery rates would be compromised by invasive non-native species.

Intermediate Risk - Priority 3 Areas: The probably of damage or loss was considered "Possible" if the area met the following criteria:

1) High or moderate fire burn severity between 200-400 feet of fire lines (mechanical) or equipment concentration points. These areas may be at increased risk of invasive plant seed deposition, primarily from wildlife, wind, and water vectors.
2) Native vegetation recovery rates would be compromised by invasive non-native species.

Intermediate/Low Risk - Priority 4 Areas: The probably of damage or loss was considered "Possible" if the area met the following criteria:

1) High or moderate fire burn severity beyond 400 feet of fire lines or equipment concentration points, which may increase the risk of seed dispersal. Primary seed deposition may be from wildlife, wind, and water vectors.
2) Native vegetation recovery rates would be compromised by invasive non-native species.

Although the likelihood of invasive weed propagules becoming established vary, the magnitude of consequences of invasive weed incursion is constant, and was considered "Moderate." Once invasive weeds become establish, noxious weeds will impede native plant recovery, threaten native biodiversity and ecological processes, and cause severe economic damage (Stohlgren et al., 1999).

Using this evaluation process, approximately 366 acres were considered at “Very High” risk, 485 acres at “High Risk” and 10,265 acres were considered at “Intermediate” risk (Table 5, Figure 4). Areas with low or unlikely probability of plant incursion and low burn severity were considered to have a “Low” risk of impeding native vegetation recovery.

Table 5. Risk associated with impeding native plant recovery associated with burned areas in the Rough Fire North Zone.

Priority	Probability of Damage	Magnitude of Consequences	Risk	Approximate Acres in Burn Perimeter
1	Very Likely	Moderate	Very High	365.7
2	Likely	Moderate	High	484.6
3	Possible	Moderate	Intermediate	264.9
4	Possible	Moderate	Intermediate	10,000
5	Unlikely	Moderate	Low	25,000

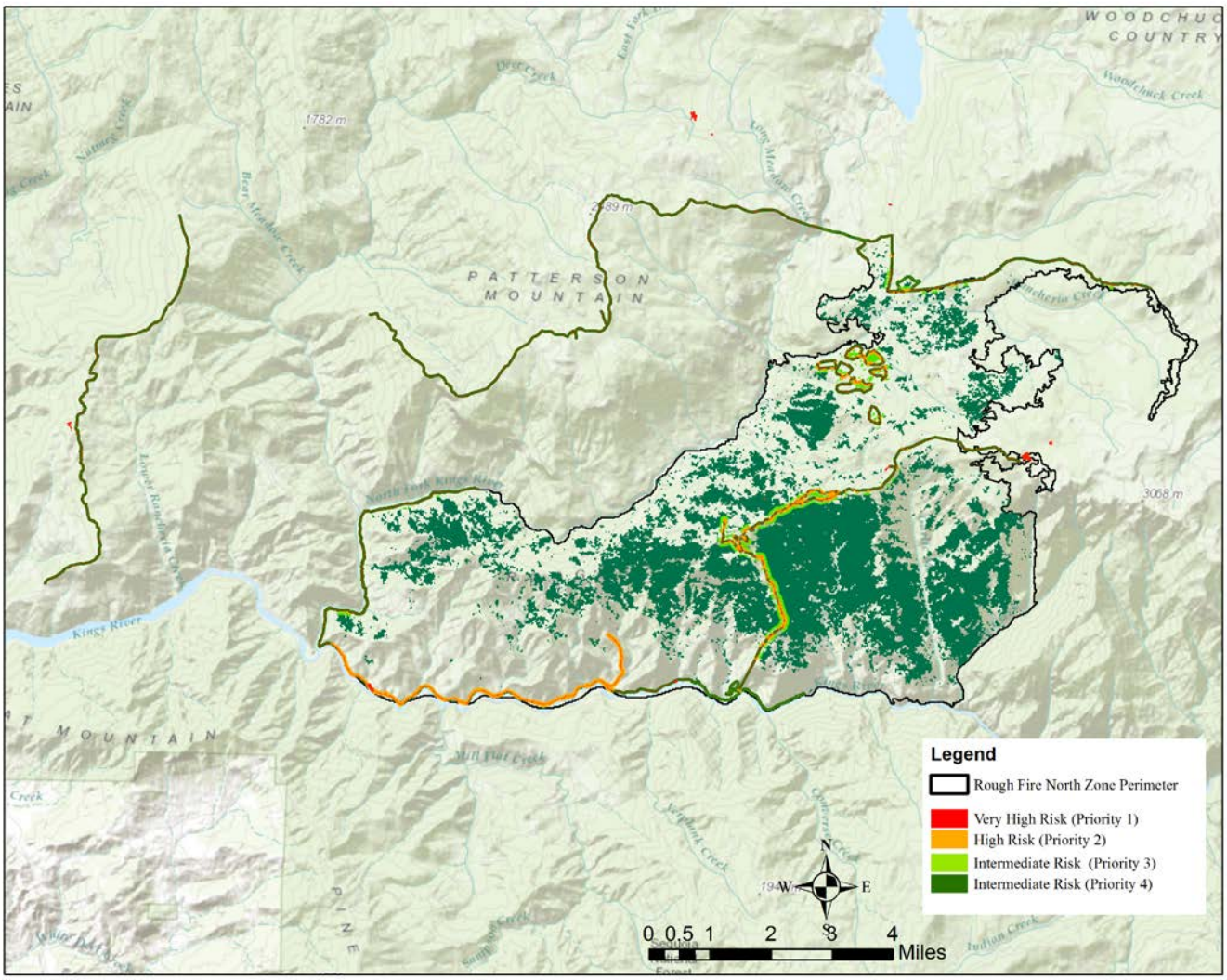

Figure 4. Risk of invasive non-native species impeding native plant recovery and diversity, indicating areas of treatment priority.

Emergency Determination

Native Vegetation Recovery and Diversity

There is an emergency related to native vegetation recovery and diversity due to the likely introduction and expansion of invasive weeds on at least 11,115 acres of the burned area (Very High, High, and Intermediate Risk). Native vegetation was identified as a Critical Value by the BAER team, as there are few invasive weed infestations present in the majority of the burned area. The fire created conditions conducive to the establishment and rapid spread of invasive weeds known to be within and adjacent to the fire area. Furthermore, suppression activities have likely vectored invasive weed seeds into or spread them further through the burned area.

Most of the mechanized equipment was not cleaned prior to line implementation, as the weed wash station was not in place until 2 weeks after the fire started, when it had already grown to 50,000 acres (Sierra and Sequoia NFs). Having equipment washing in place much sooner would have significantly reduced the potential of weeds arriving to the fire area. Weed propagules in and adjacent to the fire may have been spread through fire line construction in addition to potentially arriving from elsewhere on contaminated equipment. Field reconnaissance noted evidence of dozer and other equipment passing through known areas of Italian thistle, bull thistle, and other invasive plant species.

Although the removal of aromatic canyon gooseberry and Howell's umbrellawort plants by suppression activities (dozer line) may affect the viability of these occurrences, the Very High Risk of invasive plant incursion on these fire lines could additionally impede the recovery of these Forest Service sensitive species. Likewise, any incursion of invasive species into Tule Meadow Camp will impede native vegetation recovery in areas disturbed within the forest surrounding the camp, and has some potential to affect the FS Sensitive Bolander's clover if any of the weeds were wetland species.

As such, burned native communities in the burn area are at risk of an irreversible loss of healthy native vegetation, a reduction in the rate of recovery of native vegetation, and loss of native plant species diversity. This BAER emergency can be mitigated by detecting and treating new populations of weeds, and containing known populations to limit fire and fire suppression activity related population growth. The "Very High," "High" and "Intermediate" risk areas will likely see reduced native plant recovery and diversity in the first year after the fire and thereafter unless early detection and rapid response is implemented aggressively

Threatened and Endangered Plant Species: No federally listed plants occur within the Rough Fire North Zone area. Therefore, there is no emergency determination or need for treatments for federally listed plant species.

C. Treatments to Mitigate the Emergency

(a) Treatment Type

Invasive Weed Detection and Eradication: Early detection and rapid response (EDRR) treatments for invasive non-native plant species would be completed in locations determined to be "Very High," "High" and "Priority 3 Intermediate" risk areas, representing fire lines, mechanical equipment concentration areas, and moderate or high severity fire near anthropocentric disturbed areas. EDRR is a strategy developed to increase efficiency of weed work by combining surveying, mapping, and immediate treatment of new weed populations as they are discovered.

(b) Treatment Objective

Invasive Weed Detection and Eradication: The objective of early detection surveys and rapid response treatment is to reduce the potential for expansion of invasive weeds by detecting plants early in the invasion stages. Additional objectives are to promptly eradicate new infestations to prevent the spread of invasive weeds beyond known pre-fire occurrence boundaries; and to allow for native vegetation recovery by eliminating competition from invasive species.

(c) Treatment Description

Invasive Weed Detection and Eradication: Detection surveys in Priority 1, 2, and 3 areas may be conducted in spring (or as soon as the weed species are identifiable) to detect and control and early season invasive weeds, and/or in the summer to detect and control late season invasive weeds. Infestations will be mapped with GPS, photographed, and flagged with invasive weed tape. New or isolated infestations would be manually removed during survey and mapping (EDRR). For most invasive non-native species likely to occur in or near the Rough Fire North Zone area, hand pulling consists of pulling the plant up by the roots and bagging for disposal if flowers or seed heads are present.

Surveys and treatments would be conducted by a two-person crew, with the goal of timing the visits appropriately so that when possible only one visit per site is needed. However, depending on phenology, infestation size, and treatment strategy, some infestations may be treated more than once. Emergency surveys and treatments would be conducted for one year only with BAER funds per BAER policy. Survey and treatment in subsequent years may be accomplished through a combination of Forest Service program funding or coordination with outside partners.

(d) Treatment Cost

Invasive Weed Detection and Eradication:

The overall estimate to complete priority EDRR surveys for the Rough Fire North Zone is REDACT Appendix E provides a cost per acre comparison with recent fires on the Sierra National Forest that have been approved for similar BAER treatments. Treatment cost estimates for the Rough Fire North Zone are within the range of recent fires that have occurred on the Sierra National Forest and reflect steep terrain surveys, the amount of high and moderate burn severity, and the absence of cleaning of heavy equipment prior to fire line construction.

		366 acres, including 63 miles of fire line		485 additional burned acres		265 additional burned acres	
		Priority 1		**Priority 2**		**Priority 3**	
Item	**Daily Rate per Person**	**# Days**	**Total**	**# Days**	**Total**	**# Days**	**Total**
Personnel							
GS- 11 Botanist (hiring, training, supervision, reporting)							
GS-7 Temporary Botanist (Survey and Treatments)							
Personnel Subtotal							
Materials and Supplies							
Vehicle Mileage (survey and treatment)							
Supplies & Materials (trash bags, gloves, safety items; etc.)							
Total Weed Survey and Treatment							
Total for All 3 Priority Areas							

REDACT

(e) Probability of Treatment in First Year Prior to Damaging Storms or Events
Invasive Weed Detection and Eradication: Late fall and winter precipitation would occur prior to plant surveys that would be planned for the spring and summer of 2016 during the appropriate phenological stages. Surveys would be conducted before plants have the opportunity to fully establish and spread. This criterion differs from emergency watershed treatments that must be in place by the first storms, which does not apply well to invasive weed risk and treatments.

(f) Probability of Treatment Success
Invasive Weed Detection and Eradication: EDRR techniques have been proven to be an effective approach to reduce ecological and economic damage (Stohlgren et al., 1999). An implementation strategy to maximize success is provided in Appendix F.

II. Discussion/Summary/Recommendations

The value at risk related to Botany for the Rough Fire North Zone is native vegetation recovery and diversity. The effects to native vegetation assemblages from the introduction of invasive plants are well known. Invasive plants can reduce native biodiversity, reduce habitat for wildlife andpollinators, alter natural fire regimes and hydrological processes, and have a substantial economic effect (e.g. on rangelands, timber production land, and recreation values of public land). The early detection and rapid response (EDRR) treatments for invasive plant species have a very high level of predicted success in regards to limiting invasive plant establishment. The key to reducing both the ecological and economic damages caused by invasive species is to detect and treat individuals before they have the opportunity to become established.

Once invasive plants become established, the rate of weed spread has been estimated at 10-20% per year depending on the species and site conditions, but can be as high as 60% per year (Asher and Dewey 2005). The presence of known infestations and potential seed bank of several invasive weed species in the fire and near the fire perimeter, as well as the variety of vectors present during the course of the fire, will give invasive plants ample opportunities to establish seedlings within the burned area. Careful surveying, mapping and control treatments, especially of new satellite populations, will be essential to reduce this risk.

Treatments are proposed in this BAER assessment by priority. The most effective treatment addressing the burn area would be to conduct EDRR surveys in Priority areas 1, 2, and 3. These treatments would include EDRR treatments on fire line construction (62.5 miles) and equipment concentration points (31.2 acres) and high and moderate burn severity near disturbed areas. The overall cost of this alternative is $[redacted]. There are an additional 10,000 acres (Priority 4) that are susceptible to invasive plant incursion. These areas are farther away from anthropogenic vectors and pathways, but plant propagules could still be transported via water, wind, or wildlife. Steep slope areas may receive plant propagules through sheet erosion of contaminated soils. These Priority 4 survey areas should be monitored by Forest staff until native vegetation becomes established.

Delaying or deferring treatment in the burned area would result in the expansion of weeds at a high rate. Based on the Office of Technology Assessment (1993) assessment, the delaying or deferring treatment in the burned area could result in future costs exceeding $760,000 to achieve the same goals. This estimate excludes the cost associated with NEPA analysis, which could exceed $200,000. Budget realities would likely limit future treatments making it imperative to prevent the likely expansion of weeds throughout the burned area.

RECOMMENDATION: Create a "weed alert" flier showing invasive non-native weed species most likely to invade in the Rough Fire North Zone area. Circulate widely among FS employees and the public to improve the odds of finding and eradicating newly established infestations in and near the burn area.

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IV. Appendices

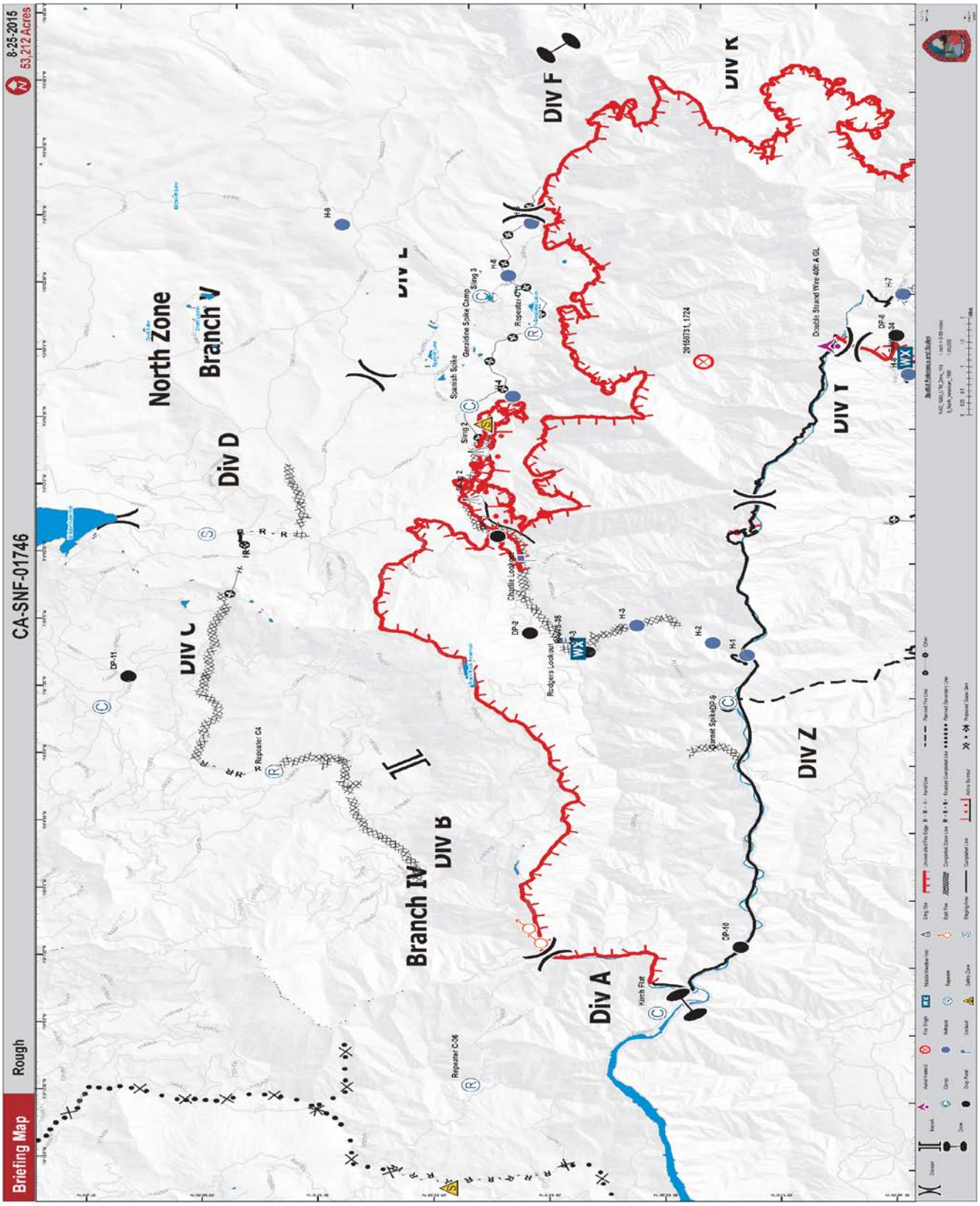
Appendix A. Species List

Threatened, endangered, and sensitive plants that are known to occur (K), or that potentially may occur (P) on the Sierra National Forest. Shaded rows indicate plats that could be affected by the invasive or noxious plant incursion in the North Zone of the Rough Fire.

Scientific Name	**Common Name**	**SIERRA NF**	**State List**	**Fed List**	**Global Rank**	**CNPS List**	**State Rank**
Allium yosemitense Eastw.	Yosemite onion	K	R		G2	1B.3	S2.3
Boechera tularensis Windham & Al-Shehbaz	Tulare Rockcress	K			G2	1B.3	S2
Botrychium ascendens W. H. Wagner	upswept moonwort	P		SC	G2G3	2.3	S1.3?
Botrychium crenulatum W. H. Wagner (soon to be *B. lunaria* var. *crenulatum)*	scalloped moonwort	P		SC	G3	2.2	S2.2
Botrychium lineare W. H. Wagner (soon to be *B. campestre* var. *lineare)*	slender moonwort	K			G2?	1B.3	S1.3
Botrychium lunaria (L.) Sw. (soon to be *B. neolunaria)*	common moonwort	P		SC	G5	2.3	S2?
Botrychium minganense Victorin	Mingan moonwort	P			G4	2.2	S1.2
Botrychium montanum W. H. Wagner	mountain moonwort	P			G3	2.1	S1.1
Botrychium paradoxum W.H. Wagner	paradox moonwort	P			G3G4	2.1	S1
Botrychium tunux Stensvold & Farrar	moosewort	P			G3?	2.1	S1
Botrychium yaaxudakeit Stensvold & Farrar	giant moonwort	P			G3G4	2.1	S1
Bruchia bolanderi Lesq.	Bolander's bruchia	K			G3	2.2	S2
Calyptridium pulchellum (Eastw.) Hoov.	Mariposa pussypaws	K		T	G1	1B.1	S1
Calyptridium pygmaeum Parish ex. Rydberg	pygmy pussypaws	K			G2	1B.2	S2
Camissonia sierrae Raven ssp. *alticola* Raven	Mono Hot Springs evening primrose	K			G3T2	1B.2	S2.2
Carlquistia muirii (Gray) B.G. Baldwin	Muir's raillardella	K			G2	1B.3	S2.3
Carpenteria californica Torr.	tree anemone	K	T		G1	1B.2	S1?
Cinna bolanderi Scribn.	Bolander's woodreed	K			G2	1B.2	S2
Clarkia biloba (Durand) Nels. & Macbr. ssp. *australis* Lewis & Lewis	Mariposa clarkia	K		SC	G4G5 T2	1B.2	S2.2
Clarkia lingulata Lewis & Lewis	Merced clarkia	K	E		G1	1B.1	S1
Collomia rawsoniana Greene	Rawson's flaming trumpet	K			G2	1B.2	S2
Cypripedium montanum Lindl.	mountain lady's slipper	K			G4	4.2	S4.2
Delphinium inopinum (Jepson) Lewis & Epl.	unexpected larkspur	K			G3	4.3	S3.3
Dicentra nevadensis Eastw.	Tulare County bleedingheart	K			G3	4.3	S3.3
Draba sharsmithii Roll. & Price	Mount Whitney draba	K			G1	1B.3	S1.3
Eriastrum tracyi Mason	Brandegee's wooly-star	K	R		G1Q	1B.2	S1.1
Erigeron aequifolius Hall	Hall's daisy	K			G2	1B.3	S2.3
Eriogonum nudum Dougl. ex Benth. var. *regirivum* Rev. & J. Stebbins	Kings River buckwheat	K			G5T2	1B.2	S2.2
Eriogonum ovalifolium var. *monarchense* D.A. York	Monarch buckwheat	K			G5T1	1B.3	S1.3
Eriophyllum congdonii Brandegee	Congdon's woolly sunflower	K	R		G2	1B.2	S2.2
Erythronium pluriflorum Shevock, Bartel & Allen	manyflower fawnlily	K			G1	1B.3	S1.3
Fissidens aphelotaxifolius Pursell	brook pocket moss	K			G1G2	2.2	S1

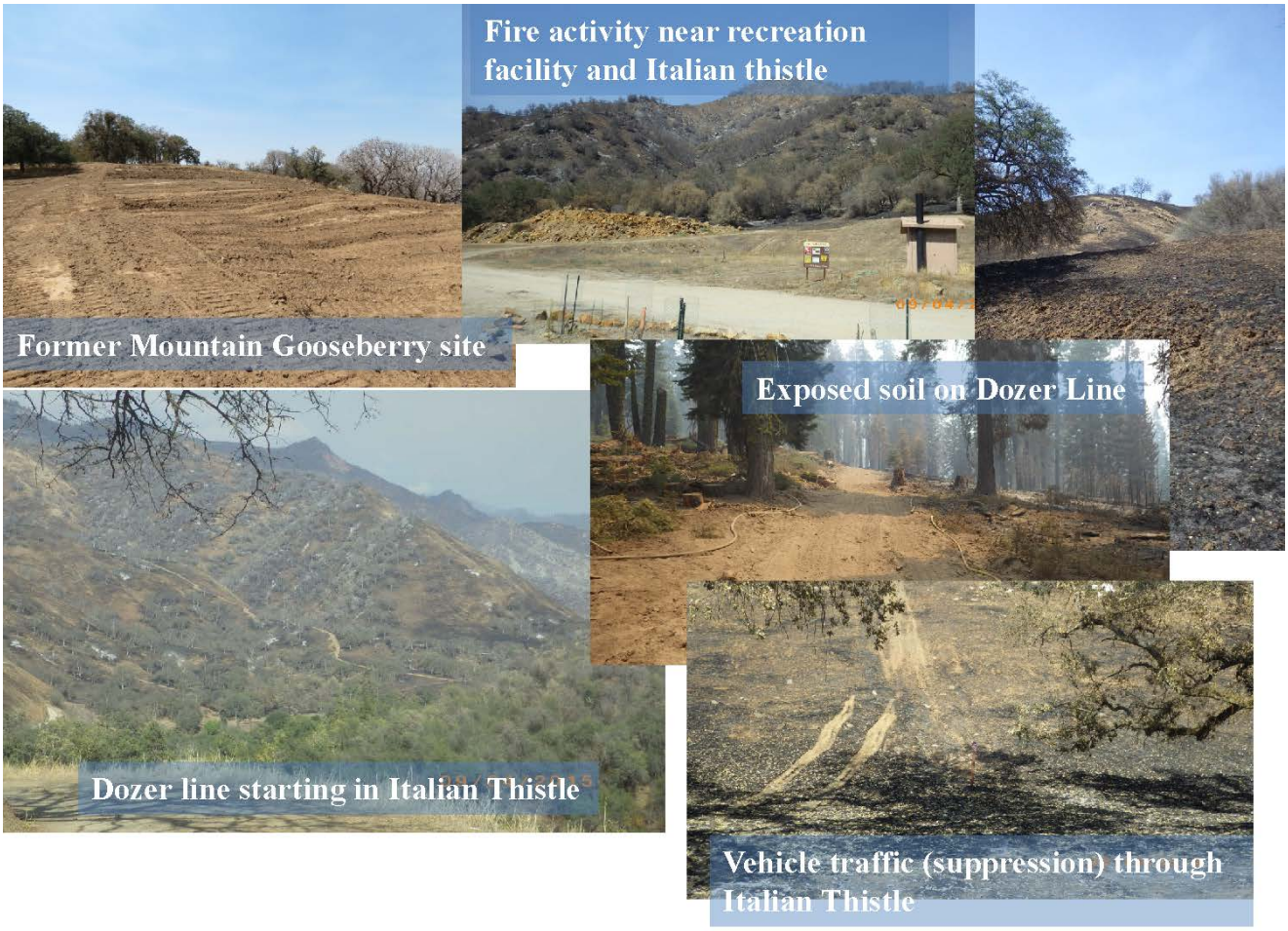
Gilia yorkii Shevock and A.G. Day	Monarch Gilia	P			G1	1B.2	S1
Helodium blandowii (Web. & Mohr) Warnst.	Blandow's bog moss	P			G5	2.3	S1
Heterotheca monarchensis York, Shevock, & Semple	monarch goldenaster	K			G1	1B.3	S1.3
Horkelia parryi Greene	Parry's horkelia	K		SC	G2	1B.2	S2.2
Hulsea brevifolia A. Gray	short-leaved hulsea	K		SC	G3	1B.2	S3
Leptosiphon serrulatus (Greene) J.M. Porter & L.A. Johnson	Madera linanthus	K			G1	1B.2	S1?
Lewisia congdonii (Rydb.) J.T. Howell	Congdon's bitterroot	K	R		G1	1B.3	S1.3
Lewisia disepala Rydb.	Yosemite lewisia	K		SC	G2	1B.2	S2.2
Lewisia kelloggii (K. Brandeg.) ssp. *kelloggii*	Kellogg's lewisia	K			G4T4?	-	
Lupinus citrinus Kell. var. *citrinus*	orange lupine	K			G2T2	1B.2	S2.2
Lupinus lepidus Dougl. ex Lindl. var. *culbertsonii* (Greene) C.P. Sm.	Hockett Meadows lupine	P			G3?T1	1B.3	S1.3
Meesia uliginosa Hedw.	broad-nerved hump-moss	K			G4	2.2	S2
Mielichhoferia elongata (Hoppe &Hornsch. Ex Hook) Nees & Hornsch.	elongate copper moss	K			G4?	2.2	S2
Mielichhoferia shevockii (A.J. Shaw) A.J. Shaw	Shevock's copper moss	K			G1	1B.2	S1
Mimulus filicaulis Wats.	slender-stemmed monkeyflower	K			G2	1B.2	S2.2
Mimulus gracilipes Robinson	slenderstalk monkeyflower	K		SC	G2G3	1B.2	S2S3
Mimulus norrisii Heckard and Shevock	Kaweah monkeyflower	K			G2	1B.3	S2.3
Mimulus pulchellus (E. Greene) A.L. Grant	pansy monkeyflower	P		SC	G2G3	1B.2	S2S3
Peltigera gowardii Lendemer & H. O'Brien (formerly *P. hydrothyria)*	Goward's waterfan, aquatic felt lichen	K			G4	-	S3.2
Petrophyton caespitosum (Nutt.) Rydb. ssp. *acuminatum* Munz	marble rockmat	P			G5T2	1B.3	S2
Pinus albicaulis Engelm	whitebark pine	K		C	G3G4	-	-
Plantanthera yosemitensis Colwell, Sheviak & P.E. Moore	Yosemite bog orchid	K			G2	1B.2	S2.2
Sidalcea keckii Wiggins	Keck's checkerbloom	P		E	G!	1B.1	S1
Ribes menziesii var. *ixoderme*	Aromatic canyon gooseberry	K			G4T2	1B.2	S2
Streptanthus fenestratus (Greene) J. Howell	Tehipite Valley jewelflower	K			G2	1B.3	S2
Tauschia howellii (Coult. & Rose) Macbr.	Howell's tauschia	K			G2	1B.3	S2
Trifolium bolanderi Gray	Bolander's clover	K			G2G3	1B.2	S2S3

Appendix B. August 25, 2015 Fire and Dozer Line Extent



Appendix C. Example photographs

Example fire severity and suppression activities that increase the likelihood of invasive non-native plant incursion into the fire area.



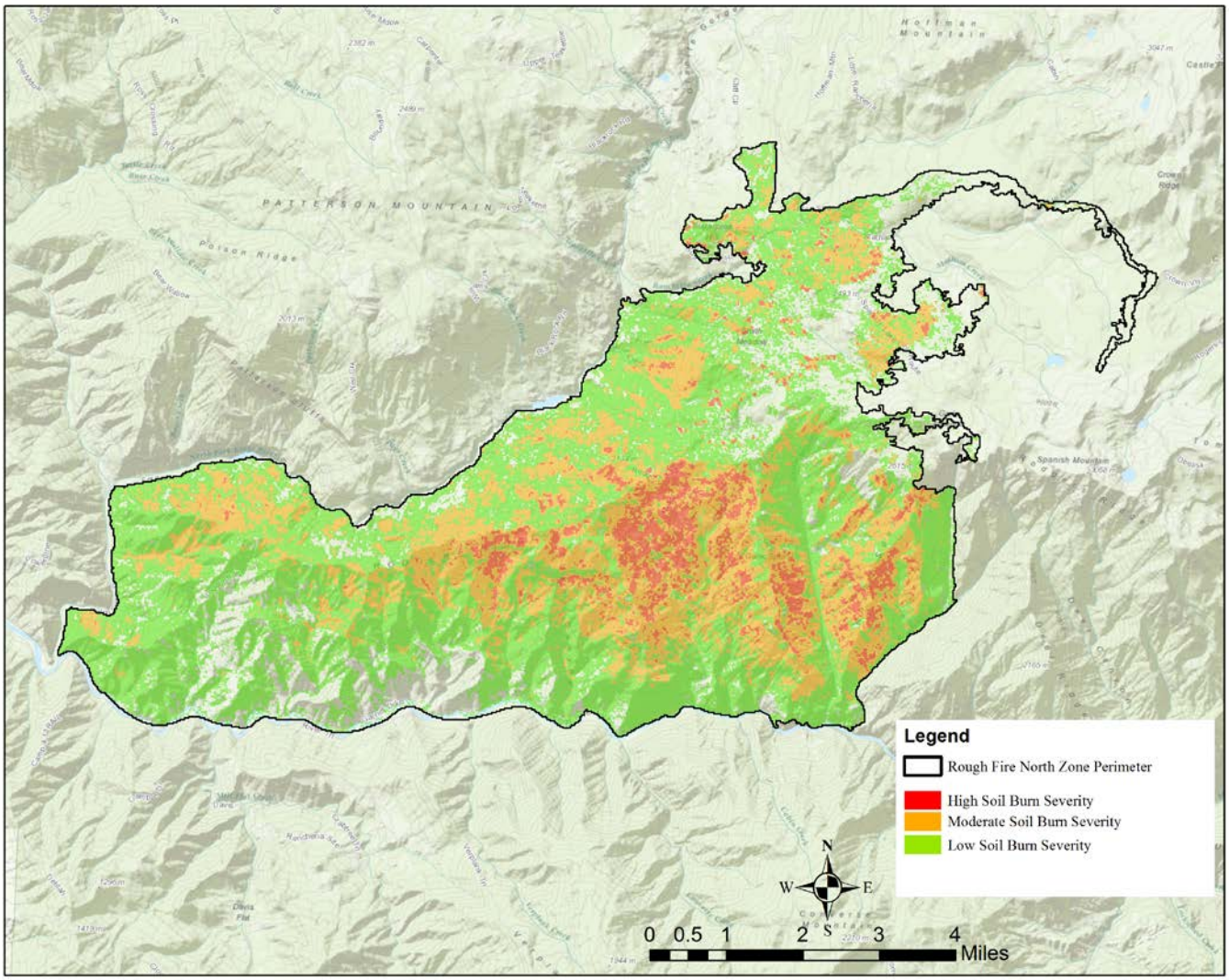
Photos by Kendal Young and Mike Nolen.

Drop points and Safety Zones with exposed soils.

Photos by Kendal Young.

Photos by Kendal Young.

Appendix D: Rough Fire Soil Burn Severity



Appendix E. Cost Comparison

Cost comparison (dollars/acre) of BAER funding for invasive species surveys/treatment on high priority ground (not entire fire acres) for the Rough and four other SNF fires.

	BAER Invasive Weed Budget	Total Fire Acres	Total NFS Acres	Acres of Drop Points, Safety Zones, Helispots, etc.	Acres of High Priority Burned Ground	TOTAL Acres to Survey for Invasive Weeds	Cost per Acre of Surveyed Ground
Rough - SNF 2015	REDACT	30,862	30,862	24.3	1091.7	1116.0	REDACT
Willow - SNF 2015		5,702	5,551	20.15	501	666.90	
Aspen - SNF 2013		22,800	22,172	50	500	722.22	
French - SNF 2014		13,835	13,832	20	925	1,017.73	
Carstens - SNF 2013		1,709	947	5	100	156.20	

Note: these costs are very difficult to use as true cost/acre comparisons. Costs vary hugely depending on the distance to the work site, topography, different BAER botanists' assessment of what priority ground is, etc.

Comparing cost estimates between fires is difficult because each fire location has a different survey need, fire area access consideration, slope, aspect, safety considerations, and ecological need. In general, steep ground requires greater amounts of survey time, which increases costs. Although fire staff attempts to document every fire line, there are instances where fire lines are either missed, or are missed mapped. Major differences in cost/acre could be due to the need to purchase equipment or extreme differences in distance of the fire from standard duty stations.

ASPEN FIRE BUFFERS USED FOR CALCULATING ACRES TO SURVEY	
Type of Area	**Buffer Amount Applied (ft)**
Drop points	150
Safety zones	300
Medivac	100
Helispots	500
Staging area	100
Constructed dozer line	200
Constructed line (other)	50
Road Monitoring	No consistent amount applied; based on survey

Estimates of personnel time required to survey fire lines is often calculated by buffering features at various intervals. For example, the Aspen fire applied different buffer amounts to different disturbances in the fire area (See Table to the left). While this approach provides a quick estimate of acres to be surveyed, it does not always account for disturbance frequency or intensity that may alter the likelihood of invasive plant incurrence into new areas. An area that is at low risk of invasive plant incursion may be easily included in a simple wide buffer, yet these areas may not be high priority areas for survey. The risk analysis approach used to determine survey priorities for the Willow and Rough fires attempts to integrate disturbance theories from the scientific literature into risk analyses to prioritize survey efforts. The highest priority areas for survey are more likely to be locations that have a high risk of invasive plant incursion, establishment, and spread. As such, cost estimates per acre between fires should be interpreted with caution.

Nevertheless, treatment cost estimates for the Rough Fire North Zone are within the range of cost/acre of BAER treatments for recent fires on the Sierra National Forest.

Appendix F. Botany Implementation Strategy

Approx. Timing	**Task**	**Responsible Person**
Winter 2015	• Advertise for GS 7 Technicians	• Forest Botanist
Jan - Feb 2016	• Review Technician Applicants • Determine/ reserve vehicles for technicians	• Forest Botanist
Feb - Mar 2016	• Purchase Supplies and Equipment • Determine /reserve lodging/camping facilities for technicians designed to minimize transportation time and costs.	• Forest Botanist
Apr – May 2016	• Hire field technicians • Conduct weed identification training • Emphasize safety – fire area is remote and hazardous	• Forest Botanist
May – Jun 2016	• Conduct ERDD for early blooming species	• Forest Botanist
June – Aug 2016	• Conduct ERDD for late blooming species • Conduct repeat surveys where necessary	• Forest Botanist
Sept – Oct 2016	• Summarize survey effort and results for BAER accomplishment report	• Forest Botanist
Oct – Dec 2016	• Seek additional funding for out-year surveys/monitoring	• Forest Botanist
Summer 2017-2018	• Depending on funding, Forest conduct follow up in Priority 1, 2, and 3 areas, and subsample Priority 4 areas.	• Forest Botanist