Exemption and Emergency Notice Monitoring Pilot Project Report

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Exemption and Emergency Notice Monitoring Pilot Project Report

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Executive Summary

The Exemption and Emergency Notice process allows for commercial timber harvest without the requirement of Timber Harvesting Plan (THP) for certain types of timber operations. The number of Exemptions and Emergencies increased relatively slowly from 1980 to 2014. However, the drought of 2012-2015 combined with an increase in the size and frequency of damaging wildfires has spurred an increase in the number of Exemptions, as well as the Notice types available for timberland owners. More recently developed Exemptions have focused on enhancing the resiliency of forests to wildfire, providing additional fuels reduction proximal to residential structures, and allowing for the abatement of fire hazard and life-safety hazards presented by drought-killed trees. As of February 2019, the Exemption and Emergency Notice process has changed in response to recent legislative and Board of Forestry and Fire Protection (Board) action, further addressing barriers for fuels and forest health-related forest management throughout the state. This report represents an assessment of Exemptions and Emergencies prior to regulatory changes effected in 2019.

The following is a first phase report that outlines trends and compliance for various Exemptions and Emergencies in use from 2008 through 2017, and post-harvest outcomes and elements of effectiveness for those available in 2018. This report is the first step in fulfilling a legislative mandate to monitor Exemption and Emergency Notices. Due to the dynamic and complex nature of Exemptions and Emergencies, this report is not comprehensive in its scope of inquiry. Nevertheless, it is intended to provide a foundation for future monitoring, as well as a framework for determining successes and failures in the implementation of Exemptions and Emergencies.

This first phase report includes:

- An evaluation of trends in use for various Exemptions and Emergencies;
- An evaluation of Exemption and Emergency FPRs from CAL FIRE inspection and violation data;
- Findings from a field-based pilot study focused on post-harvest outcomes and effectiveness using a random selection of Drought Mortality Exemptions (1038(k)), Forest Fire Prevention Pilot Project Exemptions (1038(j)), and post-fire Emergencies (1052.1);
- Findings from a remote sensing and GIS-based evaluation of Exemption and Emergency Notices;
- Discussion and synthesis of the various report components; and

- Recommendations for internal process refinements and future monitoring strategies.

Exemption and Emergency - Trends in Use and Compliance

Exemption Notices had the following trends in use from 2008 to 2017:

- An average of approximately 2,100 Exemption Notices were submitted annually (21,021 total).
- An approximate average of 2.9 million acres of timberland were under exemption notice within a given year, but this is a very poor indicator of the spatial footprint of harvest.
- The highest numbers of exemption notices over the reporting timeframe were associated with:
    - Fire Hazard Reduction (150-300 feet;1038(c); 40%);
    - Christmas Tree / Dead, Dying, or Diseased Trees (1038(a, b); 30%);
    - Less than 3 Acre Conversions (1104.1(a); 12%); and
    - Drought Mortality (1038(k); 10%).
- Christmas Tree / Dead, Dying, or Diseased (1038(a,b)) Notices represent approximately 97 percent of the acreage submitted under Exemption Notice, with acreage filed under 1038(b) Notices having a poor correlation with the actual acreage treated.

Statistically significant trends in Exemption Notice use were limited to:

- Decreases in the acreage of Christmas Tree / Dead, Dying, or Diseased Trees 1038(a,b) Notices in the Coast and increases in the South Forest Practice areas of the state, despite reported acreage being a poor indicator of actual harvested acreage.
- A rapid increase, followed by a rapid decrease in the use of and acreage under Fire Hazard Reduction 1038(c) Exemptions in the South Forest Practice area, tied to the availability of grant monies from the Emergency Supplemental Hazard Fuel Treatment (i.e., Forest Care) grant program.
- A statewide decrease in the number of Forest Fire Prevention (1038(i)) Exemptions, which coincided with the creation and increased use of the less restrictive Forest Fire Prevention Pilot Project Exemption (1038(j)), and the loss of Forest Care grant monies in the South Forest Practice area.
- An increase in the use of and acreage under Less than 3 Acre Conversion Exemptions in the Coast and Cascade Forest Practice areas, likely associated with cannabis cultivation.
- A statewide increase in the number of Utility Right-of-Way Conversion Exemptions, mostly within the Cascade and Sierra Forest Practice areas.
- A significant increase in the total acreage under Exemptions, when 1038(a,b) are excluded from the dataset. This is primarily due to the increased acreage submitted under the Drought Mortality Exemption (1038(k)) and an increase in the acreage of Utility Right-of-Way Conversion Exemptions (1104.1.c).

Emergency Notices had the following trends in use from 2008 to 2017:

- An average of approximately 170 Emergency Notices were submitted annually (1,697 total).
- An approximate average of 26,000 acres of timberland were under Emergency Notice within a given year.
- The highest numbers of Emergency Notices over the reporting timeframe were associated with:
    - Dead or Dying from Insects, Disease, Fire, Drought, Wind and Flood Notices (1052.1(a,b); 81%);
    - High or Extreme Fuel Hazard Conditions Emergency Notices (1052.1(e); 15%);
- Dead or Dying from Insects, Disease, Fire, Drought, Wind and Flood Notices represented approximately 98 percent of the acreage submitted under Emergency Notices.

Statistically significant trends in use were limited to a rapid increase, then decrease, for High or Extreme Fuel Hazard Conditions Emergency Notices in the South Forest Practice area. These trends were likely associated with the limited availability of Forest Care grant monies in southern California.

An average of approximately 1,454 and 380 inspections were done per year for Exemptions and Emergency Notices, respectively. It is unknown what percentage of Notices received inspections. Most Exemption-related violations were associated with Less than 3 Acre Conversion (1104.1.a), Fire Hazard Reduction (1038(c)), and Christmas Trees / Dead, Dying, or Diseased Trees 1038(a,b) Notices, respectively. Most Emergency-related violations were associated with Dead or Dying from Insects, Disease, Fire, Drought, Wind and Flood Notices (1052.1-1052.3), since those Notice types represented most of the submitted Emergencies. The most common FPR violation categories for Exemption Notices were licensing and professional responsibility (36%), slash treatment (22%), and general intent and requirements (14%). The most common FPR violation categories for Emergency Notices were road-related issues/erosion control (28%), general intent and requirements (26%), and licensing and professional responsibilities (23%).

Exemption and Emergency Notice Pilot Study

A pilot field-based study was implemented in 2018 to test potential field protocols and to provide initial feedback on post-harvest outcomes for a variety of environmental variables. Fifty (50) Exemption and Emergency Notices were randomly selected from the 2016-2017 population of 2,072 1038(i) Forest Fire Prevention Exemptions, 1038(j) Forest Fire Prevention Pilot Exemptions, 1038(k) Drought Mortality Exemptions, and 1052.1 Emergency Notices. A rapid field protocol was initiated at an objectively assigned field sampling location within each Notice (i.e., Notice centroid) and digital

data were recorded by multi-agency field teams. Findings reported below only apply to the aforementioned population of Exemption and Emergency Notices.

Characteristics of Random Notice Sample

Of the 50 randomly selected Notices, 60 percent were in the Sierra/South Forest Practice area, 36 percent were in the Cascade area, and four percent were in the Coast area. Eighty-four percent of the Notices were Drought Mortality Exemptions (1038(k)), ten percent were 1052.1(a,b) Emergency Notices, and six percent were Forest Fire Prevention Pilot Project Exemptions (1038(j)). The size of the sampled Notices ranged from one to 432 acres. In general, the size of the randomly selected Notices reflected the distribution of Notice sizes from the entire population. Altogether, 44 of the selected Notices could be characterized as small nonindustrial ownerships, whereas six Notices were associated with large industrial landowners. Eighty-six percent of Notices were on lands with relatively low erosion risk, with the remaining 14 percent on lands characterized as having moderate erosion risk.

Number of Notices that Received Timber Harvest

Although 50 Notices were randomly drawn from the population, only 44 notices (88%) were subject to timber operations. This means that 12 percent of the Notices were never operated upon. Due to the relatively low sample size, the number of Notices not receiving operations could be as high as 21 percent, or approximately 1/5th of the population. Of the 44 Notices evaluated in the field, 70 percent were less than or equal to 20 acres in reported size.

Generalized Harvest Silviculture and Intensity

The sampled Notices were characterized by the closest silvicultural prescription and by the approximate percentage of tree removal across the entire Notice area (i.e., harvest intensity). Approximately 77 percent (n=34) of sampled notices resembled single tree selection (i.e., removal of single trees) and this silvicultural prescription was most representative of the harvest done within Drought Mortality (1038(k)) and Forest Fire Prevention Pilot Project (1038(j)) Exemptions. Sixteen percent (n=7) represented group selection (i.e., patch cuts less than 2.5 acres) mainly associated with Drought Mortality Exemptions, while seven percent (n=3) of the Notices resembled a clearcut and were primarily associated with post-fire Emergencies (i.e., 2 out of 3 Notices). Most of the Drought Mortality Exemptions had less than 50 percent of the Notice area harvested. Forest Fire Prevention Pilot Project Exemptions exhibited harvest intensities ranging from less than 25 percent to 75 percent. Post-fire Emergency notices had the highest intensity of harvest.

Residual Stand Structure and Condition

Rapid use of variable plot sampling provided insight into post-harvest stand structure and condition. For Drought Mortality Exemptions (1038(k)) the residual basal area of

green conifers averaged 64 square-feet per acre (ft^2 ac^{-1}), with a quadratic mean diameter (QMD) of 21 inches. Most of the Drought Mortality Exemptions could be classified as treating “Small Trees” and “Medium/Large” trees under the California Wildlife Habitat Relationship (WHR) Classification. Despite the Drought Mortality Exemption being used as a permitting vehicle to remove dead or dying trees, the number of dead trees on harvested Drought Mortality Exemption Notices increased significantly from north to south. This possibly indicates that the one-year duration Drought Mortality Exemption was not entirely effective at capturing mortality over the multi-year duration of the drought.

Since only three Forest Fire Prevention Pilot Project Exemptions (1038(j)) were sampled, it is difficult to present conclusive results regarding this Exemption type. Of the three 1038(j) Notices sampled, one was in an early seral stand (i.e., 20+ year plantation) and two were in mid-seral stands. Residual basal area ranged from 75 to 127 ft^2 ac^{-1}, with QMD ranging from 8.9 inches for the early seral stand, to 18.3 inches for a mid-seral stand in the coast redwood area. Post-harvest surface fuels for the 1038(j) Notices in the redwood area exceeded 18 inches in depth multiple times, indicating the reduction in crown fuel continuity possibly came at the expense of increased surface fuel continuity.

Similarly, the small sample of Post-Fire Emergency Notices (1052.1 a,b) limits conclusive results. Residual basal area for the three notices ranged from 23 ft^2 ac^{-1} to 133 ft^2 ac^{-1}, with QMD ranging from 8.0 to 15.9 inches, and the residual trees were generally fire-killed trees.

Wildlife and Botanical Resources

Out of the 50 randomly selected Notices, seven Notices were within the range of the Northern Spotted Owl, and two Notices were within ½-mile of an activity center (AC). For California Spotted Owl, 40 Notices were within the range, with one Notice within ½-mile of an AC. When querying the California Natural Diversity Database (CNDDB), the selected Notices had the most numerous detections associated with botanical species (n=17), mammalian species (n=3), bird species (n=2), and fish species (n=2).

Water Quality

Twenty-six of the 44 Notices (59%) that were subject to timber harvest had watercourses present, thereby limiting water quality impacts to approximately 3/5th of the sampled Notices. Monitoring personnel predominantly assessed Class III watercourses (n=12), followed by Class II watercourses (n=8), Class IV watercourses (n=4), and Class I watercourses (n=1) (one watercourse was unclassified). There was no Watercourse and Lake Protection Zone (WLPZ) harvesting observed in the Class I WLPZ, and no to minimal (<33% canopy removal) harvesting in the Class II WLPZs. Only four Notices had equipment encroachments into the WLPZs and Equipment

Limitation Zones (ELZs), with ELZ encroachments on Class III watercourses representing 75 percent of the individual encroachments, and the remaining 25 percent associated with Class II WLPZs. Only one Drought Mortality (1038(k)) Notice with an ELZ equipment encroachment directly related to timber harvest resulted in an observable sediment discharge. Other sediment discharges were observed, but were primarily attributed to storm water from the "built" environment rather than from timber harvest.

Only 16 of the 44 (36%) field-sampled Notices had pre-existing watercourse crossings present within the Notice area that were assessed. Professional judgement indicated that five of the 11 culverts assessed were undersized. Two watercourse crossings (18%) had the potential for stream diversion in the event of culvert failure.

Altogether, 23 sediment discharges were recorded from road segments to watercourses, and this was associated with 12 separate Notices (27%). Twenty of the 23 sediment discharges were directly attributed to harvest-related road usage. Of those 20 harvest-related discharges, 12 of the sediment discharges occurred at watercourse crossings, with six of the crossings discharging in excess of one cubic yard (yd^3) of sediment. Eight discharges were associated with road surface drainage or maintenance and construction, although only one of these were greater than 1 yd^3. Most of the larger sediment discharges occurred on relatively few notices. Excluding non-harvest-related sediment discharges, 27 Notices had watercourses and non-public roads present, and seven separate notices had harvest-related discharges over 1 yd^3, while the remaining twenty notices had either no sediment discharges or less than 1 yd^3. The relatively low percentage of Notices (i.e., 16%) with larger sediment discharges from assessed road segments related to Notice timber harvesting indicates a relatively high level of compliance with water quality-related aspects of the FPRs and is consistent with previous THP monitoring studies.

Notice Mapping Quality

Twelve Notices contained watercourses that were not mapped on the submitted Notice maps. This represented 46 percent of the 26 Notices that actually had watercourses on site. All of these unmapped watercourses were on Drought Mortality 1038(k) Exemptions, and 11 of the 12 were associated with Notice areas less than 20 acres. Since Registered Professional Foresters (RPFs) were not required to submit 1038(k) Exemptions for harvest areas less than 20 acres prior to 2019, this indicates that mapping errors are highest when RPFs are not required for Exemption submittal.

Remote Sensing Analysis for Exemption and Emergency Notices

A remote sensing case study for larger Drought Mortality 1038(k) Exemptions and 1052.1 Emergency Notices found that many boundaries and reported acreages for notices may not reflect the actual area harvested. In the central Sierra Nevada, satellite

imagery was used to detect that a potential maximum of five percent harvesting occurred within a footprint of 93,000 acres under 1038(k) Exemption, of which approximately one percent (1.1%), or 1,060 acres, were harvested intensively in a clear-cut-equivalent silvicultural treatment. Intensively-harvested patches were largely under 5 acres in size, with nine patches identified as 20 acres or larger, with a maximum size of approximately 81 acres.

Aerial imagery and post-fire tree mortality RAVG data indicated that post-fire timber harvesting within the Emergency notice boundaries in the sample occurred largely within areas of moderate to severe fire-induced tree mortality, although two Emergency Notices had large unharvested areas within severely burned portions of each Notice. Across 282 Emergency Notices, RAVG data indicated that most Notices likely do not experience 100 percent tree mortality within the submitted and mapped boundaries.

Using 71 mapped The Forest Fire Prevention 1038(i) and Forest Fire Prevention Pilot 1038(j) Exemption boundaries and CAL FIRE FRAP Fire Hazard Zone data, Notices in the Cascade, Sierra, and South areas fell almost entirely within “Very High” fire hazard zones. The Coast Area Notices were largely in “High” hazard zones, with portions in “Very High” zones, and one Notice entirely within a “Moderate” fire hazard zone.

Findings and Recommendations

Key findings of the Exemption and Emergency Notice Monitoring Pilot Project include:

1) Results of the pilot study are primarily hypotheses generating rather than conclusive.
2) There are relatively few statistically significant trends in use for Exemption and Emergency Notices. However, the data indicates that the availability of grant monies can lead to rapid increases and decreases in Exemption and Emergency submittals, particularly in the southern portion of the state.
3) Twelve percent of randomly selected Notices were not harvested. Given the small sample size of the pilot study, the number of unharvested Notices can be as high as 21 percent in the total population from which the sample was drawn.
4) Observations and data suggest a relatively high level of compliance, implementation, and effectiveness for water quality-related operational FPRs.
5) Reported acreage under Notice rarely matched the harvested area observed within the mapped boundary, and many of the Drought Mortality Exemption (1038(k)) Notices had low levels of harvest relative to the area placed under the Exemption Notice.
6) Mapping quality was lowest for Notices that did not require an RPF for submittal.

Recommendations for data collection improvement, training, outreach, and future monitoring are provided. Substantive recommendations for future monitoring include:

1) Monitoring should be structured around clear questions and testable hypotheses, with some questions/hypotheses varying by Exemption and Emergency Notice type.
2) Future monitoring protocols should be modular.
3) Future monitoring priorities must consider changes in Exemption -related regulations due to Senate Bill 901 and Board-adopted rule amendments.
4) GIS and remote sensing techniques should continue to be explored to answer questions related to scale of Exemption and Emergency use, as well as cumulative impacts.

List of Abbreviations

AC	Activity center
AGOL	ArcGIS Online
ArcGIS	Aeronautical Reconnaissance Coverage Geographic Information System
ASP	Anadromous Salmonid Protection Forest Practice Rules
BA	Basal area
BAF	Basal area factor
BCTF	Battle Creek Task Force
BMDSF	Boggs Mountain Demonstration State Forest
BMPs	Best Management Practices
BOF	State Board of Forestry and Fire Protection
CAL FIRE	California Department of Forestry and Fire Protection
CalTREES	California Timber Regulations and Environmental Evaluation System
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CGS	California Geological Survey, Department of Conservation
CNDDB	California Natural Diversity Database
CRPR	California Rare Plant Rank
CSO	California Spotted Owl
CVRWQCB	Central Valley Regional Water Quality Control Board
DBH	Diameter at Breast Height
DEM	Digital Elevation Model
eEHR	electronic Erosion Hazard Rating
EF	Expansion factor
EHR	Erosion Hazard Rating
ELZ	Equipment Limitation Zone
EM	Emergency Notice
ESA	Endangered Species Act
EX	Exemption Notice
FHZ	Fire Hazard Severity Zone
FORPRIEM	Forest Practice Rules Implementation and Effectiveness Monitoring
FPR	California Forest Practice Rules
FPS	Forest Practice System
FRAP	CAL FIRE's Fire and Resource Assessment Program
GeoPDF	Geospatial Portable Document Format
GIS	Geographic Information System
GPS	Global Positioning System
HMP	Hillslope Monitoring Program
HWC	Hardwood cover
IMMP	Interagency Mitigation Monitoring Program
ISO	International Organization for Standardization
LGC	Live ground cover

LiDAR	Light Detection and Ranging
LTO	Licensed Timber Operator
MBF	Thousand Board Feet
MCR	Modified Completion Report Monitoring Program
NAIP	National Agriculture Imagery Program
NHD	National Hydrography Dataset
NSO	Northern Spotted Owl
NTO	Notice of Timber Operations
NTMP	Nonindustrial Timber Management Plan
PRC	Public Resources Code
QMD	Quadratic mean diameter
RAVG	Rapid Assessment of Vegetation Condition after Wildfire
RdNBR	Relative Differenced Normalized Burn Ratio
RPF	Registered Professional Forester
RWQCBs	Regional Water Quality Control Boards
SB	Senate Bill
SOD	Sudden Oak Death
SWRCB	State Water Resources Control Board
THP	Timber Harvesting Plan
TPA	Trees per acre
TPZ	Timber Production Zone
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
WHR	California Wildlife Habitat Relationship
WLPZ	Watercourse and lake protection zone

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1 Introduction

The following document summarizes the first year of pilot monitoring focused on Exemption and Emergency (EX-EM) Notices. This monitoring effort is mandated by Assembly Bills 1958 and 2029, in addition to Senate Bills 92 and 901. As such, this report represents the first step in characterizing the baseline, trends, compliance, and effectiveness of the various Exemptions and Emergencies promulgated by the California Legislature and California State Board of Forestry and Fire Protection (BOF or Board).

EX-EM Notices are documents containing strict operational prohibitions and requirements for use in exchange for ministerial review and rapid approval. Notices of Exemption are presumed to be compliant with the California Environmental Quality Act (CEQA) and not subject to discretionary review by the Review Team agencies. Notices of Exemption are only exempt from the requirement for a Timber Harvesting Plan (THP). Emergency Notices are intended to give a landowner a rapid start on timber salvage operations following tree mortality events related to fire, insect, or disease outbreaks while a THP is in development. However, timber operations conducted under either Notice type must still adhere to the operational provisions of the California Forest Practice Rules (FPRs) and be compliant with all other relevant laws and regulations for protection of natural resources.

Though considerable information has been collected on THP FPRs compliance and effectiveness, virtually no effectiveness monitoring data have been collected on EX-EM Notices prior to 2018. With expanded use of EX-EM Notices due to the massive bark beetle tree mortality event in the interior part of California from 2012 to 2016 and numerous catastrophic timber fires in the last six years (Berner et al., 2017, Stevens et al., 2017, Stephens et al., 2018), concern by the Legislature and the public has risen regarding the level of EX-EM Notice compliance with the FPRs and their effectiveness in protection of resource values. Prompted in 2016 by Assembly Bills 1958 (Wood) and 2029 (Dahle), with additional direction from Senate Bill 92 in 2017, the California Department of Forestry and Fire Protection (CAL FIRE) and the Board initiated a long-term monitoring program for EX-EM Notices.

The variety of EX/EM Notices available for use, the number of notices submitted over time, and the myriad of potential questions regarding EX/EM effectiveness make a robust statistical sample of the entire population beyond the scope of this initial effort. Rather, the objectives of this initial monitoring effort are as follows:

- Initiate a strategy for monitoring and reporting of EX/EM Notices over time.
- Provide information on trends in use and compliance for each specific EX/EM Notice type.

- Develop and implement a pilot study to address post-treatment outcomes and effectiveness for selected EX/EM Notice types.
- Outline core principles for monitoring in 2019.

1.1 Brief Description of the Different Emergency and Exemption Notice Types

At the time this pilot monitoring project was initiated there were 19 different types of timber harvesting operations allowed on non-federal, state and private timberlands through Exemption and Emergency Notices under the Forest Practice Rules. These are ministerial notices and are not subject to environmental review by CAL FIRE or the other responsible agencies. The Forest Practice Rules only exempt operations conducted under Exemption Notices from the Timber Harvesting Plan preparation and submission requirements (PRC § 4581) and from the completion report and stocking report requirements (PRC §§ 4585 and 4587) of the Forest Practice Act (FPA). Operations conducted under Exemption Notices must comply with specific requirements intended to mitigate the potential for significant adverse impacts. Operations conducted under Emergency Notices must likewise comply with certain requirements and any other applicable operational provisions of the Forest Practice Rules (FPR). Brief descriptions of the various types of notices available through December 31, 2018 are provided below (for complete rule requirements, see CAL FIRE 2018).

1.1.1 Exemption Notices

Activities covered under the following list of Exemption Notice types are exempt from certain aspects of the FPA and FPRs. This includes an exemption from the requirement to submit a THP, submitting completion and stocking reports to CAL FIRE upon completion of operations. Operations must meet any of the substantive conditions covered in the FPRs, and must comply with the operational provisions of the FPAs and FPRs.

1038(a): Harvesting of Christmas trees.

1038(b): Harvesting of dead, dying, or diseased trees in amounts less than 10% of the average volume per acre, which can be applied to ownerships of any size. This Exemption type is intended for use in controlling the spread of disease and insects.

1038(c): Removal of fire hazard trees within 150 feet of a legally permitted structure, eliminating vertical and horizontal fuel continuity. This Exemption type is intended for use by homeowners in the development of defensible space around residences.

1038(c)(6): Removal of fire hazard trees 150 to 300 feet from a legally permitted structure, eliminating vertical and horizontal fuel continuity. This Exemption type, like the 1038(c), is intended for use in the development of a larger defensible space perimeter around residences.

1038(d): Harvesting of dead trees which are unmerchantable as saw logs from substantially damaged timberlands. This modification of the 1038(b) Exemption type removes the limit of 10% of the volume per acre in 1038(b) where the Registered Professional Forester certifies that the timberland meets the definition of “substantially damaged” and minimum timber stocking requirements of the Forest Practice Rules cannot be met. It is intended for response to high levels of tree mortality that cannot be contained through discrete removals.

1038(f): Lake Tahoe Region tree removal under specific requirements intended for use only in the Tahoe Basin.

1038(g): Removal of woody debris and slash produced during timber operations and delivered for the production of energy. This Exemption type is intended to support woody biomass utilization.

1038(i): Forest Fire Prevention Exemption--removal of fire hazard trees less than 18 inches in stump diameter, eliminating vertical and horizontal fuel continuity, on logging areas less than 300 acres (numerous additional requirements). This Exemption type is intended for use in hazardous vegetative fuels reduction across larger landscapes.

1038(j): Forest Fire Prevention Pilot Exemption—similar requirements as specified for 1038(i) Exemptions, but only trees less than 26 inches in stump diameter can be removed. This Exemption type, like the 1038(i) is intended to support hazardous vegetative fuels reduction across larger landscapes. The increased diameter limit was intended to raise economic viability of high-cost fuels reduction operations.

1038(k): Drought Mortality Exemption, which allows for harvesting dead or dying trees of any size produced by drought-related stress. This Exemption was created in direct response to the statewide drought mortality epidemic in which millions of conifer trees were killed by the combined effects of sustained drought and a bark beetle epidemic.

1104.1(a): Less than three-acre conversion of timberland to a non-timber use. This Exemption is intended to allow for the one-time conversion of less than 3 acres of timberland to facilitate residential, building, road construction, agriculture, or other non-timber uses.

1104.1(b): Construction or maintenance of right-of-way by a public agency.

1104.1(c): Removal of trees by private or public utility for construction and maintenance of gas, water, sewer, oil, electric, and communications rights-of-way.

1.1.2 Emergency Notices:

The following list of Emergency Notice types are intended to allow for rapid entry into timberlands damaged by a variety of pathogens, fire, weather, and other natural causes; or emergency conditions resulting from fuel loading, road damage, or potential loss of economic value. As mentioned previously, compliance with the FPRs applicable to operations under Timber Harvesting Plans is required.

1052.1(a): Trees that are dead or dying as a result of insects, disease, parasites, or animal damage.

1052.1(b): Trees that are fallen, damaged, dead, or dying as a result of wind, snow, freezing weather, drought, fire, flood, landslide, or earthquake.

1052.1(c): Trees that are dead or dying as a result of air or water pollution.

1052.1(d): Cutting or removing trees required for emergency construction or repair of roads.

1052.1(e): Cutting and removal of hazardous fuels where there are high, very high, or extreme fuel hazard conditions, or a financial emergency exists.

1052.1(f): Removal of trees infested with Sudden Oak Death (SOD) in specified locations, where treatments are intended to eradicate or slow the spread of the disease.

1.2 The Dynamic Nature of Exemptions and Emergency Notices

When the Review Team agencies undertook this initial monitoring study in 2018, the number and type of Timber Harvesting Plan Exemptions and Emergency Notices was largely unchanged from preceding years. The Exemption for oak woodland restoration was newly in effect, but significantly limited in geographic scope. The drought mortality Exemption had been used extensively in the short time period since the Board of Forestry and Fire Protection's initial emergency rulemaking adoption in 2015. Still, notwithstanding the various revisions to the original iteration of the forest fire prevention Exemption over multiple years, the Exemption landscape was mostly static.

In developing a set of rapid monitoring protocols to comply with the successive directives of Assembly Bills 1958, 2029, and Senate Bill (SB) 92, the Review Team agencies were to analyze Exemption and Emergency Notice use, Forest Practice Rule compliance, and whether the Exemptions and Emergency Notices were achieving their intended purpose. Additionally, the report was to identify barriers and opportunities to increasing Exemption and Emergency use by small forest owners. With these objectives in mind, this pilot monitoring project was undertaken with the intent of providing actionable Forest Practice Rule amendment recommendations for the Board's and Legislature's consideration.

Not long after initiation of the pilot monitoring project fieldwork, Senate Bill 901 arrived. This bill, signed into law by Governor Brown in late 2018, provided further elements to be monitored, and directed the Board to adopt amendments to the Forest Practice Rules for Exemptions. The Board has since adopted those rule amendments and they are now in effect. The rule changes slightly reduced the total number of Exemption types, created two new Exemption types, and somewhat altered the Exemption landscape in which the pilot monitoring effort had been initiated. These Forest Practice Rules amendments had no impact on the Rules for Emergency Notices.

The two newly authorized Exemption types are intended to assist landowners in the reduction of hazardous vegetative fuels conditions. The new “Forest Fire Prevention Exemption” is specified for use on timberlands within CAL FIRE-designated moderate, high, or very high fire threat areas. A maximum of 300 acres may be treated under this Exemption and it includes an allowance for a modest amount of temporary road construction and a slight increase from previous Exemption types in the maximum diameter of tree that may be harvested.

The second new Exemption type adopted is the “Small Timberland Owner Exemption.” Under this Exemption type, small timber ownerships of 60 acres in the Coast Forest District and 100 acres in the Northern and Southern Districts may treat each acre once every decade. However, a timberland owner is limited to a maximum of three submissions of this Exemption type and the Rules expire five years from February 19, 2019.

Among others, the new rule amendments also include consolidation of the 1038(b) and 1038(g), and the 1038(d) and 1038(k) Exemption types, respectively, such that two Exemptions are created from the previous four.

As directed by SB 901, CAL FIRE will now incorporate examination of the new Exemption types into its monitoring program. Pursuant to SB 901, CAL FIRE, in consultation with the Regional Water Quality Control Boards and the California Department of Fish and Wildlife, is to provide an initial report on Exemption and Emergency Notice monitoring to the Legislature by December 31, 2019 with additional reporting required annually until at least 2025.

1.3 Summary of Past Monitoring

While Exemption and Emergency Notices have not been monitored in the past, there is an extensive history of water quality-related monitoring of timber harvesting on non-federal forestlands in California, beginning in 1975. Ten main programs or projects have been completed in the past 40+ years documenting post-harvest hillslope erosion. Brief summaries and important conclusions from these efforts are provided in Table 1.

These monitoring programs and projects have demonstrated that both California's water quality-related FPRs, and their implementation and effectiveness, have improved considerably over the past 40 years. In general, when the Rules are properly implemented, they are effective in protecting water quality. Implementation rates are similar to those reported for other western states (Ice et al. 2004, Ice et al. 2010). Instream monitoring conducted at the Caspar Creek Experimental Watershed has confirmed that implementation of the modern FPRs (after 1975) has substantially reduced water quality impacts related to forest management (Ziemer 1998, Rice et al. 2004, Cafferata and Reid 2013). Hillslope monitoring results through 2013 have also shown, however, that improvements are needed in watercourse crossing design, construction, and maintenance, and in road drainage—particularly near stream crossings. Expanded Exemption and Emergency Notice monitoring in 2019 and beyond, as well as a second phase of FORPRIEM (Forest Practice Rules Implementation and Effectiveness Monitoring), will provide data on the updated operational road rules implemented on the ground in January 2015.

Table 1. Summary of past monitoring efforts in non-federal forestlands of California.

Study Name	Study Objectives	Study Findings	Citation
Soil Erosion Study - Phase I	Determine effectiveness of control measures for preventing erosion	Adequate erosion control measures reduced erosion by orders of magnitude; initial EHR system inadequate.	Dodge et al. 1976
Timber Harvesting and Soil Erosion Interim Report	Determine implementation and effectiveness of timber harvest control measures related to erosion	Roads produced most rill and gully erosion; water bar construction and spacing were adequate 45-68% of the time.	Hauge, 1977
Soil Erosion Study - Phase II	Determine the controls on post-logging erosion	Relatively few sites produced the most erosion; mass wasting dominated erosion; roads and landings produced most erosion	WESCO, 1983
"208" Final Report (Forest Practice Rules Assessment Team Report)	Determine FPR effectiveness related to water quality	FPRs were effective when implemented correctly on less erodible terrain. Poor rule implementation responsible for most water quality impacts.	SWRCB, 1987
Critical Sites Erosion Study-Volume I and II	Determine causes and site conditions related to large erosion events	Roads on steep, erodible slopes with high subsurface water were most responsible for mass wasting. Erosion from forest management occurs on relatively small proportion of logged areas.	Durgin et al. 1988; Lewis and Rice, 1989
Hillslope Monitoring Program	Evaluate implementation and effectiveness of FPRs related to roads, crossings, landings, skid trails, WLPZs	Implementations rates of FPRs were high; FPRs effective when implemented properly; watercourse crossings had highest frequency of problems.	BOF, 1999; Cafferata and Munn, 2002
Modified Completion Report Monitoring Program	Evaluate implementation and effectiveness of FPRs related to roads, skid trails, and WLPZs on THPs	Implementations rates of FPRs were high; FPRs effective when implemented properly; watercourse crossings had highest frequency of problems.	Brandow et al., 2006
Interagency Mitigation and Monitoring Program (IMMP)	Evaluate effectiveness of mitigation measures for high risk watercourse crossings	Improper implementation responsible for large magnitude sediment inputs; road approaches produced significant erosion; LTO training and increased inspection frequency recommended.	Longstreth et al., 2008
Battle Creek Task Force (BCTF)	Evaluate whether clear-cut harvesting is adversely affecting water quality	Clear-cut harvest units delivered little sediment. Watercourse crossings and stream adjacent roads had the highest rates of sediment delivery.	BCTF, 2011
Forest Practice Rule Implementation and Effectiveness Monitoring (FORPRIEM)	Evaluate implementation and effectiveness of FPRs related to roads, skid trails, and WLPZs on THPs and NTMPs	WLPZ and road segment FPR implementation rates were high. Watercourse crossings had the highest rates of departure. FPRs effective when properly implemented.	Brandow and Cafferata, 2014

2 Trends in Use of Exemption and Emergency Notices

Data for determining trends in the use of Exemption and Emergency Notices were provided by the CAL FIRE Forest Practice GIS Program in Santa Rosa using the CAL FIRE Forest Practice System (FPS).[1] Trends were assessed qualitatively and through linear regression across all areas of the state, as well as in CAL FIRE Forest Practice Review Team Area (Figure 1). A statistically significant trend was identified if the fitted regression line had a slope coefficient with a p-value less than 0.05. Figures providing more detailed information on trends in use are provided in Appendix A.

Trend Detection: Determining time trends in use is a critical element of Exemption and Emergency Notice reporting. Statistically significant time trends in the number of Notices and acreage under Notice can be detected using simple linear regression. In this analysis, a trend is considered statistically significant if the slope coefficient of the linear regression model has a p-value less than 0.05. In short, a p-value of less than 0.05 tells us that there is a 95 percent chance or greater (1.0 – p) that there is a true upward or downward trend rather than just a flat line (i.e., a lack of trend). For example, a p-value of 0.60 indicates that there is only a 40 percent chance of a true trend. A positive (+) or negative (-) slope coefficient tells us whether the trend is increasing or decreasing.

2.1 Trends in Use by Exemption Notice Type

Data for Exemption Notice use were available for nine notice types from 2008 through 2017:

- 1038(a) Christmas Trees
- 1038(b) Dead, Dying, or Diseased Trees
- 1038(c) Fire Hazard Reduction (150 feet/300 feet)
- 1038(d) Substantially Damaged Timberlands
- 1038(g) Slash Removal/Biomass
- 1038(i) Forest Fire Prevention
- 1038(j) Forest Fire Prevention Pilot
- 1038(k) Drought Mortality
- 1104.1.a Conversion Exemption: Less than 3 acres
- 1104.1.c Conversion Exemption: Private/Public Agency Utility Right-of-Way

2.1.1 1038(a) and (b) Christmas Trees; Dead, Dying, or Diseased Trees

The number of 1038(a) and (b) Exemption Notices from 2008 through 2017 is displayed in Figure 2. In general, use can be characterized as extensive and relatively stable over time, ranging from a high of 846 notices in 2015 to a low of 431 notices in 2009. The 10-

[1] Note that FPS has now been replaced by the CalTREES system, an on-line timber harvest permit submission system that began phase-in starting October 1, 2018.

Figure 1. A map of Forest Practice Review Team Areas.

year average was 651. **There was no statistically significant trend in use over time for the total number of 1038(a) and (b) Exemption Notices** (Figure 2).

For all ten years of data, 1038(a) and (b) Christmas Trees; Dead, Dying, or Diseased Trees Notice use is approximately four times higher in the Cascade area compared to use in the Coast and Sierra areas, and very low in the South area. **There were no statistically significant trends in use over time for the number of 1038(a) and (b) Notices by Forest Practice area.**

In terms of number of acres, 1038(a) and (b) Christmas Trees; Dead, Dying, or Diseased Trees Notices follow the same general pattern of relative stability as that for the number of notices. The number of acres peaked in 2012, however, while the number of notices was greatest in 2015. The average number of acres during this 10-year period was 2,830,339, by far the largest total for any of the nine Exemption Notice types addressed in this section, since whole ownerships or large blocks of ownerships are included in this type of notice. The average size over the 10-year period was 4,346 acres. **There was no statistically significant trend in use over time for the total acreage covered under 1038(a) and (b) Notices.**

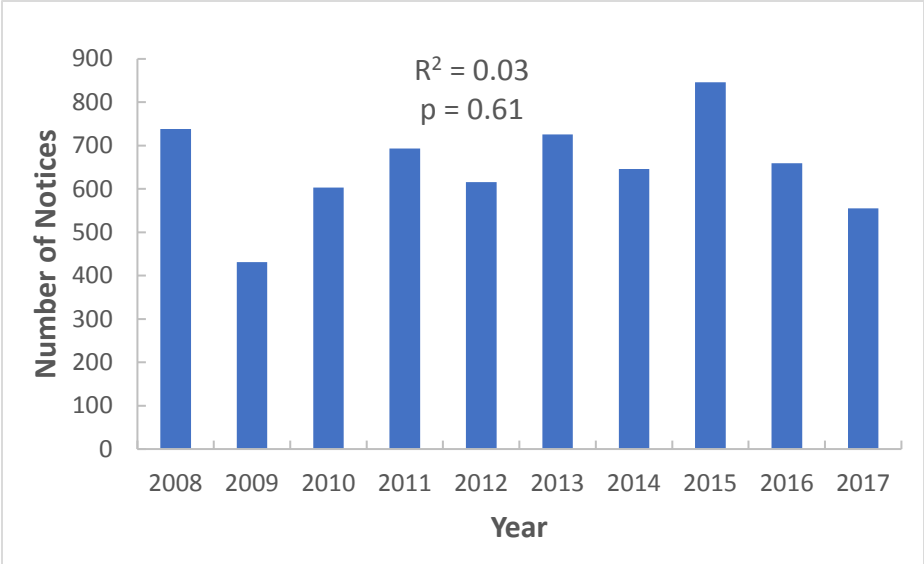

Figure 2. Total number of 1038 (a) and (b) Christmas Trees, Dead Dying, or Diseased Trees Exemption Notices by year.

While there were no significant trends over time in the total acreage under 1038(a) and (b), **there was statistically significant negative trends in acreage under 1038(a) and (b) over time for the Coast area (p=0.005) and a positive trend for the South area (p=0.007).** In the Coast area, acreage under 1038(b) decreased approximately 30,000 acres on average per year from 2008 to 2017. An example of a 1038(b) Dead, Dying, or Diseased Trees Exemption is shown in Figure 3

Figure 3. Example of a 1038(b) Dead, Dying, or Diseased Tree Exemption from the Sierra area.

1038(c) Fire Hazard Reduction (150 feet/300 feet)

The number of 1038(c) Exemption Notices from 2008 through 2017 is displayed in Figure 4. Moderate use occurred from 2008 through 2010, highest use from 2011 to 2013, and lowest use from 2014 through 2017. Number of notices ranged from a high of 1,499 in 2011 to a low of 372 in 2016. The 10-year average was 848 notices. **There was no statistically significant trend in use over time for the total number of 1038(c) Notices.**

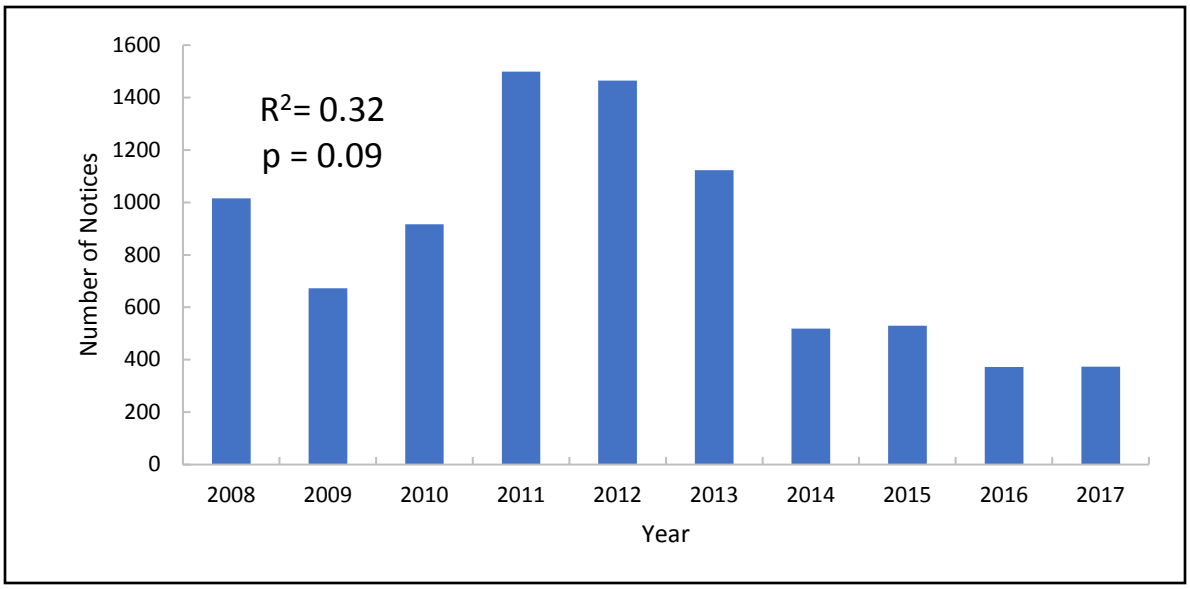

Figure 4. Total number of 1038(c) Fire Hazard Reduction (150 feet/300 feet) Exemption Notices by year.

1038(c) Fire Hazard Reduction (150 feet/300 feet) Notice use was greatest in the South area from 2008 through 2013, and then absent from use in that area from 2014 through 2017. **The increased trend in use in the South area was statistically significant from 2008 to 2012 (p=0.03), followed by a statistically significant decrease in use from 2012 to 2017 (p=0.04).** These trends coincide with the availability of grant monies from the Emergency Supplemental Hazard Fuel Treatment (Forest Care) grant program, which had two cycles of grant funding available from 2008 to 2012. The number of 1038(c) Notices used in the Coast, Sierra, and Cascade areas remained relatively constant through the 10-year period.

In terms of number of acres, 1038(c) Fire Hazard Reduction (150 feet/300 feet) Exemption Notices follow the same pattern as that for the number of notices provided above. The total number of acres peaked in 2012, and were lowest from 2014 through 2017. **There was no statically significant trend in use for acreage under 1038(c) Notices from 2008 to 2017.** The average number of acres during this 10-year period was 1,310. The average size over the 10-year period was only 1.5 acres, since this work involves fuel reduction around homes.

Like the trend in number of notices, the acreage under 1038(c) Fire Hazard Reduction (150 feet/300 feet) Notices for the South area increased significantly from 2008 to 2012 (p=0.02), followed by a significant decrease from 2012 to 2017 (p=0.04). There were no statistically significant trends over time for acreage under 1038(c) Notices for the remaining areas. An example of a 1038(c) Notice is provided in Figure 5.

Figure 5. Example of a 1038(c) Fire Hazard Reduction (150'/300') Notice in the Sierra area.

2.1.2 1038(d) Substantially Damaged Timberlands

The number of 1038(d) Exemption Notices from 2008 through 2017 is displayed in Figure 6. Very low use occurred for all years except 2009, when there were 44 notices. There was a low of 2 notices in 2013, 2014, and 2016. **There was no statistically significant trend in use over time for the total number of 1038(d) Notices.** The 10-year average was only approximately 9 notices.

1038(d) Substantially Damaged Timberlands Notice use was greatest in the Cascade area, particularly in 2009, and minimal in the other areas. There was a small spike in use in the Sierra area in 2015, likely related to the bark beetle epidemic in the central and southern Sierra Nevada. **None of the trends in use were statistically significant for the various CAL FIRE areas.** Overall, use of this notice type has been very minimal compared to several of the other types listed in this section.

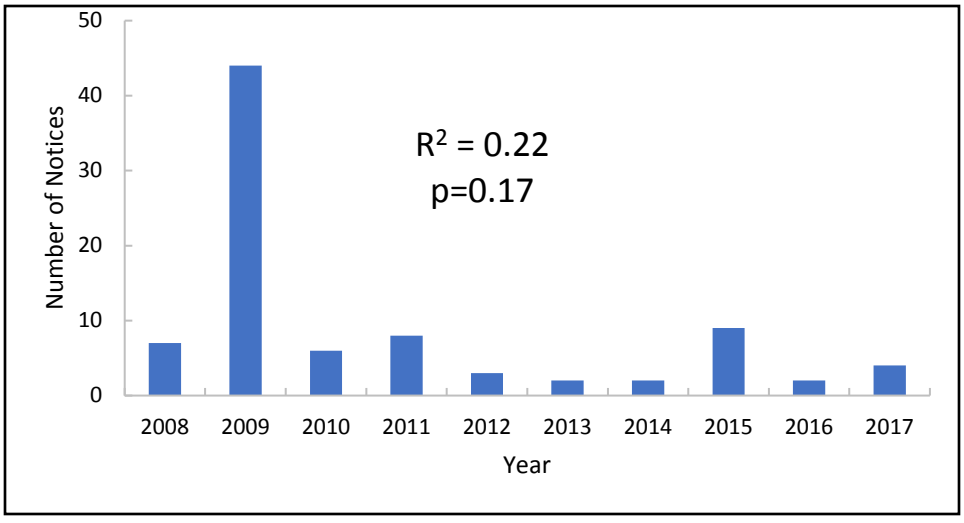

Figure 6. Total number of 1038(d) Substantially Damaged Timberland Exemption

In terms of number of acres, 1038(d) Substantially Damaged Timberlands Exemption Notices follow the same pattern as that for the number of notices. The total number of acres peaked in 2009, and were lowest from 2013 to 2014. **There were no statistically significant trends in use over time for total acreage under 1038(d) Notices.** The average number of acres during this 10-year period was 2,450, and the maximum was 13,969. The average size over the 10-year period was 282 acres. **There were no statistically significant trends in use over time for acreage under 1038(d) for the various Forest Practice areas.**

2.1.3 1038(g) Slash Removal/Biomass

The number of 1038(g) Slash Removal/Biomass Exemption Notices from 2008 through 2017 is displayed in Figure 7. Use can be characterized as very low, never exceeding nine notices in any year, with a low of 1 in 2008. **There were no statistically significant trends in use over time for the total number of 1038(g) Notices.** The 10-year average was only approximately four notices.

1038(g) Slash Removal/Biomass Notice use was generally greatest in the Cascade area, particularly in 2009, and mostly minimal in the other areas. There was a spike in use in the Sierra area in 2014 and 2015, likely related to the bark beetle epidemic in the central and southern Sierra Nevada. **There were no statistically significant trends in use over time for 1038(g) for the various Forest Practice areas.**

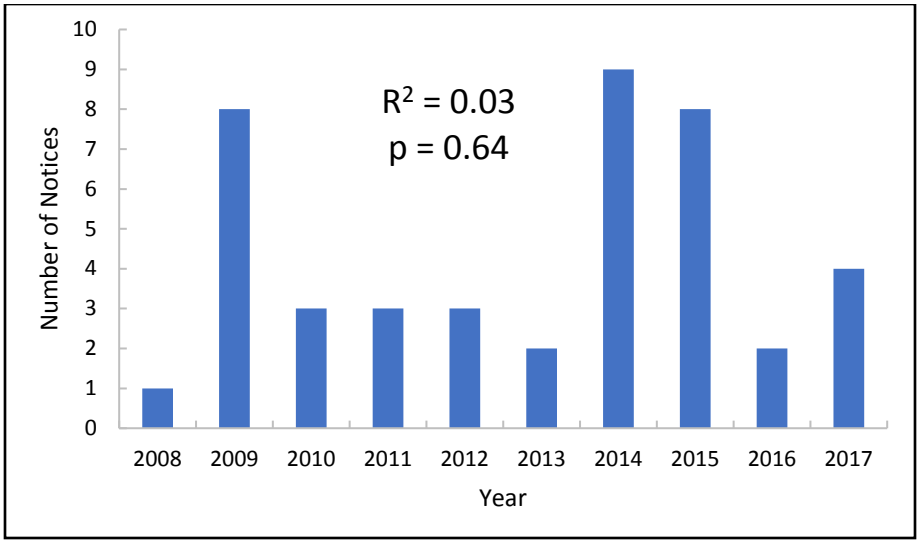

Figure 7. Total number of 1038(g) Slash Removal/ Biomass Exemption Notices by year.

The majority of the acres submitted under 1038(g) Slash Removal/Biomass Exemption Notices took place in 2014 and 2015, mainly in the Sierra and Cascade areas. The total number of acres peaked in 2014 at 11,362, and were lowest from 2008-2009, 2011-2013, and 2017. **There were no statistically significant trends in use over time for total acreage covered under 1038(g) Notices, or for acreage covered under**

1038(g) Notices by Forest Practice area. The average number of acres during this 10-year period was 2,743. The average size over the 10-year period was 638 acres.

2.1.4 1038(i) Forest Fire Prevention

The number of 1038(i) Forest Fire Prevention Exemption Notices from 2008 through 2017 is displayed in Figure 8. In general, use can be characterized as relatively stable from 2008 through 2012, intermediate in 2013, and very low from 2014 through 2017. Notice numbers ranged from a high of 68 notices in 2009 to a low of 8 notices in 2017. **There was a statistically significant decrease in the number of 1038(i) Notices over time, and on average the number of 1038(i) Forest Fire Prevention Notices decreased by approximately 8 notices per year.** The 10-year average was 38.

Forest Fire Prevention Exemption Notice use was greatest in the South area from 2009 through 2013, with intermediate use in the Cascade area, and low use in the Coast and Sierra areas. **There were statistically significant decreases in use over time for 1038(i) Notices in the Cascade (p=0.004) and South (p<0.001) areas.** Declines in the South area may be attributed to the loss of Forest Care grant monies to subsidize the operations.

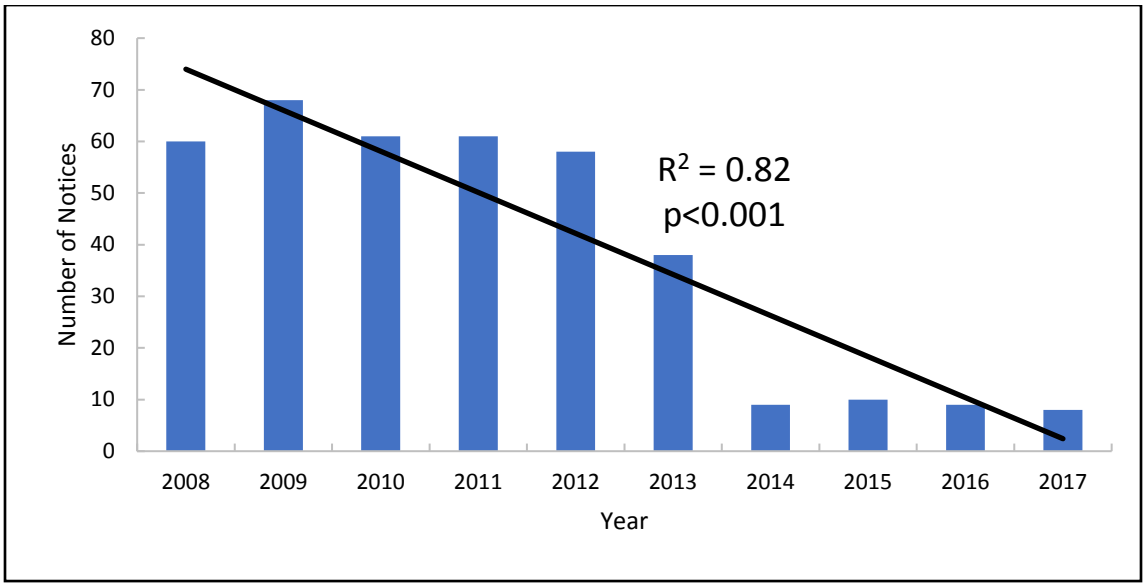

Figure 8. Total number of 1038(i) Forest Fire Prevention Exemption Notices by year.

In terms of number of acres, 1038(i) Forest Fire Prevention Exemption Notices follow the same general pattern as that for the number of notices shown in, with the noticeable exception that very few acres were submitted in 2013, and 2009 had only moderate acreage, despite having the highest number of notices. The total number of acres was highest in 2010, and lowest in 2016. **There was no statistically significant decrease over time in total acreage covered under 1038(i) Forest Fire Prevention Exemption**

Notices, or for acreage by area. The average number of acres during this 10-year period was 1,133. The average size over the 10-year period was 30 acres.

2.1.5 1038(j) Forest Fire Prevention Pilot

The number of 1038(j) Forest Fire Prevention Pilot Exemption Notices from 2008 through 2017 is displayed in Figure 9. There was no use from 2008 through 2014, since this notice type was not effective until January 2015, and very minimal use from 2015 to 2017. Notice numbers reached a high of 21 notices in 2016. The 3-year average from the date the rule became effective was 15. **No statistically significant trends over time were detected for total 1038(j) Notices.**

Forest Fire Prevention Pilot Exemption Notice use was greatest in the Cascade area from 2015 through 2017, with minor use in the Coast area during this period, and no or almost no use in the Sierra and South areas Figure 9. **No statistically significant trends were detected for the number of notices by area.**

In terms of number of acres, 1038(j) Forest Fire Prevention Pilot Exemption Notices follow the same general pattern as that for the number of notices (Figure 9). The total number of acres was highest in 2016 and 2017. **There were no statistically significant trends in the total acreage under 1038(j), or for acreage by area.** The average number of acres during the 3-year period from the date the rule became effective was 1,804. The average size over the 3-year period was 118 acres. An example of a 1038(j) Forest Fire Prevention Pilot Notice is provided in Figure 10.

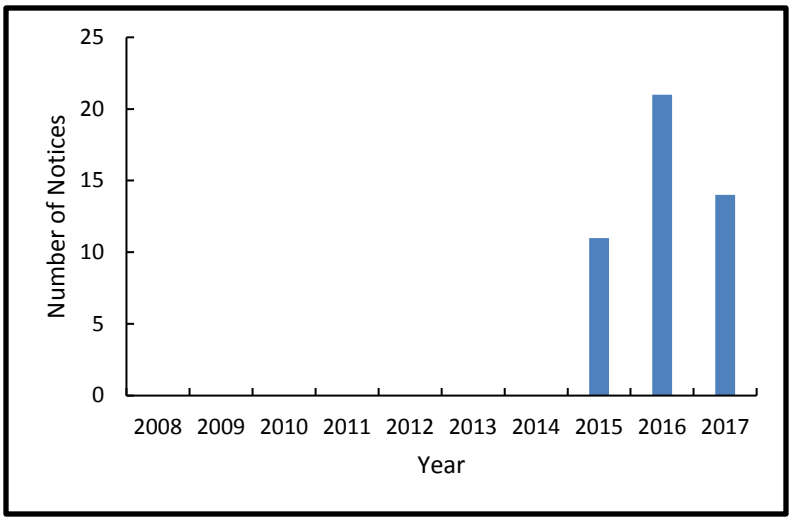

Figure 9. Total number of 1038(j) Forest Fire Pilot Exemption Notices by year. There were not enough years of use to detect a statistical trend.

2.1.6 1038(k) Drought Mortality

The number of 1038(k) Drought Mortality Exemption Notices from 2008 through 2017 is displayed in (Figure 11). There was no use from 2008 through 2014, since the rule wasn't effective until July 2015. This allowed some use in 2015, and extensive use in 2016 and 2017. Notice numbers reached a high of 1,079 in 2016. **There was no statistically significant trend in use over time for the total number of 1038(k) Drought Mortality Notices.** The average was 670 for the 3-year period following the Board's adoption of this Exemption type.

Drought Mortality Exemption Notice use was high in the Sierra area from 2015 through 2017, with moderate use in the Cascade area during this period, and very low to almost no use in the Coast and South areas, respectively. These numbers reflect the massive bark beetle epidemic centered in the central and southern Sierra Nevada caused by drought experienced by this region from 2012 through 2015. **There were no statistically significant trends in use over time for 1038(k) Drought Mortality Notices in the various areas, although there were insufficient years of use to determine a statistical trend.**

Figure 10. Example of a 1038(j) Forest Fire Prevention Exemption Notice before (left) and after (right) timber operations.

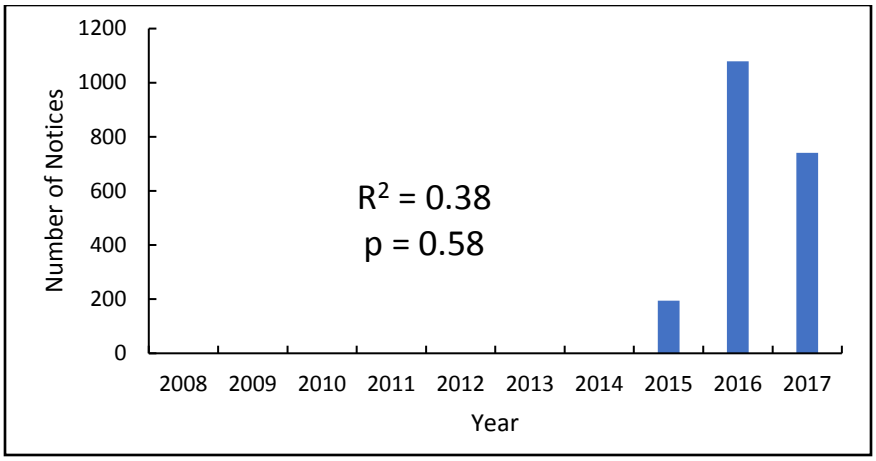

Figure 11. Total number of 1038(k) Drought Mortality Exemption Notices by year.

In terms of number of acres, 1038(k) Drought Mortality Exemption Notices follow the same general pattern as that for the number of notices. The total number of acres was highest in 2016 at 121,945, with most acreage occurring in the Sierra area. The average number of acres during the three year period since the rule became effective was 82,651 acres. **There were no statistically significant trends in use over time for total acreage covered under 1038(k) Drought Mortality Notices, or for acreage by area.** The average size over the three year period was 123 acres.

An example of a 1038(k) Drought Mortality Exemption Notice located in the Sierra area is displayed in Figure 12.

Figure 12. Example of a 1038(k) Drought Mortality Notice operation in the Sierra area (August 2017).

2.1.7 1104.1.a Conversion Exemption: Less than 3 Acres

The number of 1104.1.a Less than 3 Acre Conversion Exemptions from 2008 through 2017 is displayed in Figure 13. Notice numbers were highest in 2014 and 2015 and lowest from 2009 through 2013. Notice numbers ranged from a high of 405 notices in 2015 to a low of 132 in 2009. **There was no statistically significant trend in use over time for the total number of 1104.1.a Less than 3 Acre Conversion Exemption Notices.** The 10-year average was approximately 250.

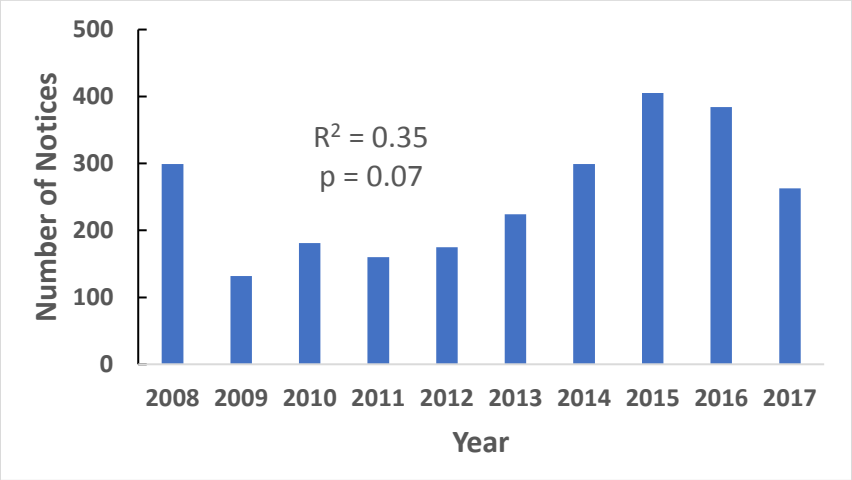

Figure 13. Total number of 1104.1.a Less than 3 Acre Conversion Exemption Notices by year.

Less than 3 Acre Conversion Exemption Notice use was greatest in the Cascade area for all 10 years, with considerable use in the Coast and Sierra areas, and almost no use in the South area. **There were statistically significant increases in the use of Less than 3 Acre Conversion Exemption Notices for the Cascade (p=0.02) and Coast (p=0.03) areas.**

In terms of number of acres, 1104.1.a Less than 3 Acre Conversion Exemption Notices follow the same pattern as that for the number of notices. The total number of acres was highest in 2015 at 837, and lowest in 2009 at 265, with the highest acreage in the Cascade and Coast areas, respectively. **There was no statistically significant trend in use over time for total acreage covered under the 1104.1.a Exemption, but there was a statistically significant increase in Exemption acreage for the Cascade (p=0.03) and Coast (p=0.03) areas.** The average number of acres during this 10-year period was 527. The average size over the 10-year period was 2.1 acres.

An example of a 1104.1.a Less than 3 Acre Conversion Exemption located in the Sierra area is displayed in Figure 14.

Figure 14. Example of a 1104.1.a Less than 3 Acre Conversion Exemption located in the Sierra area.

2.1.8 1104.1.c Conversion Exemption: Private/Public Agency Utility Right-of-Way

The number of 1104.1.c Utility Right-of-Way Conversion Exemptions from 2008 through 2017 is displayed in Figure 15. Notice numbers were highest in 2016 and 2017 and lowest from 2008 through 2015. Notice numbers ranged from a high of 317 notices in 2017 to a low of 25 in 2009. **There was a statistically significant increase over time in the number of 1104.1.c Utility Right-of-Way Exemption Notices** (Figure 15)**.** The 10-year average was approximately 93 notices.

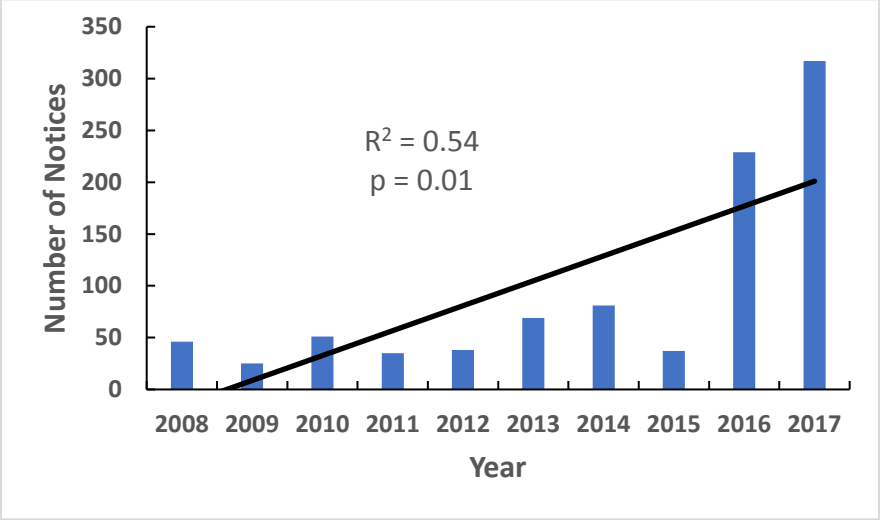

Figure 15. Total number of 1104.1.c Utility Right-of-Way Conversion Exemption Notices by year.

Utility Right-of-Way Exemption Notice use was greatest in the Sierra area for 2016 and 2017, with consistent use in the Cascade area (particularly in 2017), less use in the

Coast area, and no use in the South area. **There were statistically significant increases in the number of 1104.1.c Utility Right-of-Way Notices in the Cascade (p=0.03) and Sierra (p=0.01) areas.**

In terms of number of acres, 1104.1.c Utility Right-of-Way Exemption Notices differ from the number of notices in that the data are totally overshadowed by the massive area covered in 2017, particularly in the Sierra area. The total number of acres was 476,167 in 2017; the next highest acreage value is 11,831 in 2016. This is likely due to the massive bark beetle mortality event that occurred in the central and southern Sierra and the extensive effort to fall dead trees along powerlines. **Despite this, there is no statistically significant trend in use over time for the total acreage covered under 1104.1.c Utility Right-of-Way Notices, or for acreage by area.** The average number of acres during this 10-year period was 49,788. The average size over the 10-year period was 537 acres. Figure 16 displays an example of a 1104.1.c Utility Right-of-Way Exemption Notice.

Figure 16. Example of a 1104.1.c Utility Right-of-Way Exemption Notice located in the Sierra area.

2.1.9 Exemption Notice Discussion

Figure 17 summarizes the data presented above for the number of Exemption Notices for these nine types. **There were no statistically significant trends in use over time for the total number of Exemptions (p=0.26), or for total acreage under Exemption (p=0.51). However, if 1038(a) Christmas Trees and 1038(b) Dead, Dying, or Diseased Trees Notices are removed from the dataset, we see statistically**

significant increases in the acreage under notice (p=0.04) (Figure 18). This is largely due to the increase in acreage under 1038(k) Drought Mortality and 1104.1.c Utility Right-of-Way Notices.

Use of 1038(k) Drought Mortality Exemption Notices beginning in 2015 has been extensive due to the 2012-2017 bark beetle epidemic in the Sierra Nevada (Axelson et al. 2017, Fettig and Mortenson 2018), triggered by the recent drought (2012–2015) in California that produced large precipitation deficits. Similarly, 1104.1.c Utility Right-of-Way Notice use expanded in 2016 and 2017 due to increased efforts for clearance of dead trees in these corridors, and the number of acres treated by 1038(g) Slash Removal/Biomass went up considerably in the Sierra area in 2014 and 2015.

Hindering use of these types of notices has been a lack of sufficient Licensed Timber Operator (LTO) availability and sufficient milling capacity—particularly in the southern Sierra Nevada region (FRAP 2018). Additionally, use of 1038(c) Fire Hazard Reduction (150/300 feet) Exemptions declined considerably from 2014 through 2017 in the South area, likely due to reduced grant funds available to small nonindustrial landowners. Use of 1038(i) Forest Fire Prevention Notices also declined considerably from 2013 through 2017, particularly in the South area where the availability of grant funds declined. In contrast, use of 1038(b) Dead, Dying, or Diseased Trees Exemptions has been relatively stable through the 10-year period, likely related to greater milling capacity in the Cascade, Sierra, and Coast areas. 1104.1.a Less than 3 Acre Conversion Exemptions have generally increased over time in the Cascade and Coast areas, possibly related to expanded cannabis cultivation.

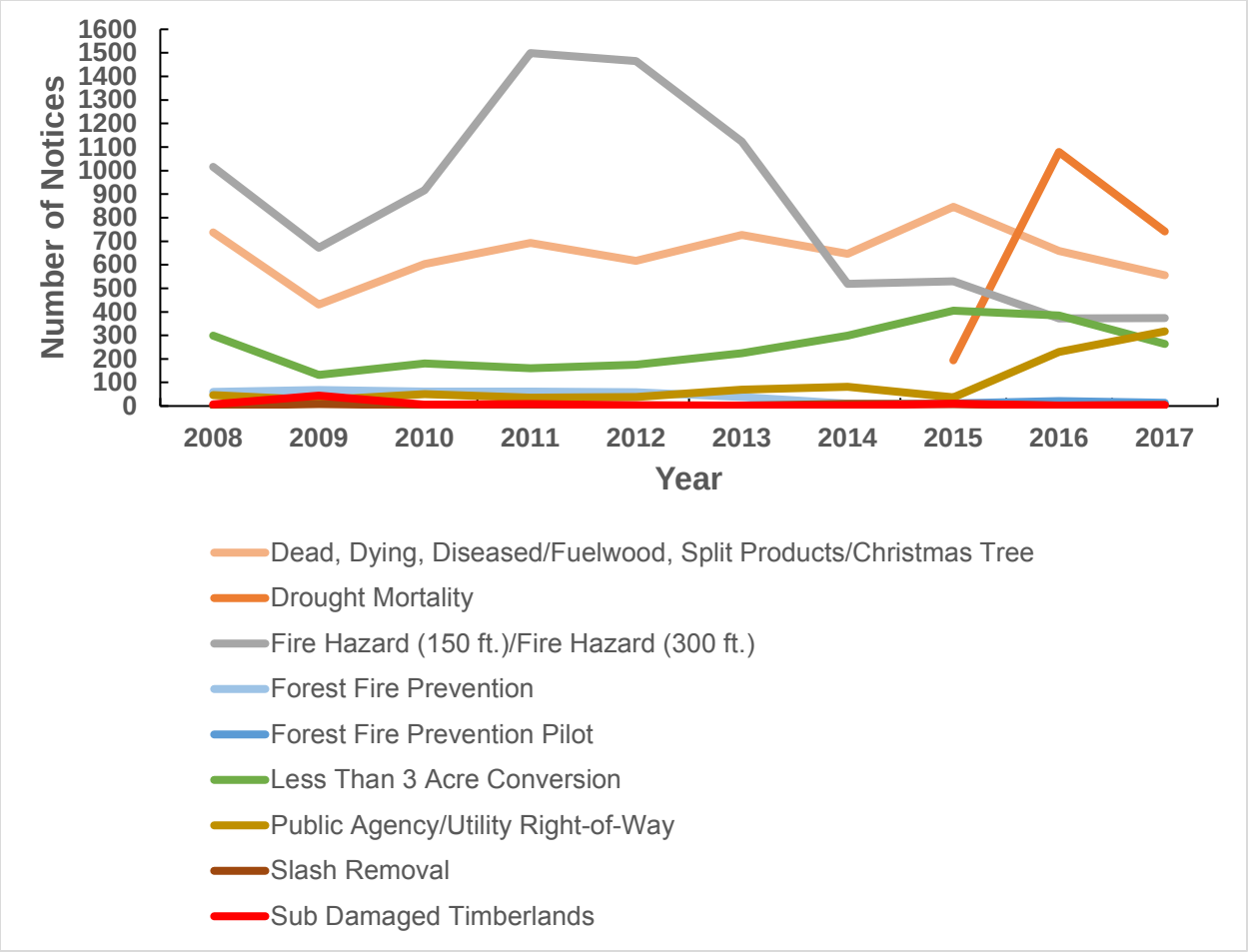

Figure 17. Plot of the number of Exemption Notices for all nine types during the 10-year period.

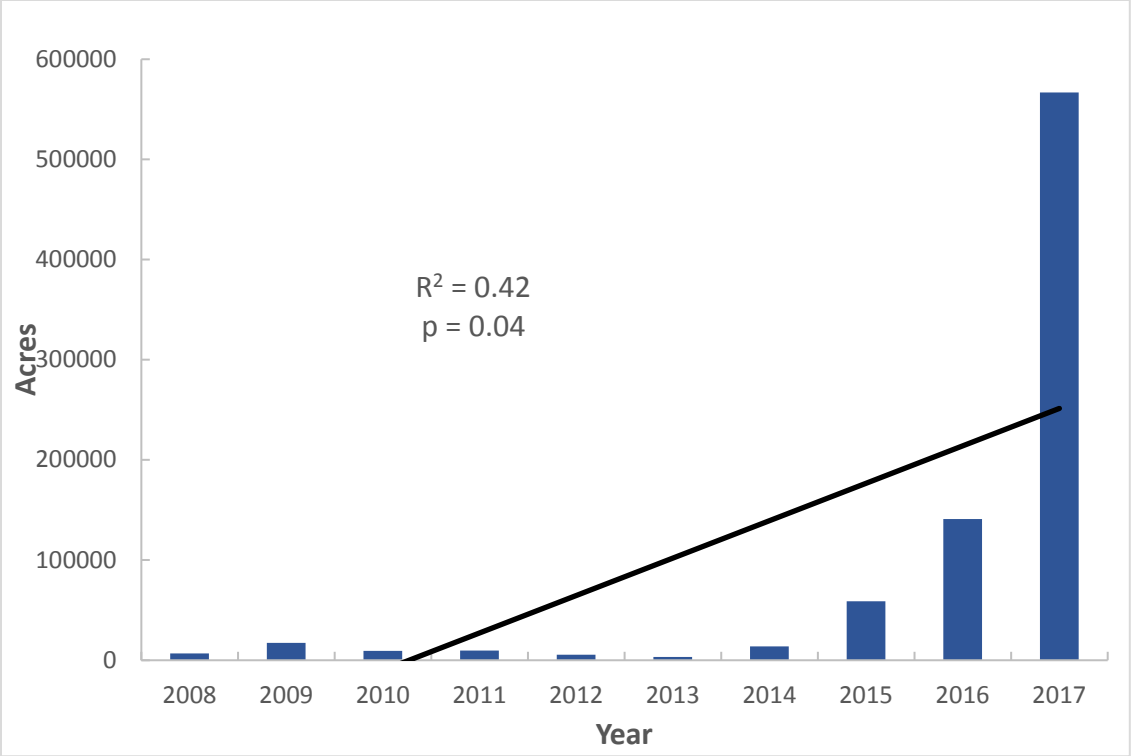

Figure 18. Total number of Exemption Notice acres overtime, excluding 1038(a,b) Christmas Trees; Dead, Dying, or Diseased Trees Exemption Notices.

2.2 Emergency Notices

Data for Emergency Notice use were available for six notice types from 2008 through 2017 (some data were combined in the GIS database query):

- 1052.1(a) Dead or dying from insects, disease, parasites, or animal damage
- 1052.1(b) Dead or dying from wind, drought, fire, flood, landslide
- 1052.1(e) High or extreme fuel hazard conditions
- 1052.1(e) Financial emergency
- 1052.1(f) Infestation of Sudden Oak Death (SOD)
- 1052.1(f) Other non-disclosed types of Emergency Notices

2.2.1 1052.1(a) and (b) Dead or Dying from Insects, Disease, Fire, Drought, Wind and Flood

The number of 1052.1(a) and (b) Emergency Notices from 2008 through 2017 is displayed in Figure 19 In general, use can be characterized as fluctuating greatly over the 10-year period, ranging from a high of 312 notices in 2008 to a low of 31 notices in 2011. **There was no statistically significant trend in use over time for the total number of 1052.1(a) and (b) Notices.** The 10-year average was 141.

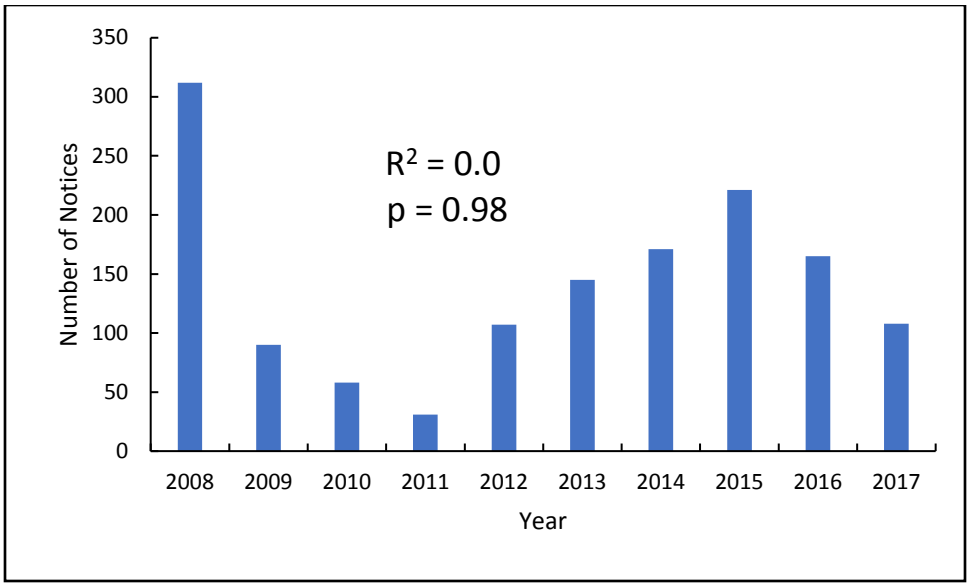

Figure 19. Total number of 1052.1(a) and (b) Dead or Dying from Insects, Disease, Fire, Drought, Wind, and Flood Emergency Notices by year.

For 9 of the 10 years during this period, 1052.1(a) and (b) use is considerably higher in the Cascade area compared to use in the Coast and Sierra areas, with no use in the South area. There is a noticeable increase in use in the Sierra area from 2013 through 2016 related to the bark beetle epidemic that occurred in the central and southern Sierra Nevada. **There were no significant trends in use over time for 1052.1 (a) and (b) Notices for the various areas.**

In terms of number of acres, 1052.1(a) and (b) Emergency Notices differ from the pattern for the number of notices provided above. The total number of acres peaked in 2014 at 49,961, as opposed to 2008. The lowest number of acres occurred in 2011 at 2,642 acres. Most of the acreage was in the Cascade area. **There was no statistically significant trend in use over time for the total acreage covered under 1052.1(a) and (b) Notices, or for acreage by the various areas.** The average number of acres during this 10-year period was 25,887. The average size over the 10-year period was 184 acres.

An example of a 1052.1(b) Dead or Dying from Fire, Drought, Wind, and Flood Emergency Notice is displayed in Figure 20.

Figure 20. Example of a 1052.1(b) Dead or Dying from Fire, Drought, Wind, and Flood Emergency Notice conducted in 2010 on Swanton Pacific Ranch, Santa Cruz County, following the 2009 Lockheed Fire.

2.2.2 1052.1(e) High or Extreme Fuel Hazard Conditions

The number of 1052.1(e) High or Extreme Fuel Hazard Conditions Emergency Notices from 2008 through 2017 is displayed in Figure 21. In general, use can be characterized as fluctuating greatly over the 10-year period, ranging from a high of 94 notices in 2012 to a low of 0 notices in 2016. **There was no statistically significant trend in use over time for total number of 1052.1(e) Notices.** The 10-year average was 27.

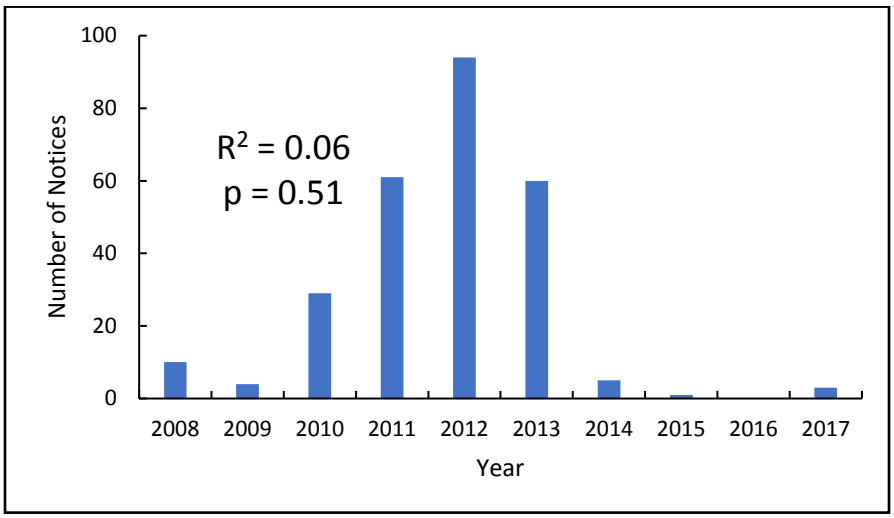

Figure 21. Total number of 1052.1(e) High or Extreme Fuel Hazard Conditions Emergency Notices by year.

1052.1(e) High or Extreme Fuel Hazard Conditions Emergency Notice use was greatest in the South area from 2010 through 2013, and then low in that area from 2014 through 2017. **There was a statically significant increase for these notices in the South area from 2008 to 2012 (p=0.009), followed by a statistically significant decrease from 2012 to 2017 (p=0.03).** The rapid increase and decrease in these Notice types in the South area is likely attributed to the availability of Forest Care grant funds. The number of 1052.1(e) High or Extreme Fuel Hazard Notices used in the Coast, Sierra, and Cascade areas remained very low and relatively constant through the 10-year period.

In terms of number of acres, 1052.1(e) High or Extreme Fuel Hazard Conditions Emergency Notices generally follow a similar pattern as the number of notices provided above, except that the acreage in 2013 was high, and the acreage was greatest in the Sierra area. The total number of acres peaked in 2013 at 779, and the lowest number of acres was 0 in 2016. **There was no statistically significant trend in use over time of acreage covered under 1052.1(e) Notices, or for acreage by the various areas.** The average number of acres during this 10-year period was 306. The average size over the 10-year period was only 11 acres.

2.2.3 1052.1(e) Financial Emergency

There were only seven uses of 1052.1(e) Financial Emergency Notices during the 10-year period. Two took place in the Coast area, covering 10 acres, and five were located in the Cascade area, covering 92 acres, for a total of 102 acres. The average size was approximately 15 acres. **There were no statistically significant trends in use over time for the total number of notices or for total acreage.**

2.2.4 1052.1(f) Infestation of Sudden Oak Death (SOD)

There was only one use of a 1052.1(f) Sudden Oak Death Emergency Notice during the 10-year period. This was a 23-acre notice in the Coast area in 2014. **There were no statistically significant trends in use over time for the total number of notices or for total acreage.**

2.2.5 Other Non-Disclosed Types of Emergency Notices

“Other” was used for situations where there was tree mortality, but it did not fit the definition of Substantially Damaged Timberland (14 CCR § 895.1) or another Emergency Notice type.

There were 14 uses of 1052.1(e) other non-disclosed types of Emergency Notices from 2008 through 2017. Nine took place in the Cascade area covering 998 acres, four in the Coast area covering 194 acres, and one in the Sierra area covering 360 acres, for a total of 1,552 acres. The average size was approximately 110 acres. **There were no**

statistically significant trends in use over time for the total number of notices or for total acreage.

2.2.6 Emergency Notice Discussion

Figure 22 summarizes the data presented above for the number of Emergency Notices for the six types described (noting that 1052.1(a) and (b) were combined). In total, 83% of these notices and 98% of the acreage were denoted as related to insects, disease, fire, drought, wind, or flood (1052.1(a) and (b)). Most of the remaining Emergency Notices and their associated acreage were 1052.1(e) High or Extreme Fuel Hazard Condition Notices (16% and 1%, respectively). **There were no statistically significant trends in use over time for the total number of all Emergency Notice types or for total acreage.**

Use of 1052.1(a and b) Dead or Dying from Insects, Disease, Fire, Drought, Wind, and Flood Notices was high at the beginning of the 10-year period, dropped off considerably, and then rose again through the drought (2012-2015) and associated bark beetle epidemic period (Axelson et al. 2017, Fettig and Mortenson 2018). Use of 1052.1(e) High or Extreme Fuel Hazard Condition Notices was high from 2010 through 2013, and then significantly declined from 2014 through 2017, possibly due to a declining chip market.

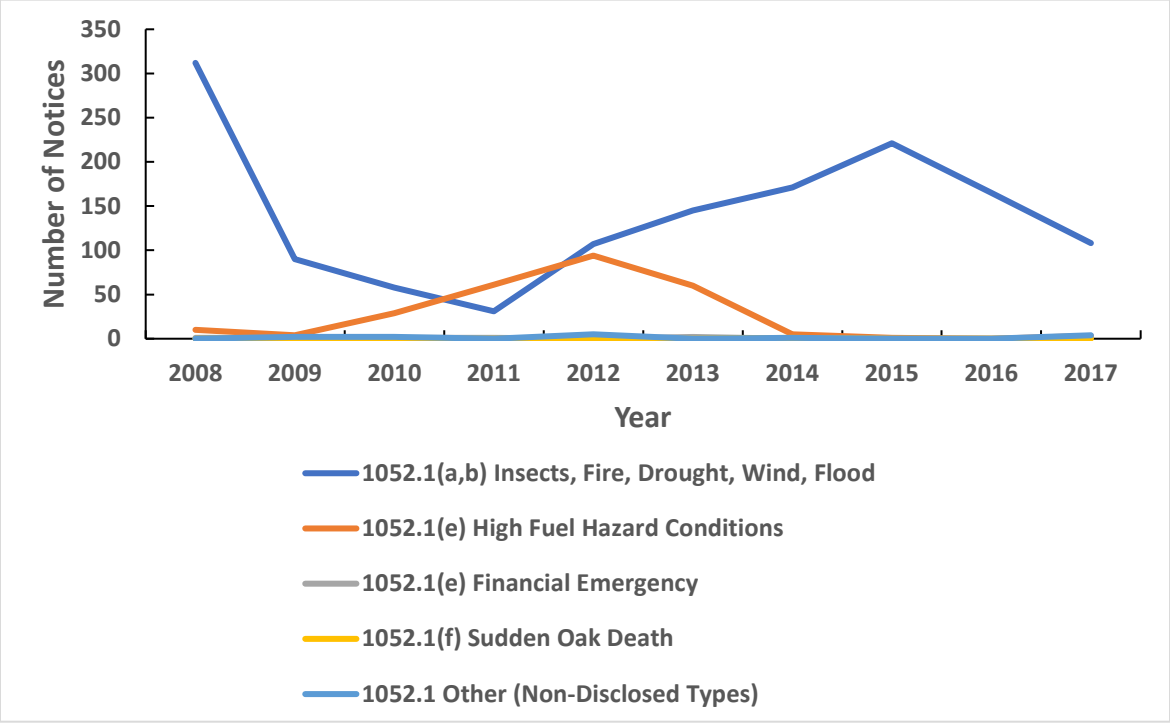

Figure 22. Plot of the number of Emergency Notices for all types during the 10-year period.

2.3 Longer Term Trends for Exemptions and Emergencies

Trends in use for the number of Exemptions and Emergencies Notices filed annually were assessed for a longer time duration spanning from 1990 to 2017. Overall, there has been a slightly negative trend in the number of Exemption Notices submitted, although the trend is not statistically significant (Figure 23). The largest number of Exemption Notices were in 1993 and 1994, and the total number of submittals for these years were driven by Less than 3 Acre Conversion Exemptions. The annual number of submitted Emergency Notices have declined significantly from 1990 to 2017 (Figure 24). However, it should be noted that the duration for timber operations under Emergency Notices has increased from 60 days to one year since 1995.

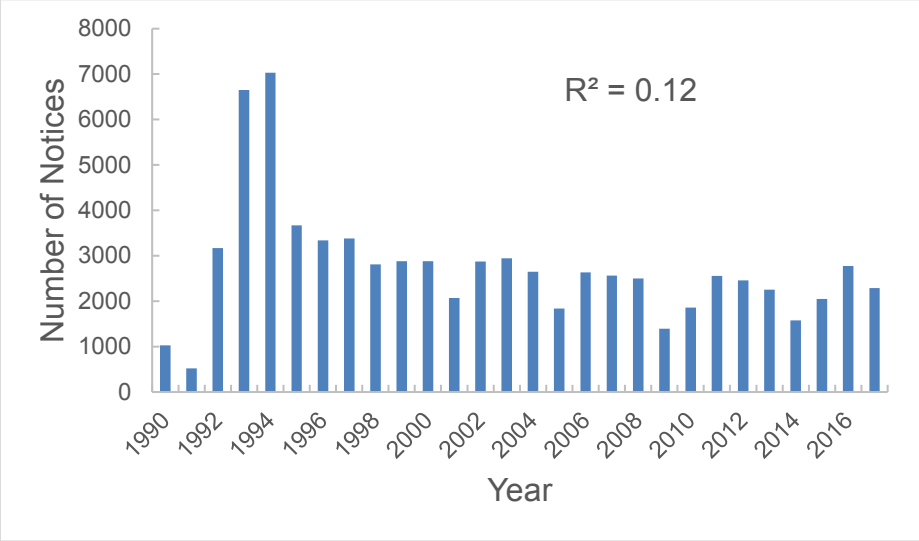

Figure 23. Number of total Exemption Notices submitted annually from 1990 to 2017.

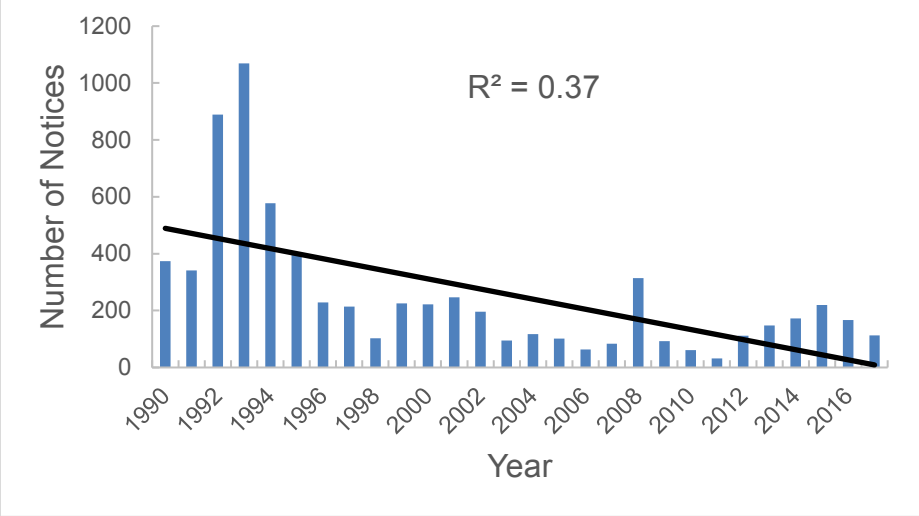

Figure 24. Number of total Emergency Notices submitted annually from 1990 to 2017.

3 Level of Compliance

Data for determining trends in the number of inspections and level of compliance for Exemption and Emergency Notices were generated using the CAL FIRE Forest Practice System (FPS).

3.1 Exemption Notice Inspections and Violations

A total of 14,119 inspections were completed for Exemption Notices statewide from 2008 through 2017, with the fewest inspections conducted in 2010 at 1040 and the most in 2016 at 2,107 (Table 2). Thirty-four percent of total inspections (i.e., for THPs, NTMPs, Exemptions, and Emergencies combined) were focused on Exemptions Notices.

A total of 766 violations were issued for Exemption Notices from 2008 through 2017 (Table 2; Figure 25). The highest number of violations occurred in 2010 with 121, and the lowest number were given in 2014 with 35. The average number of violations issued during this 10-year period was 77 per year. The majority of violations were issued to Licensed Timber Operators (43 per year), followed by Timberland Owners (30 per year), and then to RPFs (4 per year) (Figure 25).

Table 2. Violations on exemptions, 2008 to 2017, based on the year of the inspection and violation. Inspections are tallied by the year of the inspection, and are individual inspections on a project area, regardless of the number of inspectors present. "All Timber Harvest Inspection" is indicative of the total number of individual inspections performed on all timber harvest activities each year by CAL FIRE inspectors.

Exemption Violations					Inspections		
Year	Total Violations	TLO	LTO	RPF	**Total EX Inspections**	**All Timber Harvest Inspections**	**% Of Total Inspections**
2008	43	18	24	1	1396	4868	29
2009	111	47	62	2	1193	4358	27
2010	121	51	66	4	1040	3604	29
2011	80	16	55	9	1297	4367	30
2012	76	27	47	2	1372	4367	31
2013	64	47	17	0	1451	4379	33
2014	35	9	21	5	1060	3224	33
2015	65	30	33	2	1514	3887	39
2016	79	20	48	11	2107	4640	45
2017	92	31	60	1	1689	3884	43
Mean	77/year	30/year	43/year	4/year	1412/year	4158/year	34%/year

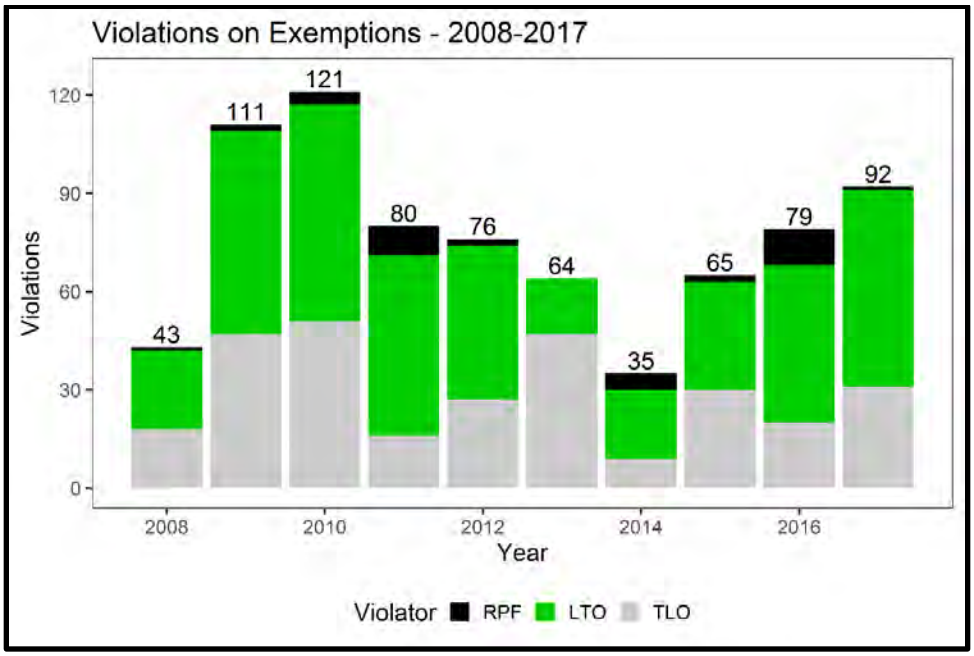

Figure 25. Violations on Exemptions, 2008 to 2017. Bar colors indicate who the violation was given to, and the number above each bar is the total number of violations in a given year.

3.2 Emergency Notice Inspections and Violations

A total of 3,521 inspections were completed for Emergency Notices statewide from 2008 through 2017, with the fewest inspections conducted in 2011 at 136 and the most in 2016 at 623 (Table 3). The 10-year average was approximately 352 inspection per year. Eight percent of total inspections (i.e., for THPs, NTMPs, Exemptions, and Emergencies combined) were focused on Emergency Notices.

A total of 105 violations were issued for Emergency Notices from 2008 through 2017 (Table 3; Figure 26). The highest number of violations occurred in 2016 with 40, and the lowest number were given in 2011 with one. The average number of violations issued during this 10-year period was 11 per year. The majority of violations were issued to Licensed Timber Operators (6 per year), followed by RPFs (4 per year), and then to Timberland Owners (1 per year) ().

Table 3. Violations on Emergencies, 2008 to 2017, based on the year of the inspection and violation. Inspections are tallied by the year of the inspection, and are individual inspections on a project area, regardless of the number of inspectors present. "All Timber Harvest Inspection" is indicative of the total number of individual inspections performed on all timber harvest activities each year by CAL FIRE inspectors.

Emergency Violations					Inspections		
Year	Total Violations	TLO	LTO	RPF	**Total EM Inspections**	**All Timber Harvest Inspections**	**% Of Total Inspections**
2008	13	1	11	1	516	4868	11
2009	13	5	5	3	549	4358	13
2010	4	1	2	1	134	3604	4
2011	1	0	1	0	137	4367	3
2012	2	0	2	0	290	4367	7
2013	14	2	10	2	312	4379	7
2014	5	0	4	1	290	3224	9
2015	4	0	3	1	354	3887	9
2016	40	1	18	21	623	4640	13
2017	9	0	0	9	316	3884	8
Mean	11/year	1/year	6/year	4/year	352/year	4158/year	8%/year

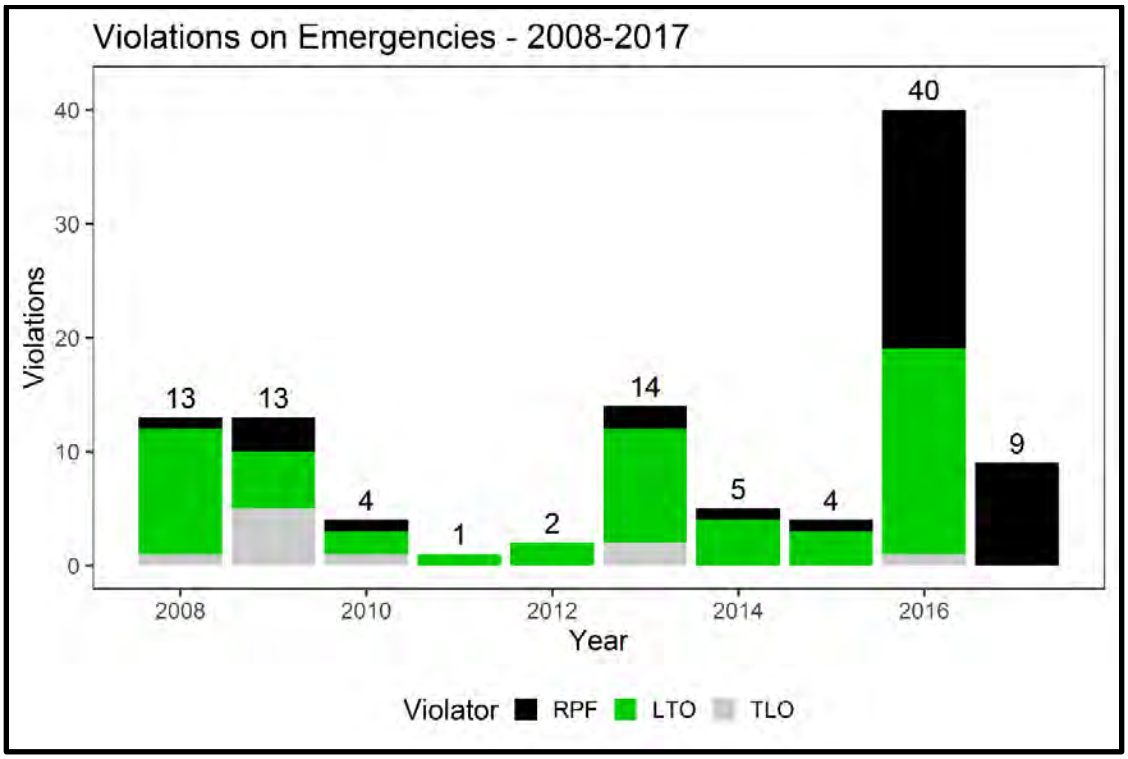

Figure 26. Violations on emergencies, 2008 to 2017. Bar colors indicate who the violation was given to, and the number above each bar is the total number of violations in a given year.

4 Exemption and Emergency Pilot Study

A pilot study was undertaken in 2018 to test potential field protocols that could be applicable to a wide range of Exemption and Emergency Notice types. The field protocol was implemented by members of the Review Team agencies (i.e., CAL FIRE, California Geological Survey (CGS), California Department of Fish and Wildlife (DFW), and the Regional Water Quality Control Boards (RWQCBs) during the summer of 2018.

4.1 Field Methods and Protocol

4.1.1 Development

CAL FIRE staff determined that the pilot project would focus on 1038(i) Forest Fire Prevention, 1038(j) Forest Fire Prevention Pilot, and 1038(k) Drought Mortality Exemptions, and 1052.1(a)(b)(e) Dead or Dying from Insects, Disease, Fire, Drought, etc./ High or Extreme Fuel Hazard Conditions Emergency Notices after consulting with USFS Pacific Southwest Research Station statisticians. The field protocol for the pilot project on Emergency and Exemption Notice monitoring was initially developed by CAL FIRE's Watershed Protection Program, part of the Forest Practice Program. The protocol was constructed to be rapid, efficient, simple, and applicable to a wide range of harvest sizes, treatments, and settings, including non-traditional built environments. The primary emphasis was on: forest stand structure and associated variables, harvest-related surface fuel, sediment discharges to watercourses from harvesting activity and road segments, watercourse crossing performance, and silvicultural treatments and harvesting intensities.

The protocol was initially tested with CAL FIRE staff from the Watershed Protection Program, Forest Practice, and Forest Practice GIS at Boggs Mountain Demonstration State Forest (BMDSF) during March 2018, where extensive 1052.1 Emergency Notices were filed following the 2015 Valley Fire (Figure 27). For this project, Forest Practice GIS staff developed a form using Survey123, an app-based program that can be used on smartphones and tablets. This application allowed digital data to be captured, including stand structure measurements, wildlife habitat elements, road segment information, sediment discharges, and photographs, reducing data entry and analysis time, in addition to producing photographs that included geospatial information.

After the initial revision, a second field beta test was conducted at BMDSF in April 2018, with representatives from CAL FIRE, CGS, DFW, and RWQCBs. This field test was to solicit practical changes to the protocol, as well as familiarize agency representatives with the new monitoring protocol and program.

A field test of the final protocol was undertaken on a randomly selected 1052.1(b) Emergency Notice located in the Coast area on June 14, 2018. Staff from the

Watershed Protection Program, Forest Practice GIS, and CAL FIRE Sonoma-Lake-Napa Unit determined if any additional modifications were needed before beginning the summer field sampling season in full and broadly training CAL FIRE Unit Foresters and Review Team agency personnel. The full protocol and data sheet can be found in Appendix B.

Figure 27. Initial field test of the monitoring protocol on BMDSF, March 2018.

4.1.2 Centroid Based Field Sampling

For all the randomly selected Emergency and Exemption Notices, a centroid was created within the mapped notice boundary in ArcGIS (Figure 28), and served as the basis for starting all field measurements (for information on the random selection of the notices and methods, see Section 5.2.1 Sample Population). GeoPDFs for each notice were created by Forest Practice GIS staff and distributed electronically. They were then imported in smart phones and tablets in Avenza to locate the notice centroid on the ground. While this meant all sampling initiated in roughly the same geospatial location for each notice, it provided an objective, rather than subjective, approach to sampling that was simple and rapid. For notices that had multiple units mapped, we allowed the software to use its own algorithms to determine the most central point within the boundaries.

Figure 28. Centroid location (red dot) for a randomly selected notice.

4.1.3 Sample Variables and Analysis

4.1.3.1 Stand Structure, Condition, and Habitat Features

The field sampling initiated at the notice centroid. When the centroid was in an unsafe or inaccessible location, a new randomly selected centroid was generated (see Appendix B). The centroid served as one of three plots where a 1/100th acre diameter circle was used to identify the percent live ground cover, percent hardwood cover, and number of downed large wood pieces, in addition to determining if the plot had been harvested or not. From that same point, a variable radius plot was used to gather stand structure data. A basal area factor (BAF) was determined that would yield approximately 5-7 trees per plot. Each tree had the species, condition (green, snag, red phase, gray phase), diameter at breast height (DBH), and harvest-related fuel depth at the half way point between the tree and plot center recorded, in addition to if the tree was a nest or den tree (Figure 29). Digital photographs were taken in the four cardinal directions from plot center.

Figure 29. Variable plot sampling for a 1038(k) Drought Mortality Notice located in Nevada County

A second and third plot were then established and measured for the same metrics, and utilized the same basal area factor. The second plot was chosen using a random compass azimuth direction and pacing two chains (132 feet) in that direction. The third plot was the same distance away from the centroid but in the opposite direction. Plots could be relocated as needed (see Appendix B), particularly for very small parcels. Last, based on visual observations from the plots and within the notice area, the main yarding method, approximate area harvested, and closest silvicultural treatment were assigned to the notice by field observers. In addition, the seral class, and any observed site preparation were recorded.

Wildlife habitat was not inventoried rigorously within the randomly selected Emergency and Exemption Notices. Rather, habitat elements were tallied at the fixed and variable plots to maintain the rapid nature of the protocol. Habitat elements chosen to be inventoried as part of the pilot project included snags, large woody debris, nest and den trees, hardwood cover, and live ground cover. The purpose of this method was to see what habitat elements were retained following timber operations. These habitat elements were chosen because some can provide nesting and denning substrate, and others provide food or browsing sources for a variety of different wildlife species, not just those that are listed as rare, threatened, or endangered.

4.1.3.2 Road segment surveys and watercourse crossing performance

For the road component of the pilot project, a 1,320-foot road segment was evaluated if present. Road drainage, watercourse crossing performance when applicable, and sediment discharges were assessed for each road segment. The road survey was initiated at the nearest watercourse crossing to the centroid (Figure 28), or in the absence of a crossing, the nearest road segment in a random cardinal direction. We did not survey any public roads, and if only public roads were associated with the harvest document, no road segment survey was conducted.

The field protocol included assessment of the road's use for residential access (i.e., driveway), the road surfacing, class, shape, slope, and hillslope gradient, along with approximate topographic position on the landscape. The road surface was evaluated for any surface erosion features, and the number of road drainage structures encountered on the segment were recorded. We also assessed the road segment for any sediment discharges to a watercourse, recording the receiving watercourse class, sediment source, length from the source to watercourse, downslope roughness and cover class, status (chronic or episodic), erosion feature type (e.g., rill, gully, fill slope failure), and the estimated volumetric discharge ("trace", <1 yard^3, 1-5 yard^3, 5-10 yard^3, and > 10 yard^3).

The watercourse crossing, where present, was assessed for watercourse classification at the crossing, the crossing type (culvert, ford, etc.), diameter when applicable,

construction date (pre-existing, or newly constructed with the notice), adequacy of crossing capactiy (based on professional judgment), and diversion potential.

4.1.3.3 Watercourse segment survey and protection assessment

Watercourse segments were assessed in the protocol, where present. For this component of the protocol, we used the watercourse crossing from the road segment, and in absence of that starting point, the nearest watercourse in a random compass direction from the centroid was chosen (see Figure 28, Appendix B). In the case of either starting point, the watercourse segment was walked for 200 feet in each direction upstream and downstream, with data recorded including an estimate for the amount of canopy within the watercourse and lake protection zone (WLPZ) or Equipment Limitation Zone (ELZ) harvested, and the number of encroachments into these zones by heavy equipment. Additionally, using the same approach as for the road segment survey, any sediment discharges from harvest related activity, such as skid trails or tractor operations, were recorded.

4.1.3.4 Methods to calculate stand structure metrics

For all Emergency and Exemption Notices, basal area (BA), trees per acre (TPA), and quadratic mean diameter (QMD) were calculated using tree data from the variable radius plots. In the case of two Exemptions, only two variable radius plots were measured; in each case, the Exemptions were reported as one acre in size, and the field notes indicated the built environment precluded establishing three variable radius plots. The basal area factor was consistent across the plots in each notice, but differed for each notice based on site specific conditions. The basal area factors used ranged from a 5-factor to a 40-factor.

To calculate the basal area (BA), the total number of trees measured in the three plots was taken and multiplied by the basal area factor (BAF), and the result was divided by the number of plots in order to determine the BA in ft^2 ac^{-1} (Zobrist et al., 2012):

$$BA\ (ft^2 acre^{-1}) = \frac{(\#\ Trees\ in\ plot\ 1 + \#\ Trees\ in\ plot\ 2 + \#\ Trees\ in\ plot\ 3) \times BAF}{Number\ of\ plots}$$

Trees per acre (TPA) was determined by finding the individual tree basal area for each tree in a variable radius plot, using the measured diameter at breast height (DBH) in inches:

$$Tree\ basal\ area = 0.005454 \times DBH^2$$

The “expansion factor” (EF) was calculated from the BAF, which equates to the number of trees per acre that individual tree represents. The results for each tree are summed for the entire Emergency or Exemption (TPA_{sum}) and averaged by the number of plots, yielding the TPA (Zobrist et al., 2012):

$$EF = \frac{BAF}{Tree\ basal\ area}$$

$$TPA_{sum} = \sum EF$$

$$TPA = \frac{TPA_{sum}}{Number\ of\ plots}$$

The quadratic mean diameter (QMD), which gives greater weight to the larger trees that were sampled, was calculated to represent the average diameter of trees in the notice by squaring and summing the DBH measurements, dividing by the number of trees measured in a notice, and taking the square root of the result (Curtis and Marshall, 2000):

$$QMD\ (inch) = \sqrt{\frac{\sum DBH^2}{Number\ of\ trees\ measured}}$$

For each notice, the BA, TPA, and QMD were also calculated for subsets of green conifers, green hardwoods, and all the dead standing trees combined, including snags, red phase trees, and gray phase trees. The individual trees were classified into their respective California Wildlife-Habitat Relationship (WHR) size categories (Table 4) based on the measured DBH. The calculated QMD for the entire notice, based only on green conifer trees, was also subsequently binned into WHR size categories to characterize the entire notice. This pilot study did not assess for WHR size class 6 (multi-layered), but instead used a rapid visual field assessment of the seral class for forest complexity.

Table 4. California WHR size class descriptions. Note: This pilot stud did not utilize WHR size class 6, which describes multi-layered forest systems.

WHR Size	Description	DBH
1	Seedling	< 1”
2	Sapling	1” ≤ DBH < 6”
3	Pole	6” ≤ DBH < 11”
4	Small tree	11” ≤ DBH ≤ 24”
5	Medium/Large tree	24” < DBH

The hardwood cover (HWC) and live ground cover (LGC) measurements were assessed both at the single plot scale, and for the entire notice. The median HWC and LGC classification was taken as the notice-wide representative cover class for the entire notice.

4.1.3.5 Statistical methods to compare 1038(k) Drought Mortality Notices

The pilot project did not have a specific objective for a rigorous statistical analysis of forest structure. However, a basic analysis of differences in the basal area, quadratic mean diameter, and trees per acre by the reported volume removed, observed seral class, and percent of the notice harvested was completed. This assessment for BA, QMD, and TPA was performed only for green conifer trees recorded on the variable radius plots, as the green conifers are likely the most significant forest feature to potentially be affected by drought mortality and subsequent timber harvesting.

To do this, we extracted the results from the 1038(k) Drought Mortality Notices, and used a mixed effect model approach to conduct the analysis. The LME4 package (Bates et al., 2015) was used to build a linear mixed effects model, and the emmeans package (Lenth, 2018) was used to compare differences in the group estimated marginal means. This approach was chosen due to the unbalanced nature of samples in the pilot and to incorporate a random effect for Forest Practice area, acknowledging the inherent ecological differences found across the state. Residual plots were used to assess model assumptions; for the basal area and trees per acre, a $\log_{10}$ transformation was used on the response variable to normalize residuals. A p-value of 0.05 was used to test for significance.

4.1.3.6 Wildlife office evaluation methods

The Spotted Owl Database,[2] operated and maintained by DFW, was queried with the most current locations of Activity Centers (AC). Using GIS, a ¼-mile and ½-mile buffer around ACs was plotted to determine proximity of Emergencies and Exemptions. While 0.7 and 1.3 miles are considered the home range for coast and interior northern spotted owls (NSOs), respectively, the ¼- mile distance was chosen as this is generally a disturbance buffer and survey distance as mentioned in the United States Fish and Wildlife Service (USFWS) survey protocol and take avoidance guidance (USFWS, 2012 and 2012a). The ½ -mile distance is a general distance for habitat retention analysis.

The California Natural Diversity Database (CNDDB) is also maintained and operated by DFW and is part of natural heritage programs under NatureServe.[3] CNDDB is a positive detection spatial database that relies on voluntary submissions of survey data, meaning that if an area is not particularly rich with species detections that could mean that surveys were done and not submitted and/or with no detection, or that surveys weren't conducted. Additionally, the occurrences in the CNDDB database are depicted as polygons that represent a general area of a species' location, typically based on habitat or the nature of the detection. As stated on the CNDDB website, the size of a polygon generally represents different degrees of inaccuracy in the data (CNDDB 2011). A rule

[2] https://www.wildlife.ca.gov/Data/CNDDB/Spotted-Owl-info
[3] https://www.wildlife.ca.gov/Data/CNDDB

of thumb is the size of the polygon is inversely proportional to the accuracy of the detection.

The CNDDB is used as a scoping tool to determine the potential of species being found within a project area. A generally accepted methodology is to select all species detections within the nine quads surrounding a project area to capture areas that have had positive surveys. A project proponent can then determine if habitat for species detected is present within the project area and provide appropriate protection measures.

For the pilot project, the CNDDB database was only queried for detections within randomly selected notice footprints to provide an example of results, as well as to keep them manageable given the number and geographic range of Emergencies and Exemptions. The CNDDB was queried specifically for species listed under ESA, CESA, BOF Sensitive Species, and California Rare Plant Rank (CRPR) 1A-B and 2A-B botanical species, as they meet the ministerial requirements of not operating in areas of known sites of rare, threatened or endangered plants or animals or in buffer zones of sensitive species. Additionally, CRPR list 1A-B and 2A-B botanical species were only considered, as they are described by the California Native Plant Society as generally extirpated, rare, threatened, or endangered.[4]

4.2 Pilot Study Results

Summary: With the sample limited to 1038(i), 1038(j), and 1038(k) Exemptions, and 1052.1(a)(b)(e) Emergency Notices, the eligible population for sampling was dominated by small (under 20 acres) of 1038(k) Drought Mortality Exemption Notices, reflective of recent Exemption and Emergency Notice numbers in California. The randomly selected sample was similarly dominated by the small 1038(k) Notices.

Of our random sample, 44 notices were commercially harvested, while six, despite timberland owners submitting documents to undertake timber operations, were never harvested. The majority of field sampling on harvested notices occurred in the Sierra/South areas, followed by the Cascade area. Based upon the recently created FORPRIEM 2.0 erosion risk rating system (Steel and Cunningham 2018), most notices were low erosion risk; on the Coast area, the two notices were both moderate risk. Almost the entirety of notices sampled in the Sierra/South areas were rated as low erosion risk.

4.2.1 Sample Population

As stated above, CAL FIRE determined that the Emergency and Exemption Notice pilot monitoring project would only utilize 14 CCR § 1038(i) Forest Fire Prevention, 1038(j) Forest Fire Prevention Pilot, and 1038(k) Drought Mortality Exemptions, and 14 CCR § 1052.1 Emergency Notices. A list of 2,072 eligible notices was compiled by the CAL

[4] https://www.cnps.org/rare-plants/cnps-rare-plant-ranks

FIRE Forest Practice GIS staff consisting of these Exemption and Emergency Notice types from all the Forest Practice areas (Table 5). From the list of eligible notices, 50 were chosen at random using R Statistical Software (R Core Team, 2018), such that all 2,072 notices had an equal chance of being chosen regardless of Forest Practice area, reported acreage, or the type of Exemption or Emergency Notice.

Table 5. The total count, minimum, mean, and maximum reported acreage of Exemption and Emergency Notices from which the random sample of 50 notices were chosen from, broken down by type and Forest Practice area.

Notice type	**Coast** [# (Min-Mean-Max acres)]	**Cascade** [# (Min-Mean-Max acres)]	**Sierra/South** [# (Min-Mean-Max acres)]
1038(i)	2 (58-174-290)	9 (3-53-158)	6 (4-27-57)
1038(j)	5 (58-63-70)	29 (4-115-300)	1 (161-161-161)
1038(k)	36 (2-156-3,493)	456 (1-70-4,047)	1,325 (1-125-9,524)
1052.1	50 (1-136-2,130)	69 (1-166-1,350)	84 (1-117-3,277)

Landowner access letters were mailed in May 2018 explaining the process and requesting permission to enter their property. In most cases, this was followed by a phone conversation with the landowner.

From the 50 randomly chosen notices, 18 were in the Cascade area, 30 in the Sierra and South areas, and two in the Coast area (Figure 32). Forty-two (42) notices were 1038(k) Drought Mortality Exemptions, three were 1038(j) Forest Fire Prevention Pilot Exemptions, and five were 1052.1 Emergency Notices (Figure 32) Six of the 50 notices were never operated on per discussions with the timberland owners; these notices were not monitored in the field, but included in this report as data points to capture these occurrences. Two unharvested notices were 1052.1 Emergencies and four were 1038(k) Drought Mortality Exemptions. Of the 50 randomly selected notices, six were submitted by large industrial landowners and 44 were submitted by small nonindustrial landowners (Figure 30).

Figure 30. Example of a small (2 acre) nonindustrial 1038(k) Drought Mortality Exemption Notice included in the random sample located in Tuolumne County.

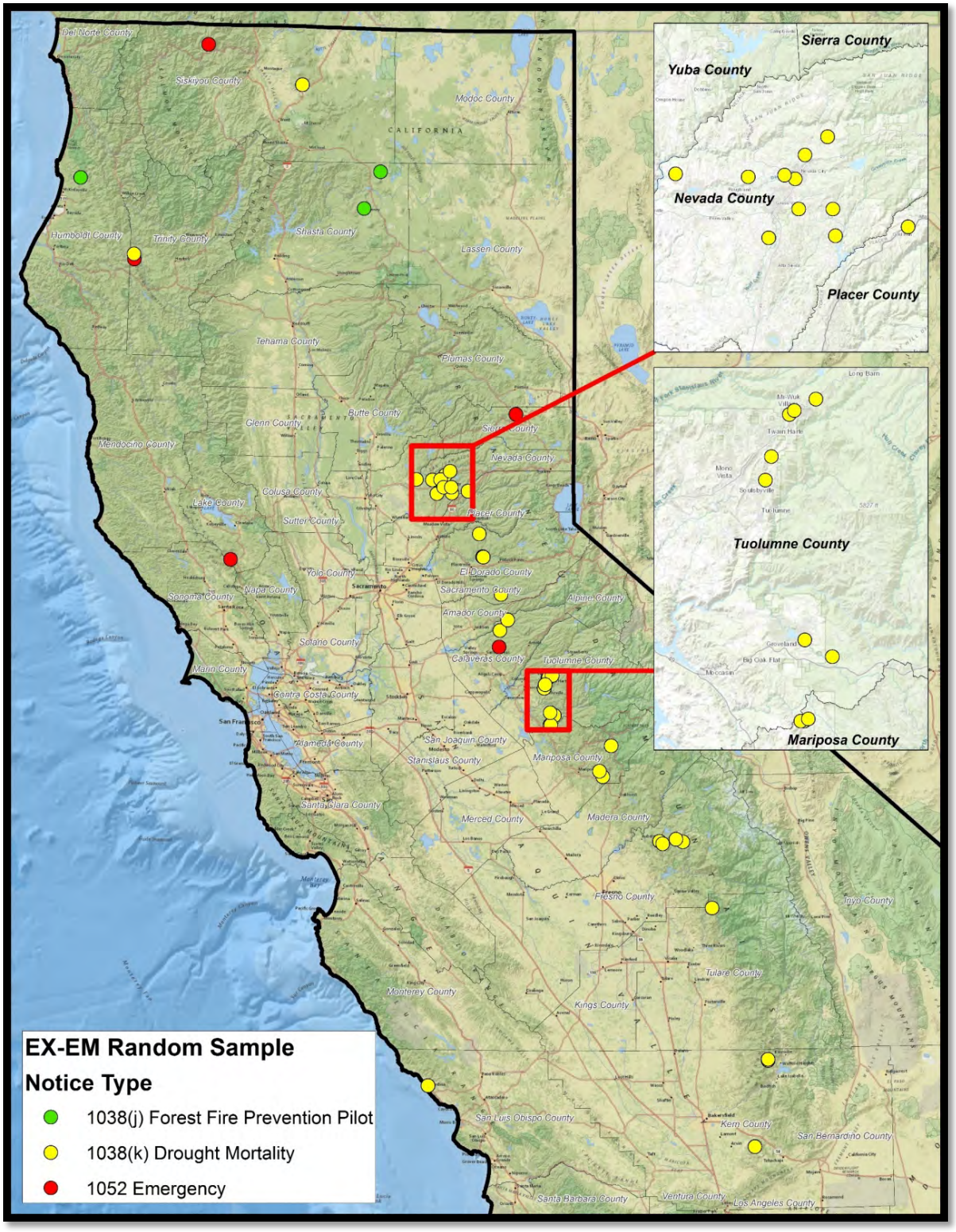

Figure 31. Map showing the locations and types of the 50 randomly selected Exemption and Emergency Notice locations.

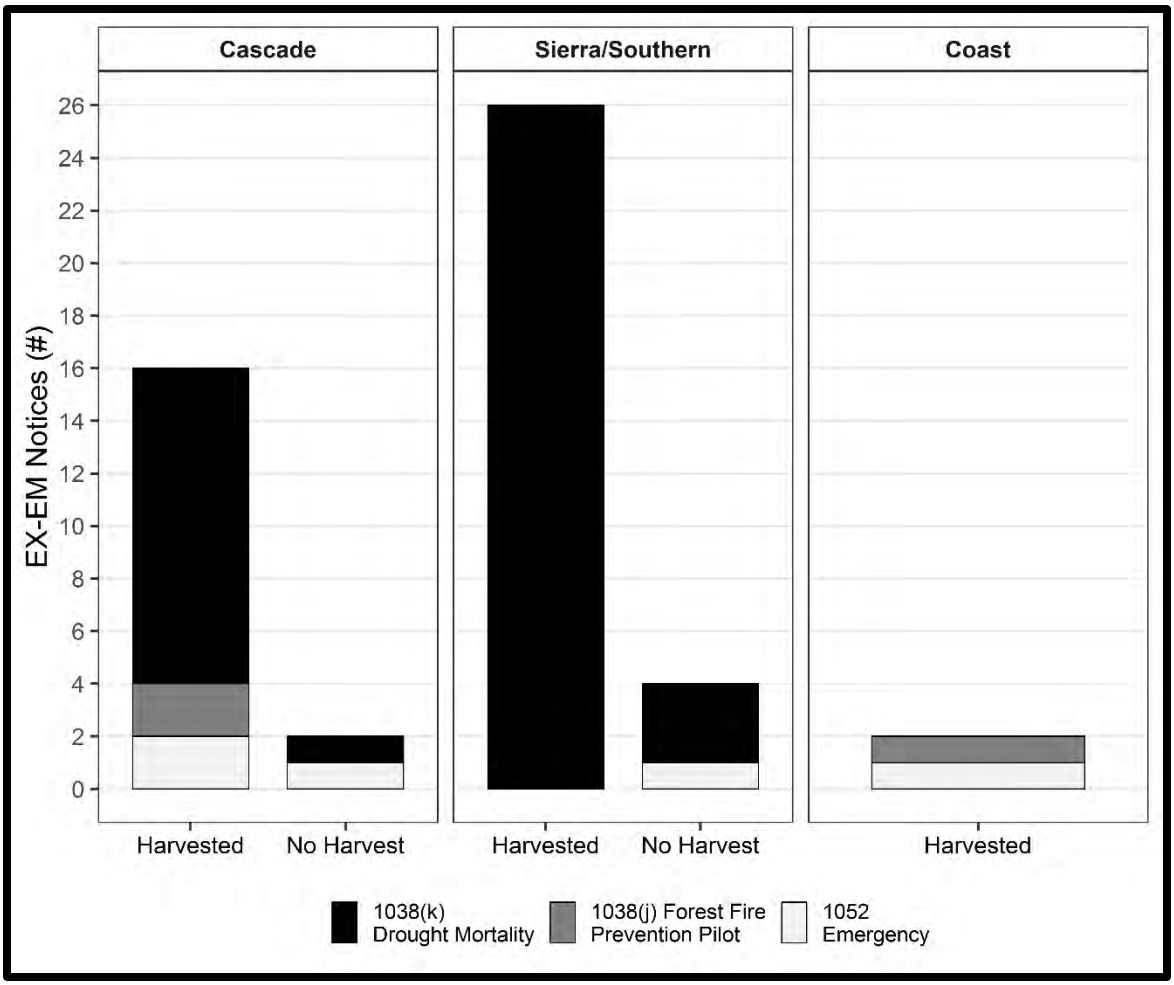

Figure 32. The 50 randomly selected notices, by type, Forest Practice area, and harvest status.

The distribution of reported acreage on the 50 notices that were selected is shown in Figure 33, and is compared to the entire population broken down by area and type. The reported acreage spanned from one acre to 432 acres. No 1038(k) Drought Mortality Exemptions were selected in the Coast area, while the selected 1038(j) Forest Fire Prevention Pilot Exemptions were in both the Cascade and Coast areas. Of the five 1052.1(b) Emergency Notices selected, three were in the Cascade area, one in the Sierra/South areas, and one was in the Coast area. All five Notices were submitted for the harvest of fire-killed or fire-damaged timber.

The distribution of the selected notice reported acreage, type, and Forest Practice area for this pilot project reflects general trends of the 2,072 notices from the sample population. No measures were taken to stratify the sample (e.g., landowner type). Notably, 1038(k) Drought Mortality Notices dominated the population, and this is reflective of the recent tree mortality event in California (Fettig et al. 2019). As such,

1038(k) Notices dominated the sample, particularly in the Sierra/South areas, where tree mortality was the greatest.

The majority of the randomly selected notices evaluated in the field (44 total) were small, with 70 percent less than 20 acres and greater than 50 percent less than 10 acres (Figure 33). Field evaluations were conducted with interagency teams, with 89 percent of the notices having multi-agency participation (Figure 34). In many instances, landowners or RPFs also participated in the field evaluations. Field evaluations generally took between one and three hours to complete.

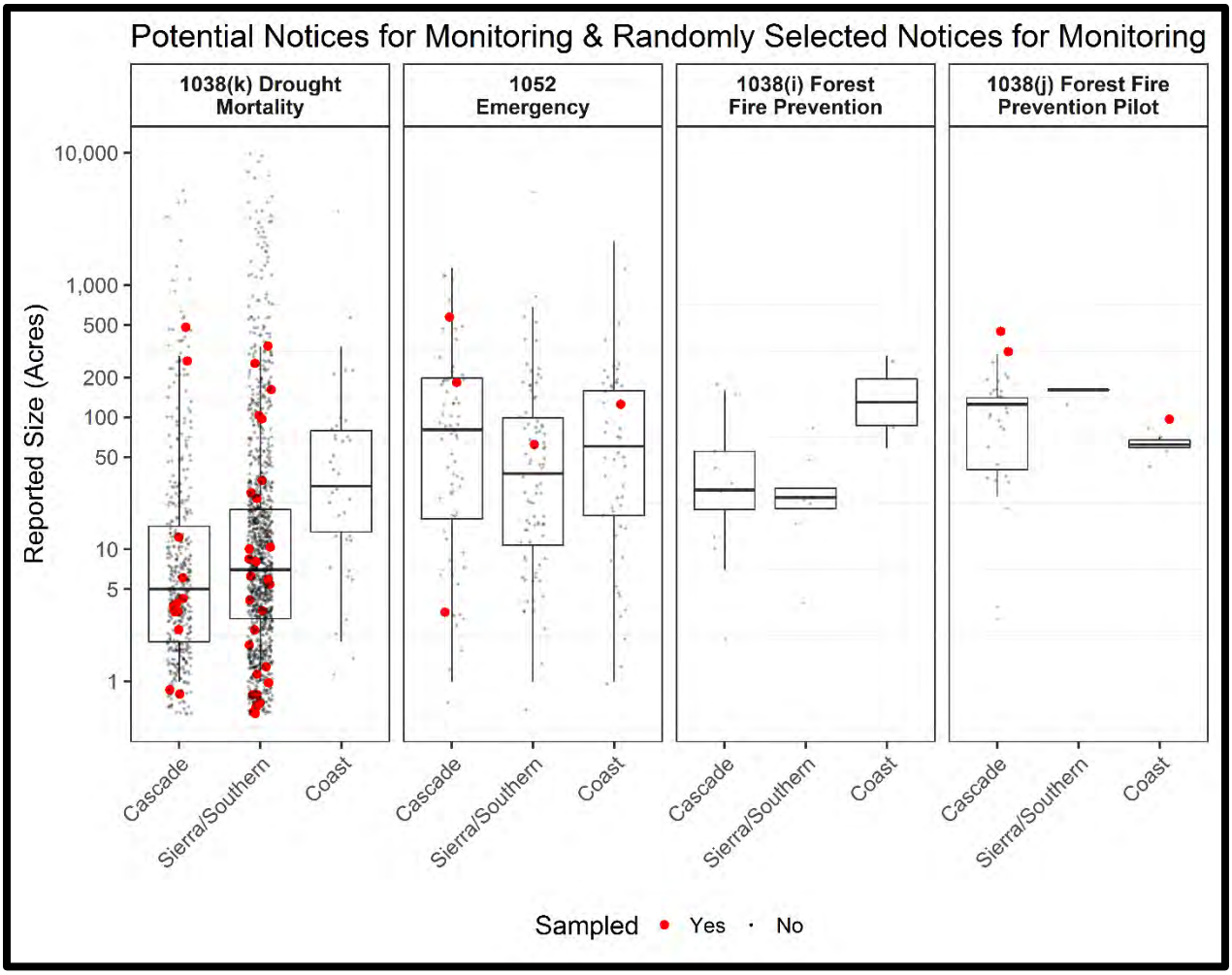

Figure 33. Box plots of randomly selected Emergencies and Exemptions, shown as red dots, by type and Forest Practice area, when compared to the entire population of eligible notices, shown as black dots. The dark horizontal line within each box represents the median of the entire population. The bottom and top of the boxes represent the 25th and 75th percentiles of the elite population, respectively. The data above and below the vertical lines represent outliers. The y-axis is shown with log_{10} spacing, and the points are for better display, the actual minimum reported notice acreage is one acre.

Figure 34. Example of a 1038(k) Drought Mortality Exemption Notice being evaluated by a multiagency team in Fresno County, with the landowner participating.

4.2.1.1 Erosion risk rating of selected and harvested notices

Using the FORPRIEM 2.0 Erosion Risk Rating approach (Steel and Cunningham 2018), the randomly selected notices that were operated on were rated based on the mean slope within mapped notice boundaries, annual precipitation (inches), deep seated landslide susceptibility (0 being no susceptibility, 10 being the highest susceptibility for existing deep seated landslides) (Wills et al. 2011), rock strength (1-3, 3 being weakest and 1 being highest rock strength), and drainage density (mi mi^{-2}). For drainage density, the USGS National Hydrography Dataset (NHD) was used as the basis for determining the density of watercourses in each notice. The USGS NHD likely underestimates drainage density, due to the absence of many ephemeral and intermittent streams, particularly at the scale of the smaller 1038(k) Drought Mortality Notices. Drainage density was included in the risk rating despite this potential underestimation to illustrate the erosion risk of the plans relative to each other and in each Forest Practice area.

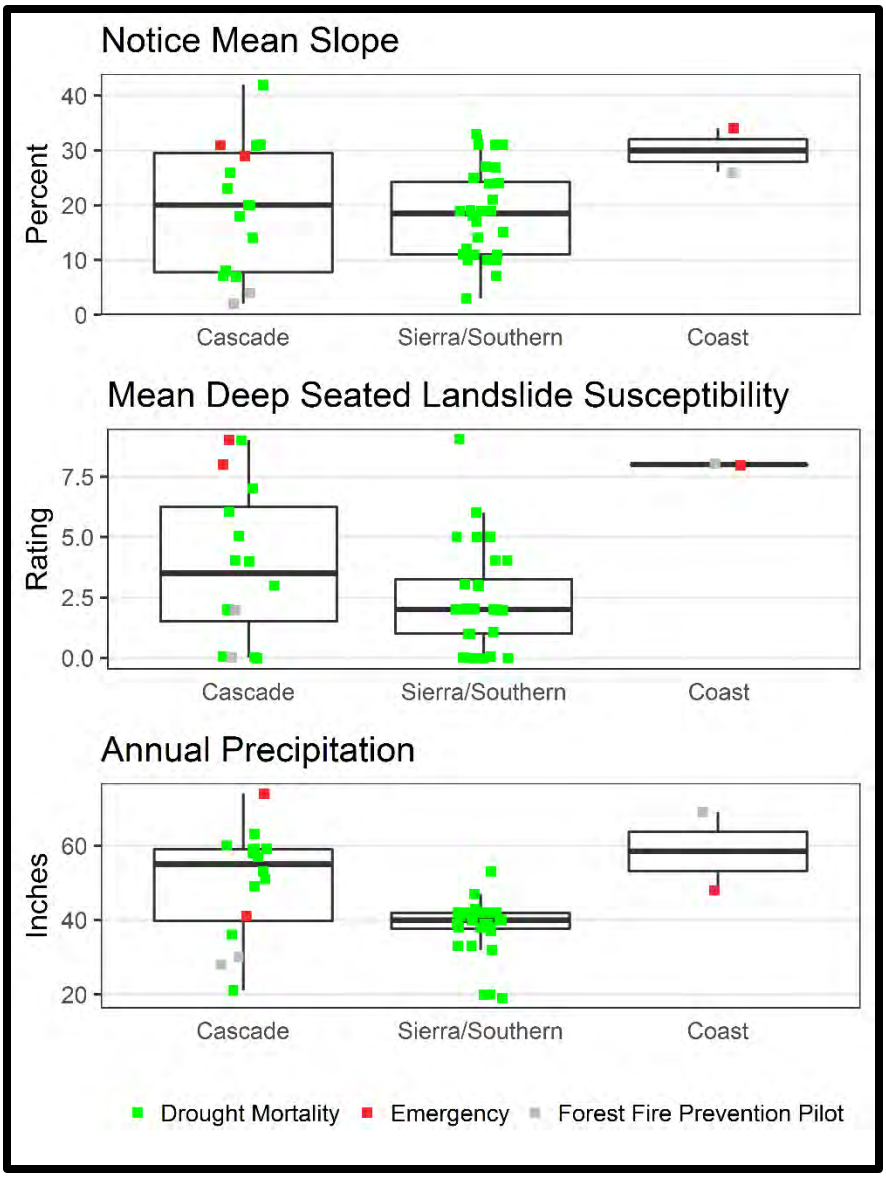

Figure 35. Results for randomly selected notices that were harvested displaying erosion risk categories for annual precipitation, deep seated landslide susceptibility, and slope, shown by notice type and Forest Practice areas. An explanation of box plots is contained in the caption of Figure 33

Figure 35 illustrates the individual data points for the 44 harvested notices for the mean slope, deep seated landslide susceptibility, and annual precipitation, separated by Forest Practice area. None of the 44 notices subject to timber operations were rated as “High” for erosion risk, while only six (14 percent) were rated as “Moderate” (Figure 36). The remaining 86 percent of notices (n=38) were rated as having “Low” risk. Of the notices rated as “Moderate” risk, two were 1038(k) Drought Mortality Notices, one each in the Cascade and Sierra/South area, while all three 1052.1 Emergency Notices fell into the “Moderate” risk rating. The only 1038(j) Forest Fire Prevention Pilot Notice in the Coast area was ranked as “Moderate”, due to a higher mean slope (26%), annual

precipitation (69 inches), deep seated landslide susceptibility (8), and moderate rock strength (2), while the other two 1038(j) Notices were rated as “Low”.

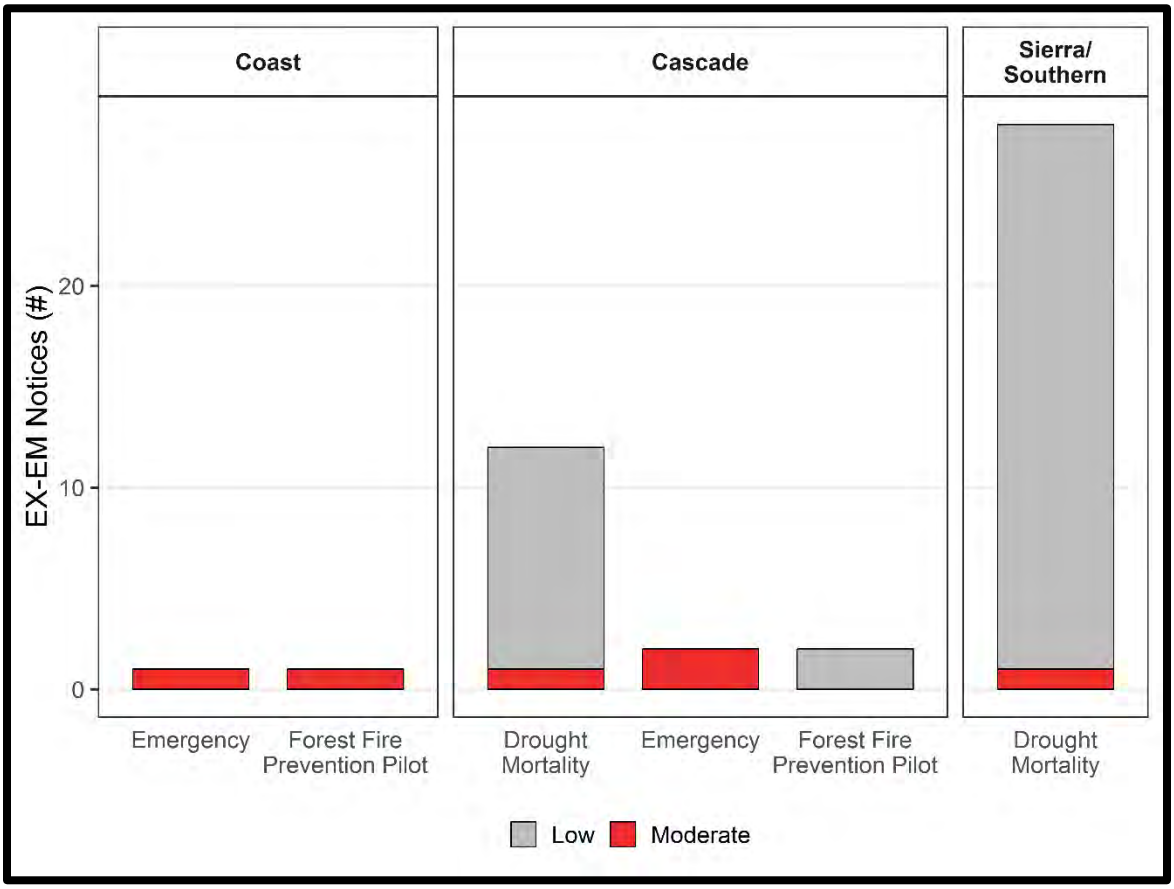

Figure 36. The final erosion risk rating for notices that had timber operations occur, based on the rating system devised for FORPRIEM 2.0.

4.2.2 Generalized Harvest Intensity and Silviculture by Notice Type

Summary: The 1038(k) Drought Mortality Notices employed almost entirely single tree selection silviculture, with group selection used in a minority of cases, which is likely reflective of tree mortality patterns. The 1038(j) Forest Fire Prevention Pilot Exemptions used single tree selection only, also reflective of the Exemption intent and purpose. 1052.1 Emergencies were split between group selection and clear-cut silviculture. Harvest intensity in the notices was generally low, with most notices having timber harvesting operations occurring on 50% or less of the notice area. Site preparation was generally absent, or limited to only harvest-related slash cleanup.

The Emergency and Exemption Notices mostly used single tree selection, followed by group selection, for silviculture (Figure 37). The 1038(k) Drought Mortality Notices largely employed single tree selection, followed by group selection, which likely is explained by tree mortality patterns. One 1038(k) Notice used a clear-cut harvesting approach. Within the 1038(j) Forest Fire Prevention Pilot Exemptions, only single tree

selection was employed, which reflects the intent of the Exemption. One of the 1052.1 Emergencies used a group selection approach, while the other two notices used clear-cut silviculture.

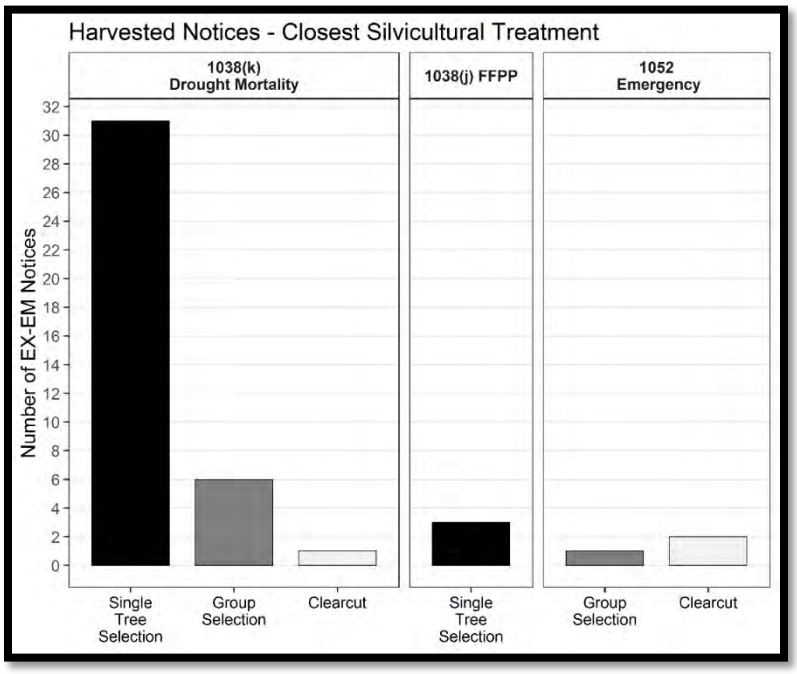

Figure 37. Closest approximation of silviculture in the sampled Exemptions and emergencies.

The harvest intensity in the notices covered a range of results, but predominantly was found to be 50% of a notice footprint harvested or less (Figure 38). There were no general trends in how much of a notice was harvested and operated on relative to the reported acreage (Figure 38). The 1038(k) Drought Mortality Notices were split with 16 having 0-25% harvested, 16 having 25-50% harvested, 50-75% harvesting occurring on five notices, and one notice identified as 75-100% harvested (Figure 38). The 1038(j) Forest Fire Prevention Pilot Notices similarly spanned a range of area harvested, while the 1052.1 emergencies were split between 25-50% and 75-100% of the area harvested.

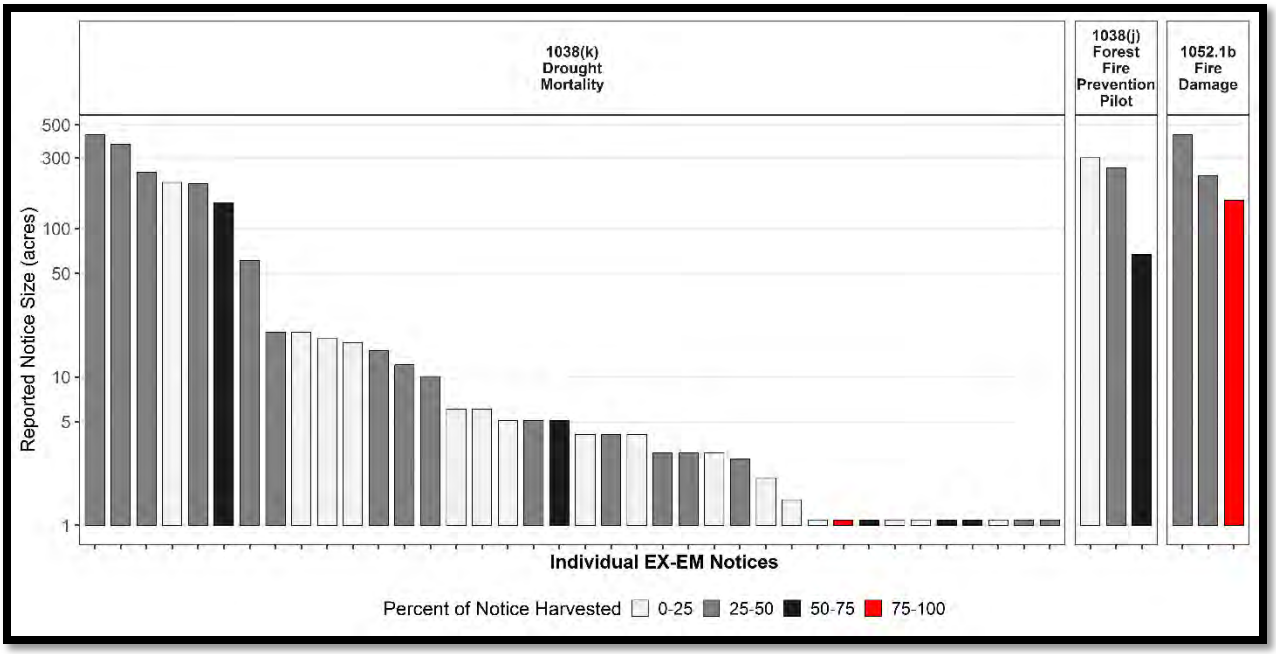

Figure 38. Sampled notices, by notice type and ordered from left to right by decreasing reported acreage. Bar colors indicate the field-estimated percent of the notice harvested and operated on.

Ground based tractor yarding was used in every Exemption and Emergency Notice monitored; field teams did not encounter any usage of cable yarding or other alternative methods. Site preparation was largely absent on many notices, which may reflect many of the non-traditional settings of harvest areas, and non-traditional timberland owners (e.g., residential lots and homeowners). Where site preparation activities occurred, the most frequently observed actions were piling and burning or chipping; in only one case was chemical herbicide application observed, and that was in a post-fire 1052.1 Emergency Notice that also had subsequent tree planting work done.

4.2.3 Stand Structure, Stand Condition, and Habitat

4.2.3.1 1038(k) Drought Mortality Notices

For the 1038(k) Exemptions, basal area averaged 64 ft^2 ac^{-1} for green conifers, while the green hardwoods and standing dead trees were 22 ft^2 ac^{-1} and 14 ft^2 ac^{-1}, respectively. Including all measured trees across the 1038(k) Drought Mortality Notices, regardless of tree type or condition, total basal area ranged from a minimum of 22 ft^2 ac^{-1} to a maximum of 307 ft^2 ac^{-1}, and averaged 101 ft^2 ac^{-1} (Figure 39 A). The basal area in most of the notices consisted of green conifers; a minority of notices sampled were dominated by either hardwoods or standing dead trees (Figure 39 A). The maximum basal area of hardwoods was 73 ft^2 ac^{-1}, and 107 ft^2 ac^{-1} for standing dead trees. In the context of trees per acre, the 1038(k) Drought Mortality Notices averaged 112 trees per acre, with a minimum and maximum of 17 and 466 trees per acre, respectively, with green conifers averaging 66 trees per acre (Figure 39 B).

In terms of residual tree size following harvesting, the 1038(k) Drought Mortality Notices had an average QMD of 23 inches, inclusive of all tree types and conditions, bounded by a minimum and maximum notice-wide mean of 7 and 34.5 inches (Figure 40). For the residual green conifers and hardwoods, specifically, the mean QMD was 21 inches and 17 inches, respectively. Surprisingly, despite the intent of the 1038(k) Notice, the dead standing trees that were measured had a mean QMD of 11 inches, and were present on 20 separate notices (Figure 40).

The variable radius plot data, in the context of the WHR size class and across the entire sample of 1038(k) Drought Mortality Notices, regardless of tree type or condition, are presented in Table 6. Table 6 also shows the WHR size class breakdown by tree type and condition. Forty-eight percent of the measured trees that were live (green) conifers fell into the WHR 4 or WHR 5 size class, while 20% of the green hardwoods also fell into the two largest WHR size classes. Although the standing dead trees were only 12% of the total measured trees in the 1038(k) notices, 10% of these were in the WHR 4 or WHR 5 size class. Using the notice-wide QMD of green conifers, 16 of the notices were classed as a WHR 5 size stand, 18 as WHR 4, three as WHR 3, and one fell into the WHR 2 size stand (Figure 41).

Within the 1038(k) Drought Mortality Notices, the proportion of a notice having dead standing trees appears to increase following the southern gradient (Figure 42 A). Latitude alone explained approximately 37% of the variability in percent of a notice with dead standing trees, as seen in Figure 42 B. The regression shown in Figure 42 B has had one outlier removed; a 1038(k) Notice filed in Trinity County was subsequently identified as being a post-fire environment. This Exemption, which is identified in Figure 42 A, had a very high proportion of standing dead trees, despite one of the more northern latitudes of the sample, and the proportion of dead trees appeared to be in part due to the effects of the earlier fire, in addition to drought mortality. As noted above, despite the intention of the 1038(k) Drought Mortality Exemption, the results indicate that there are residual dead standing trees left behind on notices, and proportionally higher in the southern latitudes of the state.

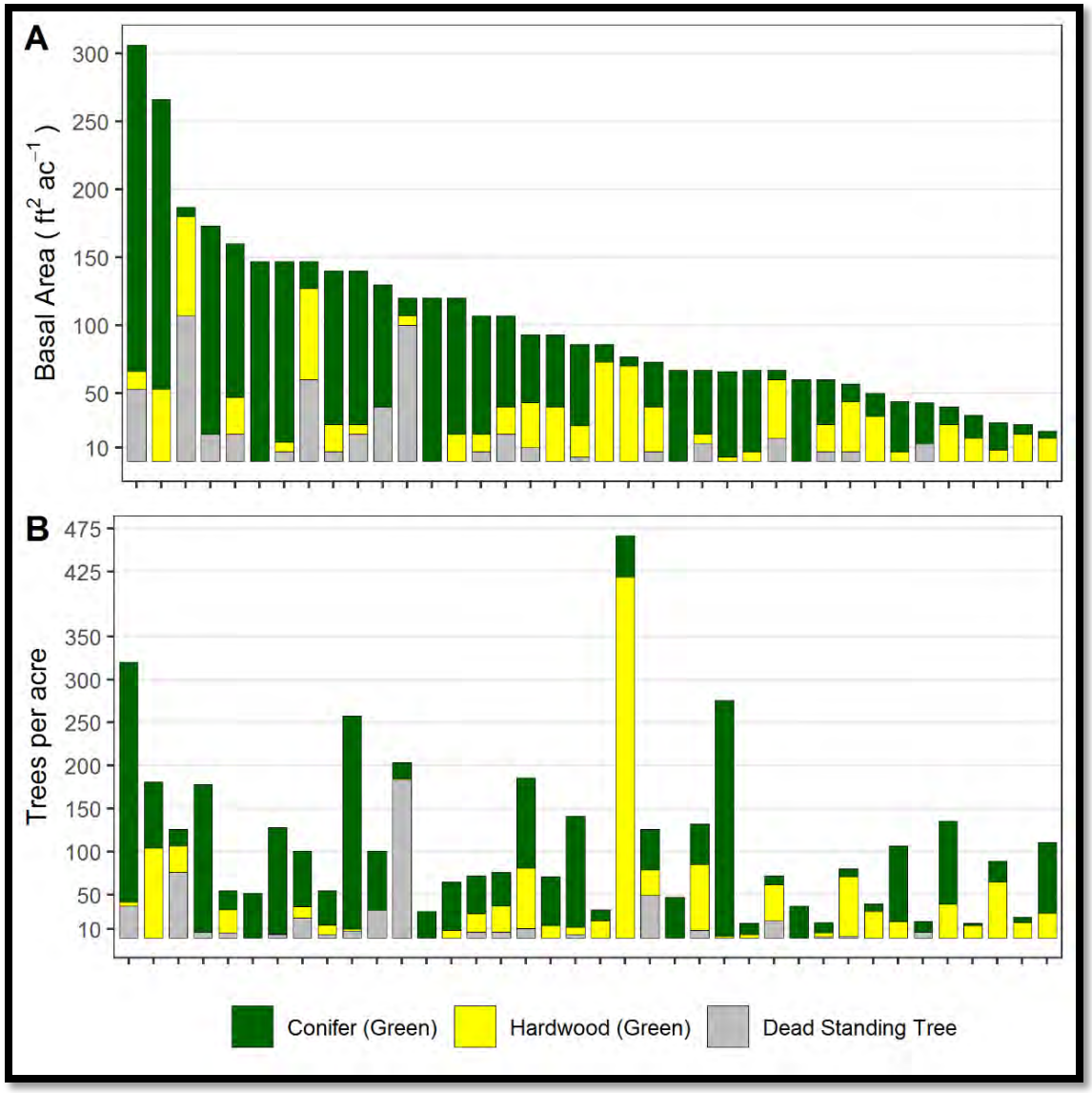

Figure 39. Basal area as calculated for each 1038(k) Drought Mortality Notice from the variable radius plots, by tree type and condition category (A). The maximum height of each bar represents the total basal area for the entire notice, based on the plots. Trees per acre (B) as calculated from the variable radius plots, by tree type and condition; the maximum height of each bar represents the total trees per acre. Individual notices are ordered in panel A and B by the total basal area in each notice.

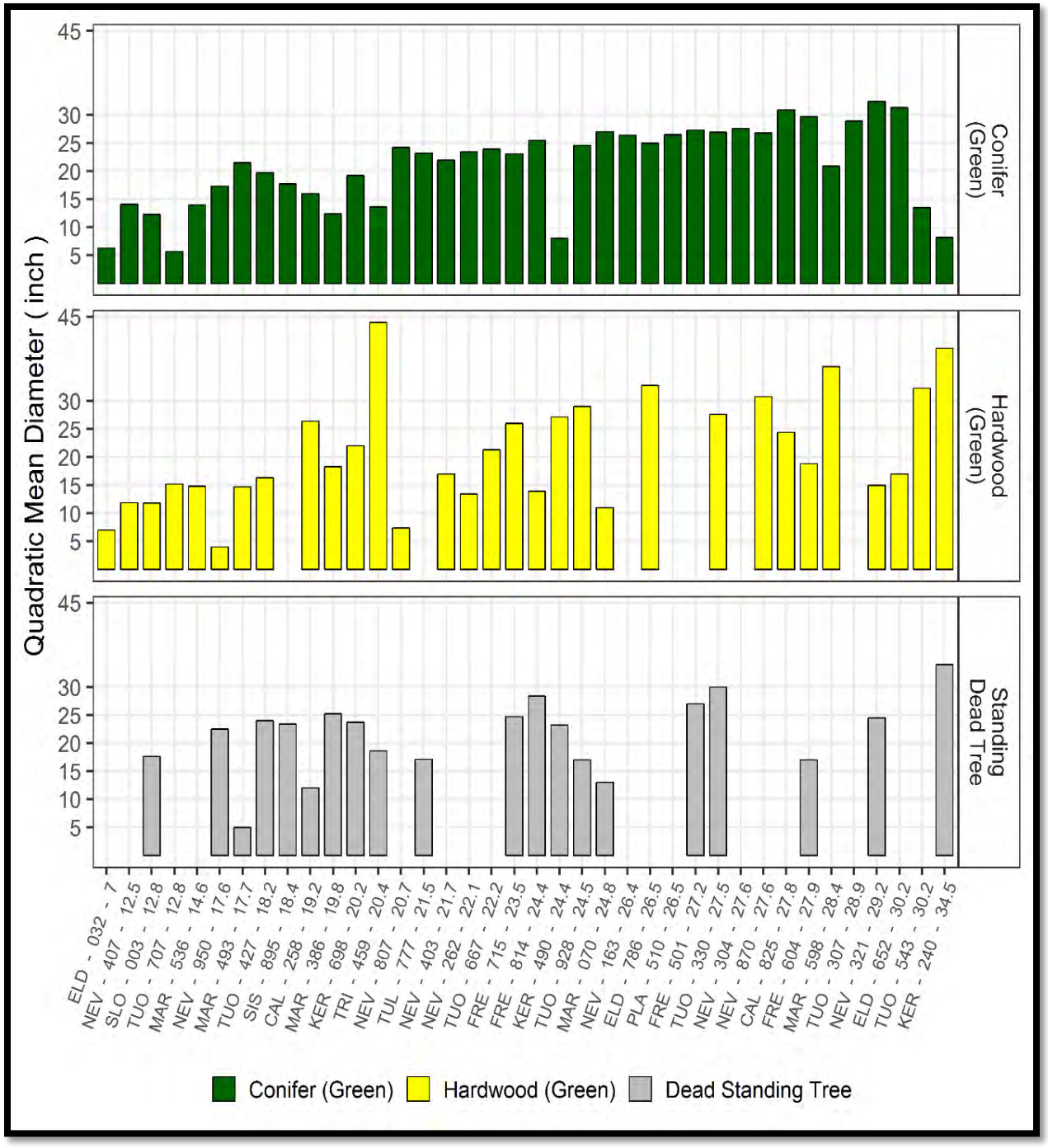

Figure 40. Quadratic mean diameter of trees by type and condition for each 1038(k) Drought Mortality Notice. The x-axis is ordered from left to right in ascending order of the QMD for the entire notice across all trees, regardless of type or condition. Blank spots indicate no trees were measured in that particular type or condition for a notice. The x-axis labels indicate the county, notice number, and QMD for the notice inclusive of all trees.

Table 6. Variable radius plot data, binned into California Wildlife Habitat Relationship (WHR) size classes. The top four rows show the WHR size class breakdown across all tree types and conditions, while the bottom twelve rows show the WHR size class breakdown by tree type and condition

Across all 1038(k)'s and Tree Types/Conditions	WHR Size	# of trees	% of total
	2	47	7
	3	94	14
	4	266	41
	5	245	38
By Tree Type and Condition			
Conifer (Green)	2	23	4
Conifer (Green)	3	51	8
Conifer (Green)	4	144	22
Conifer (Green)	5	168	26
Hardwood (Green)	2	20	3
Hardwood (Green)	3	33	5
Hardwood (Green)	4	82	13
Hardwood (Green)	5	48	7
Dead Standing	2	4	1
Dead Standing	3	10	1
Dead Standing	4	40	6
Dead Standing	5	29	4

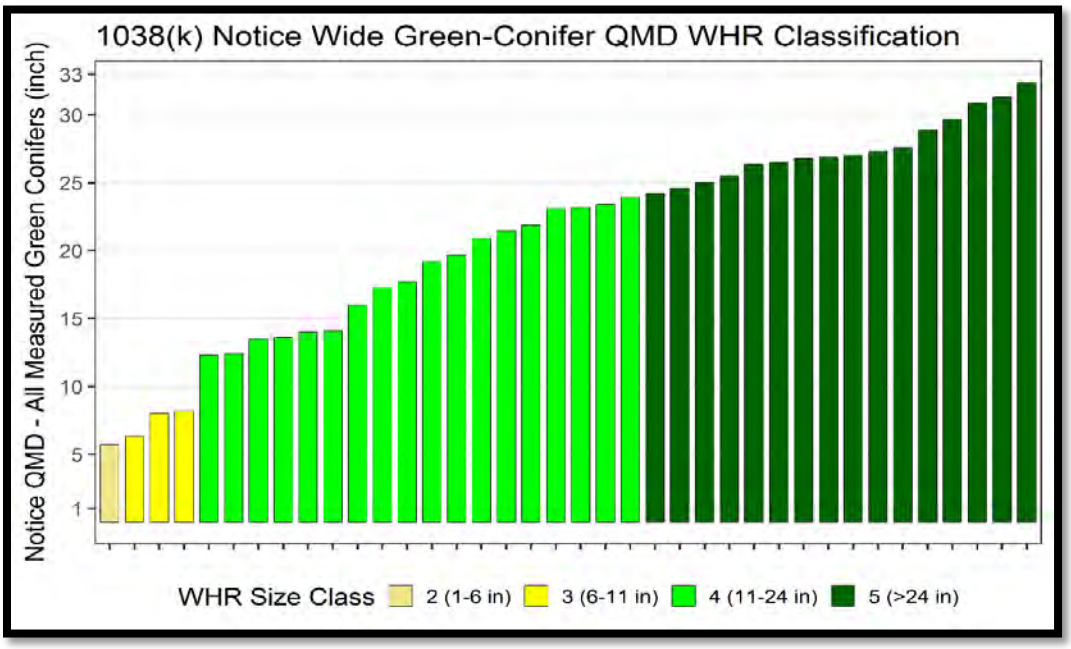

Figure 41. Notice WHR size classification, based on the notice-wide QMD of all measured green conifers. Notices are ordered from left to right by increasing QMD size

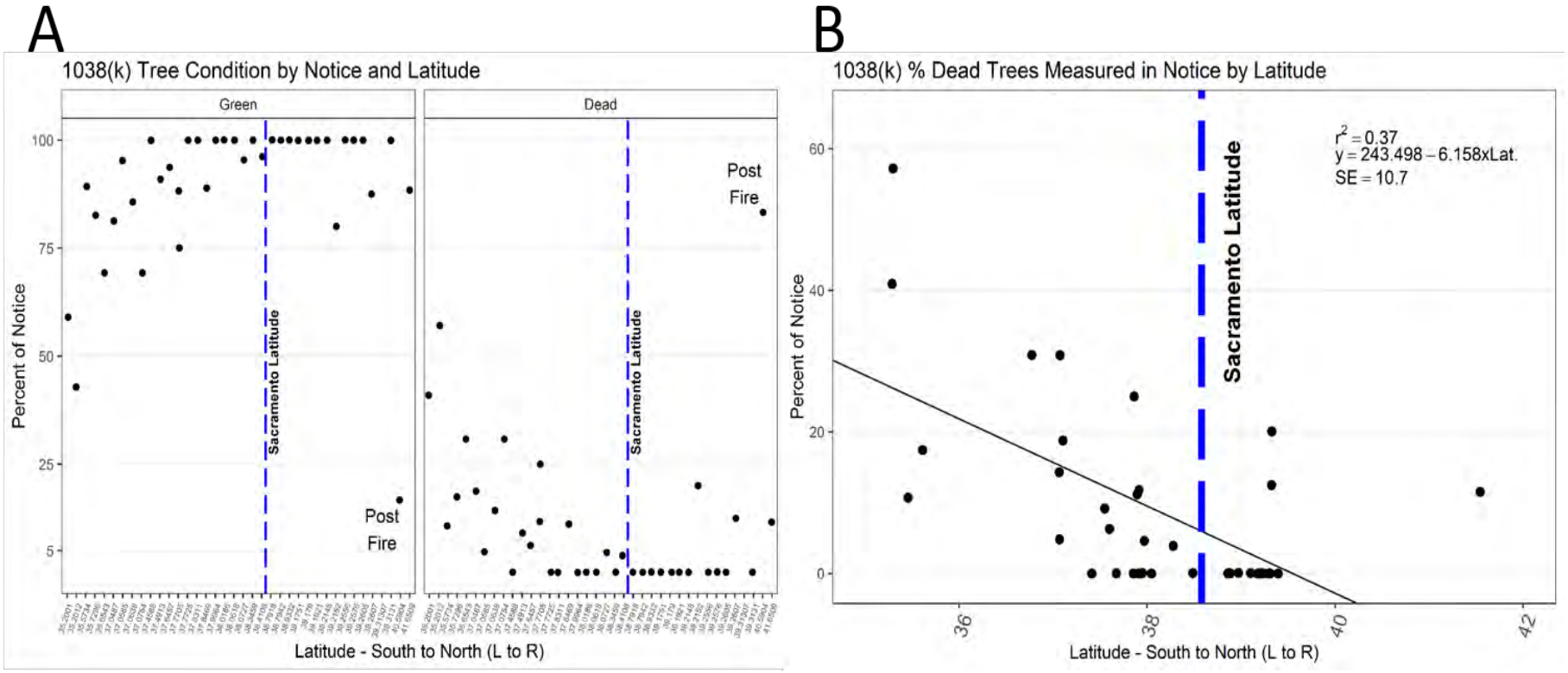

Figure 42. (A) Proportion of live and dead standing trees on each 1038(k) Drought Mortality Notice, ordered by latitude from left to right by increasing latitude. The Sacramento latitude is labeled to help give context to the spatial location in the state, and the post-fire 1038(k) outlier is identified in each panel. (B) The percent of dead standing trees in each 1038(k) Notice vs latitude. The post-fire 1038(k) Notice has been removed in this linear regression, and the Sacramento latitude line serves to illustrate the spatial location of each notice.

Finally, acknowledging that tree species may influence if a dead standing tree was harvested, the residual structure left after harvesting largely consisted of conifer species, as opposed to hardwoods (Table 7). In the Cascade area for 1038(k) Drought Mortality Exemptions, dead standing trees were predominantly composed of Douglas-fir and fir (43.5% and 21.7%), followed by ponderosa and sugar pine, and then incense cedar and hardwoods. In the Sierra and South areas, the overwhelming majority of dead standing trees were ponderosa and sugar pine (61.7%), followed by incense cedar (16.7%) and fir (13.3%), while hardwoods comprised only 3.3% of the total measured in those Exemptions. Figure 43 shows a 1038(k) Notice in the South area with most of the pine species dead.

Table 7. Count and percent of dead standing trees in 1038(k) Drought Mortality Exemptions by tree species and Forest Practice area. There were no 1038(k) Notices sampled in the Coast area. The number in parentheses next to the area indicates the number of Exemptions sampled.

	Douglas-Fir-Dead	Fir-Dead	Hardwood-Dead	Incense Cedar-Dead	Other Conifer-Dead	Ponderosa or Sugar Pine-Dead
CASCADE (12)						
Tree Count	10	5	2	2	0	4
Percent	43.5	21.7	8.7	8.7	0.0	17.4
SIERRA / SOUTH (26)						
Tree Count	0	8	2	10	3	37
Percent	0.0	13.3	3.3	16.7	5.0	61.7

Figure 43. 1038(k) Drought Mortality Notice in Kern County with nearly all pine species dead.

4.2.3.2 Fuel depths for 1038(k) Drought Mortality Exemption Notices

The notice-wide mean harvest-related surface fuel depth for individual 1038(k) Drought Mortality notices ranged from zero inches up to eight inches, with a standard deviation of 5.3 inches. The average across all the 1038(k) Drought Mortality Exemptions for harvest related surface fuel was approximately one inch. Of note is that 87%, or 567 of 652, of the individual harvest-related surface fuel measurements in the variable radius plots were zero inches, or no harvest-related surface fuel present.

The maximum harvest-related fuel depths in 1038(k) Drought Mortality Exemptions were as low as one inch, when present, and as high as 72 inches, with a standard deviation of 16 inches across all the notices. Some of the plots had much higher fuel depths related to bucked logs still on site. Within only plots identified as having been harvested, the mean harvest-related surface fuel was two inches, slightly higher than the one inch mean across all the Drought Mortality Exemptions.

The low harvest-related surface fuel measurements likely reflect whole tree yarding methods and low harvest intensity within many notices, with 84% of the notices recorded as 50% or less of the notice area harvested.

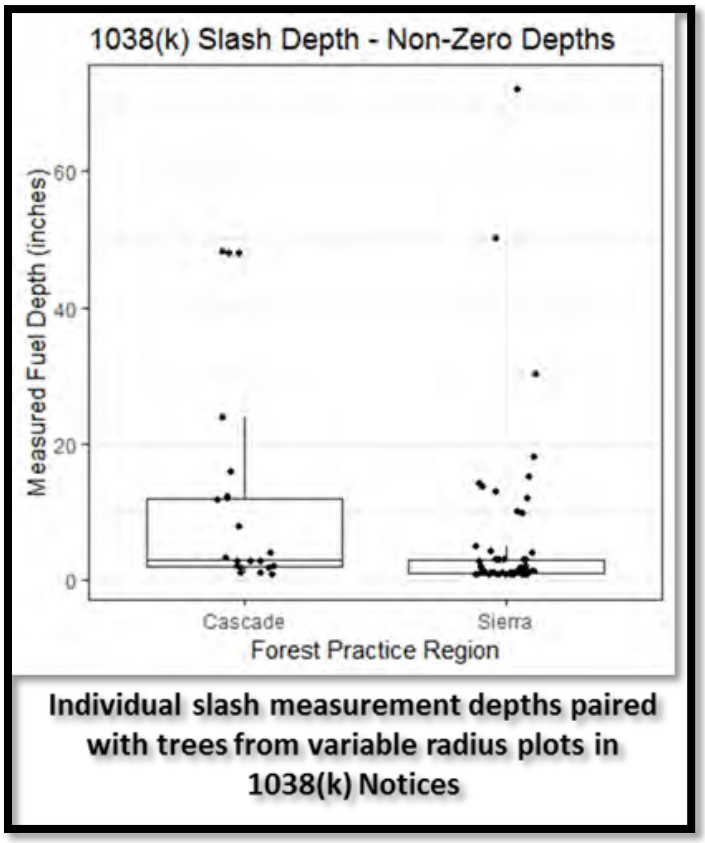

Figure 44. 1038(k) Drought Mortality Exemption Notice non-zero slash depth related to the current harvesting.

4.2.3.3 1038(j) Forest Fire Prevention Pilot Exemptions

Of the three 1038(j) Forest Fire Prevention Pilot Exemptions monitored, one was identified as early seral while the other two were recorded as mid-seral stands. The two Exemptions selected in the Cascade area were dominated by pine and cedar tree species, while the Coast area Exemption was dominated by redwood with Douglas-fir and hardwood trees present.

The 2016 Cascade 1038(j) Forest Fire Prevention Pilot Notice was classified as mid-seral, with a QMD of 17.9 inches, 107 trees per acre, and 120 ft^2 ac^{-1} of basal area, which can be compared to the statement within the notice that the post-treatment basal area will be 60-220 ft^2 ac^{-1} (Table 8). Field observations indicated that only 0-25% of the notice area was harvested. Due in part to a previous biomass removal operation, the notice had a median live ground cover measurement of < 10%, and functionally the notice had an average harvest-related surface fuel depth of zero inches (Figure 45).

The 2017 Cascade 1038(j) Forest Fire Prevention Pilot Notice was identified as a stand that was re-planted after a previous wildfire; the QMD across the notice was 8.9 inches, which matched a notice-wide WHR size class of three, or six to 11 inches DBH (Table 8). No measured tree on the Exemption exceeded a DBH of 14 inches, and all fell exclusively into the ponderosa or sugar pine tree species category. The measured basal area and trees per acre, based on the variable radius plots, were 75 ft^2 ac^{-1} and 213 trees ac^{-1}, respectively. The median live ground cover value was 10-40% in the plots (Table 8); visual observations in the field indicated all ground cover was surface vegetation with minimal height. The field evaluation estimated that 25-50% of the notice was harvested and operated on, and there was no harvest-related surface fuel, due in part to the site prep and yarding methods used (Figure 45).

The 2017 Coast 1038(j) Forest Fire Prevention Pilot Notice was a mid-seral stand with a QMD of 18.3 inches, placing it in WHR size class 4. The notice indicated that the pre-harvest basal area was 210 ft^2 ac^{-1}; the calculated post-treatment basal area was 127 ft^2 ac^{-1} based on the three variable radius plot measurements (Table 8). The assessment protocol only placed field measurements in one of two “units” that were treated in the 67-acre Exemption. The Exemption had a median value of < 10% for live ground cover, and three plot averages of seven, seven, and 12 inches for harvest-related surface fuel depth, for a notice-wide average of nine inches. Three harvest-related surface fuel measurements exceeded 18 inches in depth (Figure 45). Portions of the harvest-related surface fuel was due to the use of tractor scatter-crush site prep methods, particularly on skid trails, likely as a BMP to reduce soil compaction and surface erosion.

In keeping with the intent of this Exemption, all three of the Forest Fire Prevention Pilot Notices utilized single tree selection silviculture. In the nine plots across the three

Exemptions, only one was identified as being unharvested. The 2016 Cascade and 2017 Coast area Exemptions both had one downed large wood piece recorded.

Table 8. Field measurements of the 1038(j) Forest Fire Prevention Pilot Exemptions. The seral class is based on field observations, and notice-wide WHR refers to the WHR size class based on the notice wide quadratic mean diameter of measured green conifers.

1038(k)	Basal Area (ft^2 ac^{-1})	Trees $Acre^{-1}$	QMD (inch)	Median Live Ground Cover	Seral Class	Notice WHR
2017 Coast	127	127	18.3	< 10%	Mid	4
2017 Cascade	75	213	8.9	10-40%	Early	3
2016 Cascade	120	107	17.9	< 10%	Mid	4

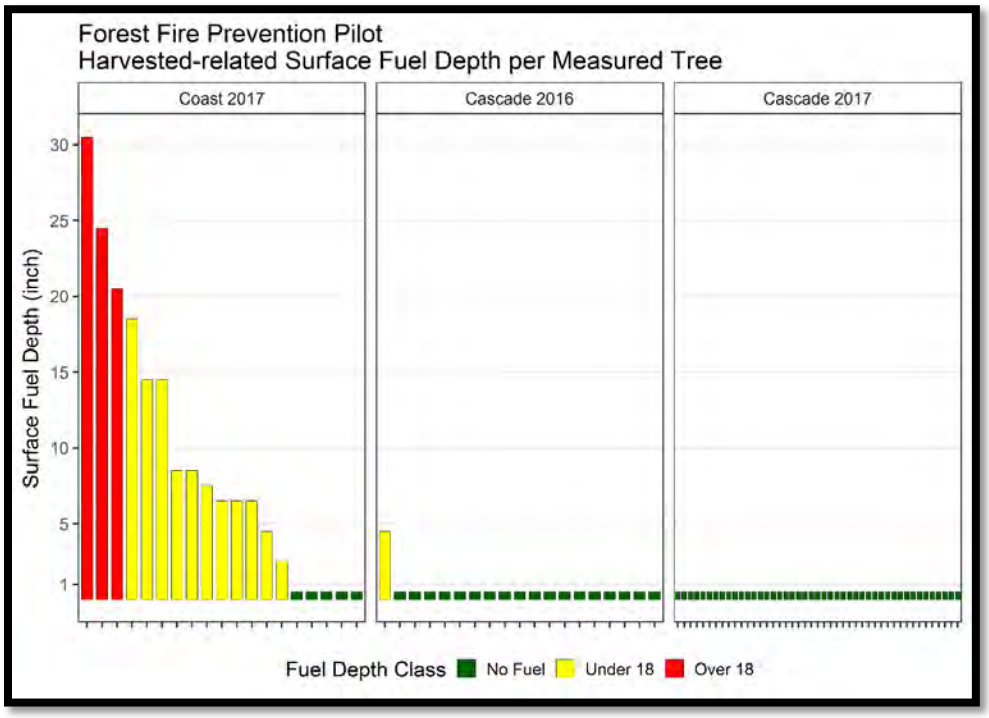

Figure 45. Harvest-related fuel depth measured in the variable radius plots for each 1038(j) Forest Fire Prevention Pilot Notice. The y-axis is the surface fuel depth in inches, and the bar color indicates if the depth was classed as "No Fuel", "Under 18 inches", or "Over 18 inches".

4.2.3.4 1052.1 Emergency Notice of Timber Harvest Operations

Three 1052.1 Emergency Notices were sampled in this pilot, and all three were for fire-related tree mortality harvesting. The three notices were filed in 2016, with two in the Cascade area and one in the Coast area. In our variable radius plots across all three, there were no live green trees measured. However, field observations qualitatively

indicated that each notice did have live green trees remaining; this discrepancy is likely reflective of the rapid nature of our field protocol and fire intensity variability.

Fire severity in the three Emergency Notices is presented in Table 9Error! Reference source not found. Using Rapid Assessment of Vegetation Condition after Wildfire (RAVG) data from the USDA Forest Service (https://www.fs.fed.us/postfirevegcondition/whatis.shtml). These data utilize satellite imagery and established protocols to classify areas of a fire by the vegetation condition following the wildfire, based on the Relative Differenced Normalized Burn Ratio (RdNBR) (Miller and Thode, 2007). Both the percent change in canopy cover and percent change in basal area are shown in Table 9, and are from the initial post-fire assessment. The initial data are shown as opposed to the extended best assessment, as subsequent salvage logging may be captured by the satellite imagery at the later date. The data shown do not necessarily reflect the fire itself, but instead only the fire effects within the mapped GIS boundary for each Emergency Notice.

The 2016 Cascade-1 Emergency and 2016 Coast Emergency were mapped as predominantly having had full canopy loss and basal area loss (75-100% loss) across the majority of the notice areas (Table 9). The 2016 Cascade-2 Emergency was far more mosaiced; almost half of the mapped boundary had zero percent change in the canopy and basal area using the RAVG data, with the rest of the footprint spread out across the other categories.

Table 9. RAVG data for the three 1052.1 Emergency Notices assessed. For each notice, the percent footprint of the notice in each RAVG category is shown; the sum of each row equals 100%. The RAVG data are the initial assessment data provided by the US Forest Service

RAVG – Percent Change in Canopy Cover Following Wildfire					
	0%	*0% to 25%*	*25% to 50%*	*50% to 75%*	*75% to 100%*
2016 Cascade -1 (%)	3	5	2	3	88
2016 Coast (%)	0	2	4	11	83
2016 Cascade -2 (%)	46	23	7	6	17

RAVG – Percent Change in Basal Area Following Wildfire							
	0%	*0% to 10%*	*10 to 25%*	*25 to 50%*	*50 to 75%*	*75 to 90%*	*>90%*
2016 Cascade -1 (%)	3	3	2	2	3	3	85
2016 Coast (%)	0	1	1	4	11	8	75
2016 Cascade -2 (%)	47	15	7	7	6	4	13

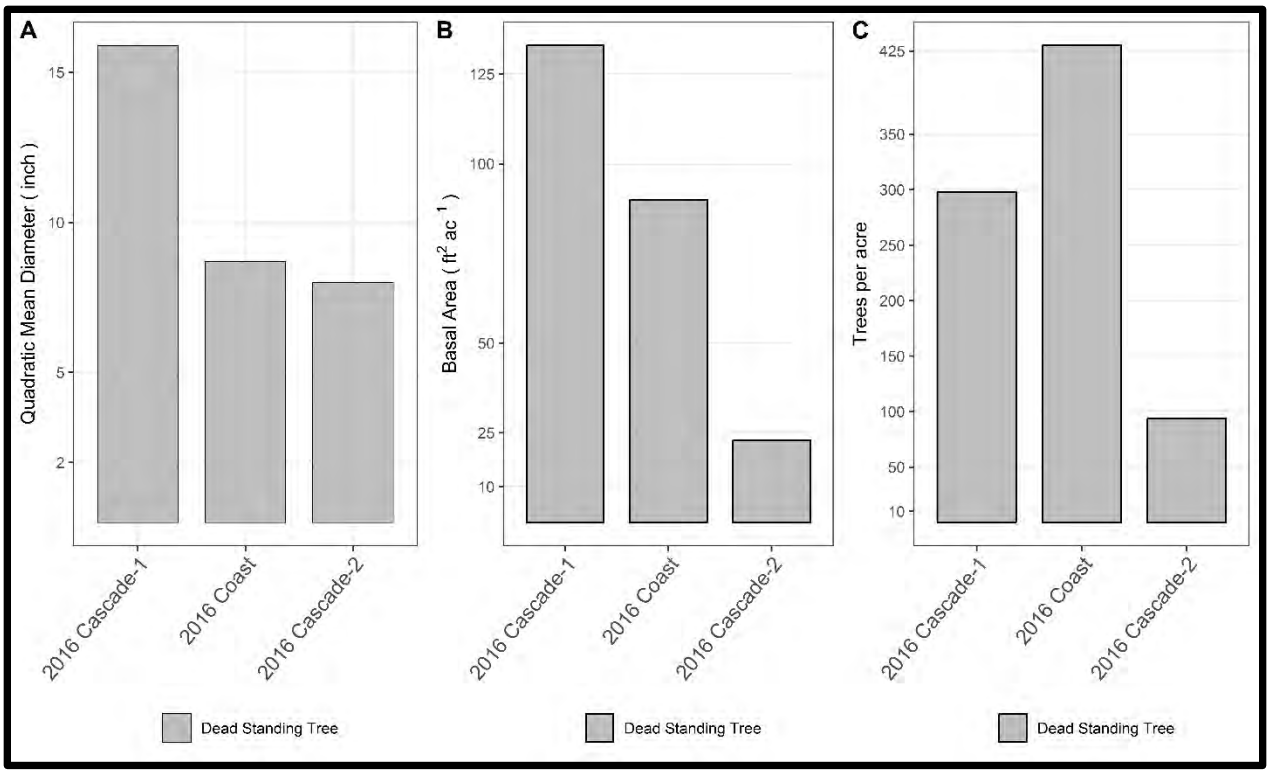

Figure 46. The quadratic mean diameter, basal area, and trees per acre for the standing dead trees measured on the 1052.1 Emergency Notices. Panel A is the QMD in inches, panel B is the basal area in ft^2 $acre^{-1}$, and panel C is the trees per acre, analogous to the density of snags remaining. All three panels are ordered from left to right by decreasing QMD

Throughout the three Emergency Notices, individual tree DBHs ranged from as low as 3 inches up to 30 inches, with the QMD for the three notices measuring 8.0, 8.7, and 15.9 inches (Figure 46 A). The basal area ranged from a low of 23 ft^2 ac^{-1} to a high of 133 ft^2 ac^{-1}, and almost entirely was composed of dead standing snags (both conifer and hardwood species), with a dead fir recorded in the red phase within one plot on the 2016 Cascade-2 Emergency (Figure 46 B). The notices subsequently spanned 88, 298, and 430 dead trees per acre (Figure 46 C). Noticeably, the 2016 Coast Emergency had the highest density of dead trees, but they were also smaller diameter, indicating a high density of sub-merchantable timber left behind following harvest.

While the 2016 Coast and 2016 Cascade-1 Emergencies were largely comprised of entirely high canopy and basal area loss categories, the 2016 Cascade-2 Emergency had nearly 50% of the footprint for both canopy cover and basal area loss in the zero percent category. However, field measurements indicated this Emergency had the lowest basal area, QMD, and tree density, in addition to no green trees measured.

4.2.3.5 Habitat elements

Four den trees and no nest trees were inventoried as part of the 132 variable radius plots (3 x 44 notices) established for the pilot project. Within fixed radius plots,

hardwood cover and live ground cover percentages were recorded in the following categories: 0%, < 10%, 10-40%, 40-75%, > 75%. Median live ground cover and hardwood cover by Notice type are shown in Figure 47.

Large wood pieces greater than 12 inches in diameter and 10 feet in length that intersected the fixed radius plots were also recorded. Twenty-two of the notices had no large wood tallied, 12 had one piece, and the remaining 10 notices had two or more pieces recorded. Many of these occurrences were where an LTO felled, bucked, and piled trees, and left them onsite (Figure 48).

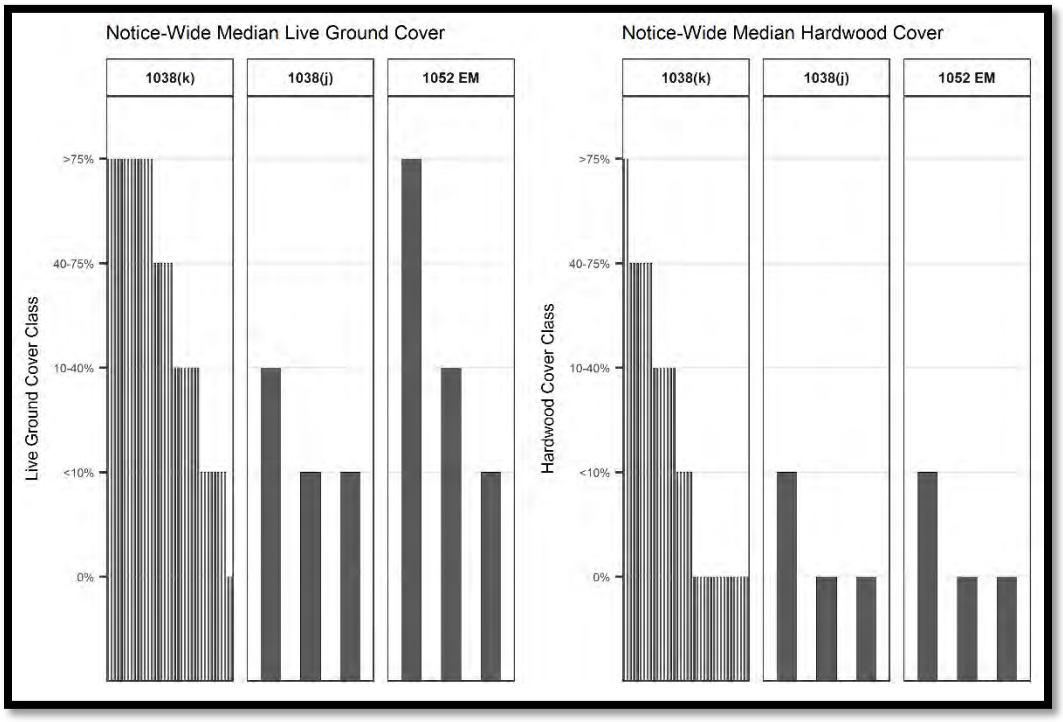

Figure 47. Median ground cover and hardwood cover by binned percentage for the sampled notices.

Figure 48 Piled logs left on a 1038(k) Drought Mortality Notice in Mariposa County.

4.2.4 Wildlife

4.2.4.1 Northern and California Spotted Owl

For the 50 randomly selected notices, seven were within the NSO range, two were within a ½-mile of an activity center (AC), and one was within ¼-mile of an AC (Table 10). For California Spotted Owl (CS), 40 projects were within the range, one was within ½-mile, and none were within ¼-mile of an AC. There were no fire salvage Emergency Notices in the 50 random samples that were within the range of the ½ mile area of an NSO AC.

Table 10. Number of Exemption and Emergency Notices within NSO and CSO range and activity centers.

Species	Within the Range	Within ¼ - mile of an AC	Within ½ - mile of an AC	3 acres or less within ¼ / ½ - mile of an AC
NSO	7	2	2	0/0
CSO	40	0	1	0/0

4.2.4.2 California Natural Diversity Database detections

Table 11 quantifies the number of detections and the number of distinct species (elements) found within the Emergency and Exemption Notice footprints. As previously stated with regard to spotted owl activity centers, species detections within Emergency and Exemption Notice footprints do not automatically infer take of any species. Timing of operations and/or species presence on site determine whether operations have the potential for take.

Table 11. CNDDB detections and elements by family.

	Number of Detections	Number of Elements
Insects	0	0
Reptiles	0	0
Amphibians	1	1
Crustaceans	0	0
Fish	2	2
Birds	2	2
Mammals	4	3
Botanical Species (CRPR 1A-B, 2A-B)	18	17

4.2.5 Emergency Exemption Watercourse Presence, Protection, and Crossing Results

4.2.5.1 Presence of watercourses

Across the 44 notices sampled in this pilot, inclusive of all notice types, 26 notices had watercourses present, while 18 notices had no watercourses either mapped or observed in the field. Of the 1038(k) Drought Mortality Exemptions, 21 had a watercourse present (55%), and 17 had no watercourse present (45%). Two of the three 1038(j) Forest Fire Prevention Pilot Exemptions had watercourses present, while all three of the 1052.1 Emergency Notices had watercourses within the notice boundaries.

The pilot monitoring results identified and assessed predominantly Class III watercourses (12), as these were the most prevalent watercourse classes encountered. Class IV watercourses accounted for four assessments, and Class II watercourses accounted for eight watercourse assessments. One Class I watercourse was assessed on a 1038(k) Drought Mortality Exemption (Figure 49). Within the 1038(k) Exemptions, 29% of the watercourses identified were Class II's, 48% Class III's, and 19% were Class IV watercourses (Figure 49). Of the two 1038(j) Forest Fire Prevention Pilot Exemptions with watercourses, one Class III watercourse was assessed, while the second watercourse was an unclassified watercourse (Figure 49); field observations found it was a disconnected ephemeral watercourse that flowed through a grazing field with a culvert crossing and no associated timber harvesting activity in the immediate vicinity. The 1052.1 Emergency Notices were split, with two of the watercourses recorded as Class II's, and the remaining watercourse a Class III (Figure 49).

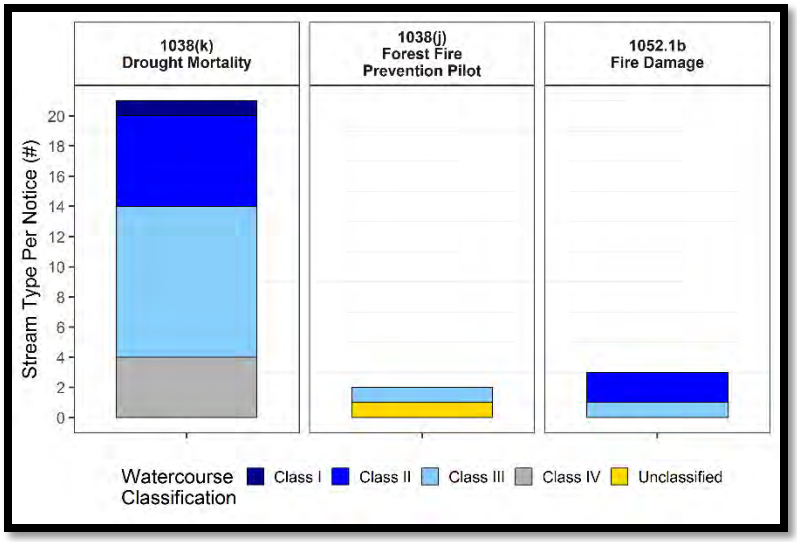

Figure 49. Watercourse classification by notice type for assessed watercourses in the notices. The y-axis represents the number of types present in each notice type, and the colors indicate the watercourse classification

4.2.5.2 Watercourse and Lake Protection Zone (WLPZ) harvesting

The percent canopy harvested in the WLPZ/ELZ indicated that none of the Exemptions exceeded 66% harvest (Figure 50). The single Class I had full WLPZ protection observed, while two of the Class II's had no canopy harvest, and the remaining eight had 0-33% canopy harvest in the WLPZ (Figure 50). Both the Class III and Class IV watercourses were identified as having occurrences of 33-66% canopy harvest, the highest canopy removal category recorded in this pilot (Figure 50). For the Class III watercourses, just over half of the observed harvesting in the ELZ fell into the 0-33% canopy harvest category, with the remaining occurrences as either 0% or 33-66% canopy harvest. Class IV watercourses were split between the 0% or unharvested category, and the 33-66% canopy harvest category. The unclassified watercourse had no canopy cover due to being in a grazing pasture, and therefore had no canopy removal due to harvesting.

The notices with >25 MBF (thousand board feet) reported volume removal had a maximum harvest canopy of 0-33% observed. The 33-66% canopy harvest categories were recorded on two notices with 25-50% of the notice harvested, and one occurrence on a notice with 50-75% of its footprint harvested. The highest prevalence of canopy harvested/percent notice harvested/reported MBF were seven occurrences of the 0-33% canopy harvest category where 25-50% of the notice area was harvested and >25 MBF of timber volume removal was reported (Table 12). Qualitatively, it appears that the limited canopy harvest may reflect an overall limited volume removal and/or area harvested on the Exemption and Emergency Notices, in addition to operational requirements under the Forest Practice Rules, such that harvesting was largely excluded or limited from the WLPZ/ELZ.

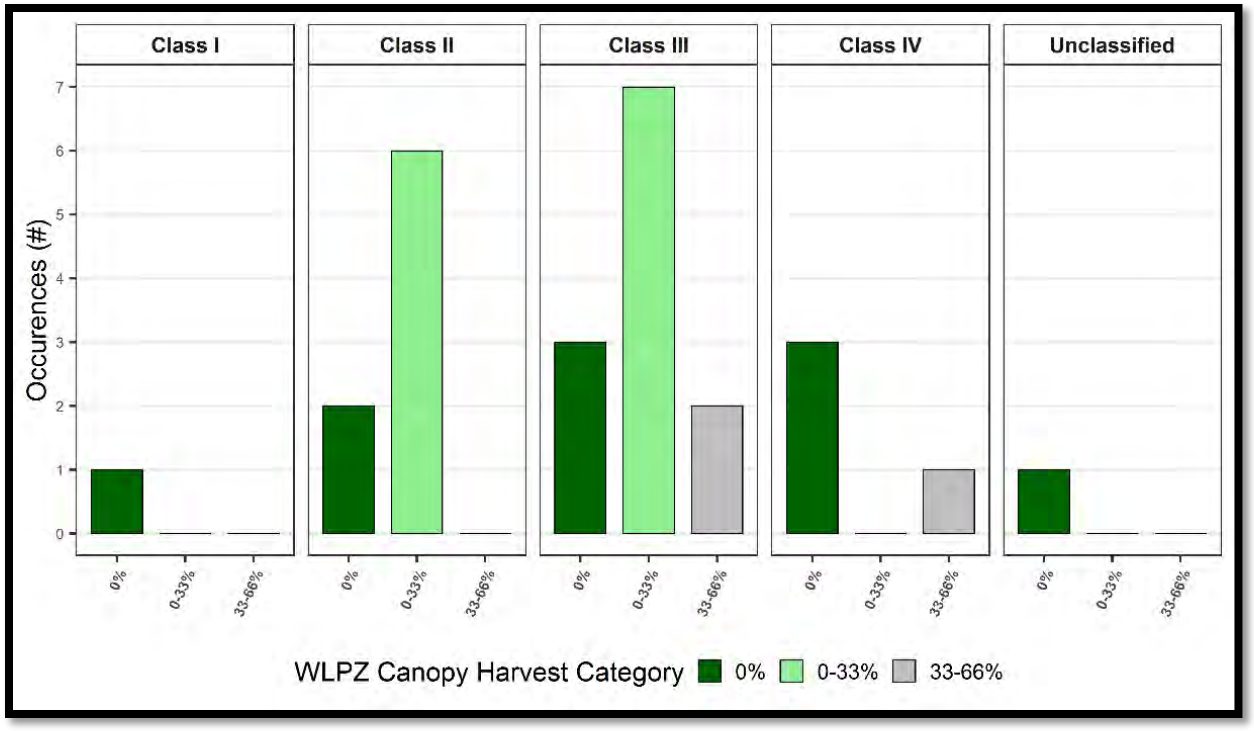

Figure 50. WLPZ/ELZ canopy harvest category occurrences by watercourse class. The sum of occurrences for each classification equals the number of assessed watercourses for each classification.

Table 12. WLPZ/ELZ canopy harvest category, ordered by category, associated notice percent harvested, reported volumes, and the number of occurrences for each combination of canopy harvest, harvesting extent, and volume

WLPZ/ELZ Canopy Harvest Category	Notice Percent Harvested	Reported Vol. (MBF)	Occurrences
0%	0-25	8 to 15	1
0%	0-25	16 to 25	1
0%	0-25	>25	3
0%	25-50	8 to 15	1
0%	25-50	16 to 25	1
0%	25-50	>25	1
0%	50-75	>25	2
0-33%	0-25	<8	1
0-33%	0-25	8 to 15	1
0-33%	25-50	8 to 15	1
0-33%	25-50	>25	7
0-33%	25-50	No Data	1
0-33%	50-75	>25	1
0-33%	75-100	No Data	1
33-66%	25-50	8 to 15	1
33-66%	25-50	16 to 25	1
33-66%	50-75	<8	1

4.2.5.3 WLPZ/ELZ equipment encroachments

The WLPZs and ELZs for surveyed watercourse segments were largely unentered by heavy equipment in our pilot project, with only four notices having any recorded entries

into these zones, all four of which were 1038(k) Drought Mortality Notices (Table 13). These notices had reported acreages of 20, 61, 200, and 432 acres. The equipment encroachments into the WLPZ or ELZ occurred on one Class II and three Class III watercourses. On the Class II occurrence, three separate encroachments were found, while the Class III watercourses had one, five, and six encroachments (Table 13).

Table 13. Equipment encroachments found on surveyed watercourse segments

Notice	Surveyed Watercourse Segment	Equipment Encroachments
2016 1038(k) Tuolumne – 20 ac	Class III	6
2017 1038(k) Fresno – 61 ac	Class II	3
2017 1038(k) San Luis Obispo – 200 ac	Class III	5
2017 1038(k) Siskiyou – 432 ac	Class III	1

4.2.5.4 Watercourse crossing assessments

Of the 44 notices sampled with watercourses present, 16 had watercourse crossings which were directly assessed per the protocol for performance (Figure 51). Some notices had observations of multiple crossings, some of which were subsequently identified as sediment discharge points. The additional crossings were not assessed for performance, but they were subsequently assessed for sediment discharges, and those data are presented in the “Sediment Discharges to Watercourses under Emergency and Exemption Notices” section (4.2.6). We did not identify the total number of watercourse crossings in every notice for this pilot project.

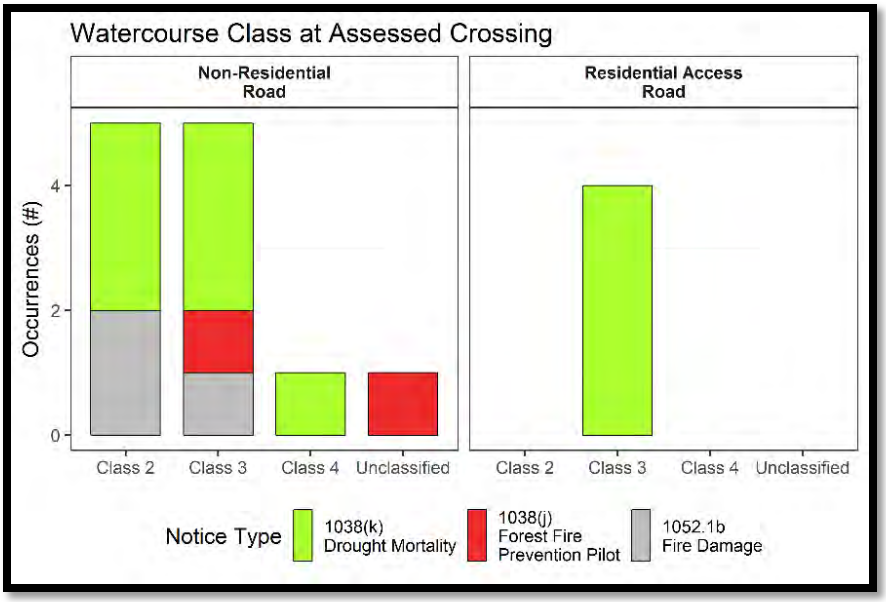

Figure 51. Watercourse crossings assessed for performance, by notice type and non-residential vs. residential access roads.

For the 1038(k) Drought Mortality Notices, three crossings were on Class II watercourses, seven were on Class III's, and one crossing was on a Class IV. Four Class III crossings on the 1038(k) Notices were also recorded as residential access roads (i.e., a driveway) (Figure 51). Two of the three 1038(j)'s had watercourse crossings, with one Class II and one "unclassified" crossing assessed. All three 1052.1 Emergency Notices had crossings, with two assessed on Class II's and one assessed on a Class III. In five instances, watercourses were present but without any crossings by non-public roads.

Nearly all of the watercourse crossings were identified as pre-existing before the notice was filed; in one case, the field team was unable to estimate the age of the crossing. In a second case, a crossing in a Cascade area post-fire Emergency Notice had been removed following operations. While technically no longer a crossing, it was identified as a "new" abandoned crossing and recorded. Within the same Emergency Notice, a second "new" abandoned crossing was encountered in the road segment assessment. This notice was the only case where the field team observed removed and abandoned crossings.

The assessed crossings in this pilot project were largely culvert crossings (a total of 11), with the remaining crossings recorded as fords or "other", including the abandoned crossing mentioned above. Professional judgement in the field indicated that five of the 11 culverts assessed were inadequately sized. At two Class II watercourse crossings with inadequately sized culverts, it was determined there was a potential for crossing failures to result in a stream diversion.

4.2.6 Sediment Discharges to Watercourses under Emergency and Exemption Notices

4.2.6.1 Harvest-related sediment discharges to watercourses

One notice of the 44 assessed had recorded sediment discharges from timber harvesting operations. The notice was a 1038(k) Drought Mortality Exemption in the Sierra/South area, with four separate discharges. Three were noted as being related to mastication work that was done on the notice, and the fourth was due to skidding activity. Three of the discharges were estimated at < 1 yd^3, and the fourth was estimated as a "trace" discharge. In each case the discharge was related to a crossing of the Class III watercourse (see Figure 52 as an example).

A second notice had a recorded sediment discharge to a watercourse, and provides an example of the difficulty of applying the operational Forest Practice Rules in non-traditional timber harvesting environment. The notice was a 1038(k) Drought Mortality Exemption in the Sierra/South area, in this case Fresno County, a region of California with extensive drought mortality, including in built environments. Within the notice boundary, the field team identified an ongoing sediment discharge, estimated to have delivered 1-5 yd^3, that was sourced from the drainage flowing off a structure. While this was not due to timber harvesting activities, it was recorded as a sediment discharge to a watercourse, as it occurred within the notice boundary. This serves to highlight the difficulty in separating sediment discharges to watercourses in non-traditional timber harvests from pre-existing conditions, and those related to the harvesting of timber as part of the notice.

Figure 52. Sediment discharge to a Class III watercourse due to masticator operations related to timber harvesting

4.2.6.2 Road-to-watercourse sediment discharges on surveyed road segments

In terms of road hydrologic disconnection, the field observations for road drainage points and watercourse crossing sediment discharges indicated varying results. Twenty-three (23) sediment discharges were recorded from road segments to watercourses,

with 20 of these related to harvest activity or hauling. These discharges occurred on 12 separate Exemptions and Emergencies, with some notices having multiple points of sediment discharge (Table 14). Four occurrences were recorded of watercourse crossings being present, and no sediment discharge being observed from the crossing (Table 14). There were four occurrences of both roads and watercourses being present in a notice, but no crossings, with no recorded discharges from road drainage points. In another five occurrences, there were watercourses present on a notice but no roads (Table 14).

Twelve of the harvest or hauling-related sediment discharges occurred at watercourse crossings, including the highest discharge volume estimate of over 10 yd^3. This largest discharge was located in the Sierra/South area at the site of an overtopped culvert with a lack of downslope surface cover delivering sediment to a Class II watercourse (Figure 53). Two crossings were estimated to have discharged 5-10 yd^3, one to a Class III and one to a Class II watercourse, both in the Sierra/South area. Three crossings resulted in 1 to 5 yd^3 of sediment discharge, two on a Class II in a post-fire Emergency Notice, and one to a Class III. This latter discharge was on a residential access road due to a short culvert and an over-steepened fill face that was failing. The remaining discharges were either less than 1 yd^3 or only a trace amount on Class III and Class II watercourses. Three crossings were identified in the field that had no observed sediment discharges, one of which was a residential driveway.

One trace discharge also had an application of straw to the crossing location, in addition to rock armoring downslope, in a post-fire environment (Figure 54), and is an example we encountered of preventative actions taken by an RPF/LTO in a more erosion prone environment. The two ‘new’ abandoned Class II crossings encountered had sediment discharge estimates of less than 1 yd^3 for each, mainly due to the nature of the post-reconstruction adjustments of the watercourse (Figure 54). One crossing, in the Coast area as part of a post-fire Emergency, was on a Class II watercourse and identified as having 1 to 5 yd^3 of discharge due to a diversion and failed culvert; the field team could not determine if the crossing failed following harvest, or if it was pre-existing (Figure 55).

Figure 53. Overtopped culvert delivering >10 cubic yards of sediment to a Class II watercourse in the Sierra area

Most of the larger sediment discharges occurred on relatively few notices. Six separate notices (i.e., 14 percent) had discharges over 1 yd^3, with four of the notice-related discharges attributed to timber operations (i.e., 9 percent). The majority of the larger discharges were associated with 1038(k) Drought Mortality Notices, but this was primarily due to the much larger sample size relative to the other notice types. Four out of the six notices with discharges greater than 1 yd^3 occurred in the Sierra/South area.

Figure 54. Armored crossing drainage on a Class III in the Cascade area, left, in a post fire Emergency Notice, that was recorded as having a trace amount of sediment discharge. An abandoned crossing on a Class II post-fire Emergency in the Cascade Region, right, that resulted in less than one yd^3 of sediment discharge based on field observations

Outside of watercourse crossings, eight harvest or hauling-related sediment discharges were identified on surveyed road segments. Two were unrelated to any harvesting or hauling activity, but were within the mapped notice boundary. One was related to drainage off of the built environment, while another was related to road drainage that had been ongoing for at least a decade. Drainage points that discharged sediment to watercourses occurred at waterbars, rolling dips, and unintended road drainage locations, sometimes on residential access roads (i.e. a driveway), where traditional forest road design and best management practices may not have been implemented.

Figure 55. A failed crossing in a post-fire Emergency Notice in the Coast area, where 1-5 yd^3 of sediment were estimated to have been discharged.

Table 14. Sediment discharge estimates from roads to watercourses by general source category. A red number in parentheses indicates an occurrence that was not directly related to the timber harvesting itself. The green shading indicates discharge estimates that likely have minimal-to-no impact, while gray shading indicates discharge estimates that may detrimentally impact water quality and aquatic resources

Source Category	"Trace"	< 1 CY	1-5 CY	5-10 CY	> 10 CY	None
Crossing	1	3 (1)	3	2	1	3 (1)
Abandoned Crossing		2				
Built Environment			(1)			
Road Drainage	2	4	1	(1)		
Road Maint/Const		1				
4 occurrences where roads and watercourses were present together in a notice, with no crossings, and no discharges were observed in the field						
5 occurrences of watercourses present, no roads or non-public roads present in notice						

The sediment discharges from surveyed road segments that were related to harvest activity occurred on Class II watercourses (n = 12) and Class III watercourses (n = 8) (Figure 56). Of the seven road-to-watercourse sediment discharges that were also associated with the Exemption or Emergency timber harvesting itself (i.e., four separate notices) and exceeded 1 yd^3, all seven occurred on roads with slopes in the 5-10% category. Three of these were on hillslopes with gradients in excess of 30%. Of the notice-related discharges that were less than 1 yd^3, ten were on roads with slopes of 5% or less, while three were on a road with a slope of 5-10%. This suggests that in addition to road maintenance and design, the increased road slope and hillslope

gradient may have played a role in the generation of greater sediment discharges to watercourses. These causal factors have been reported for forest roads in the Sierra Nevada previously (Coe, 2006).

In addition to road slope potentially playing a role in sediment delivery, monitoring data indicated the importance of having adequate surface cover and roughness below a sediment source (Figure 57). While the gradient of the hillslope and road, quality of road construction and maintenance, and distance from a watercourse are important factors determining sediment delivery and magnitude, the surface cover and roughness was the most consistent variable in increasing sediment delivery magnitude. This is not unique to timber harvesting under Exemption and Emergency Notices, but applies in all timber harvest environments. Where field teams observed the greatest sediment discharges were also typically areas with substantial bare soil downslope, or inadequate amounts of surface cover downslope of road drainage points. Qualitatively, our limited sample indicated that post-fire settings may require extra effort in order to ensure sediment delivery is minimized from the road network. While some of these sites had high levels of effort to minimize discharges, others were observed with less effort and correspondingly greater sediment discharges (two 1-5 yd^3 discharges in one 1052 Emergency, Figure 57).

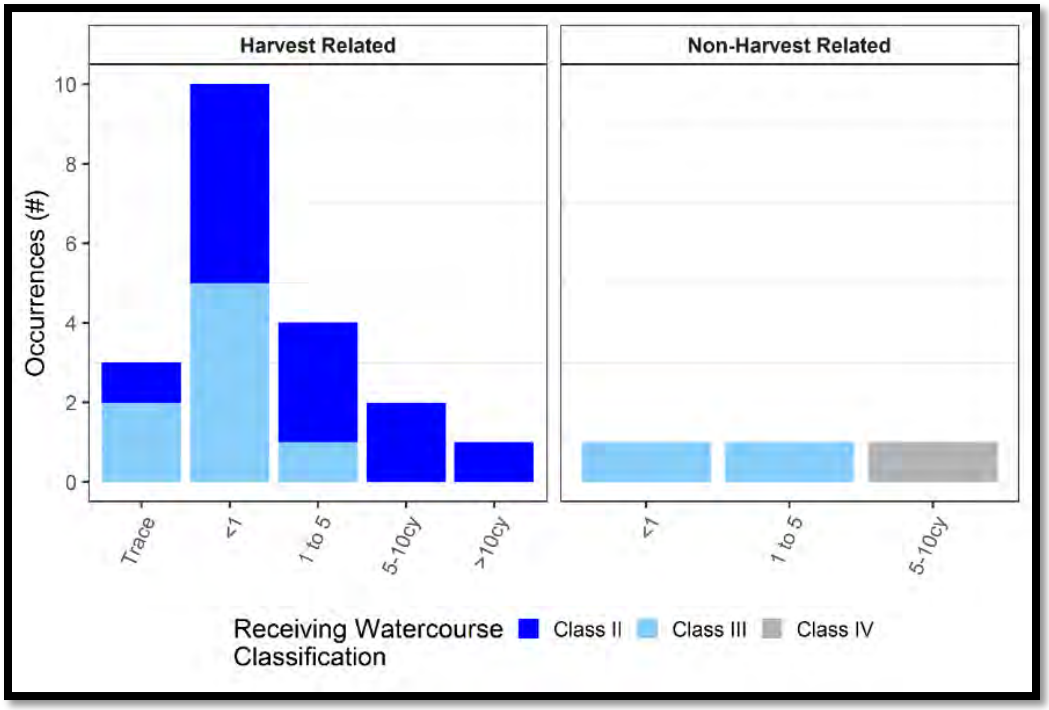

Figure 56. Road to watercourse sediment discharge estimates, by harvest and non-harvest related categories. The bar colors indicate the receiving watercourse classification

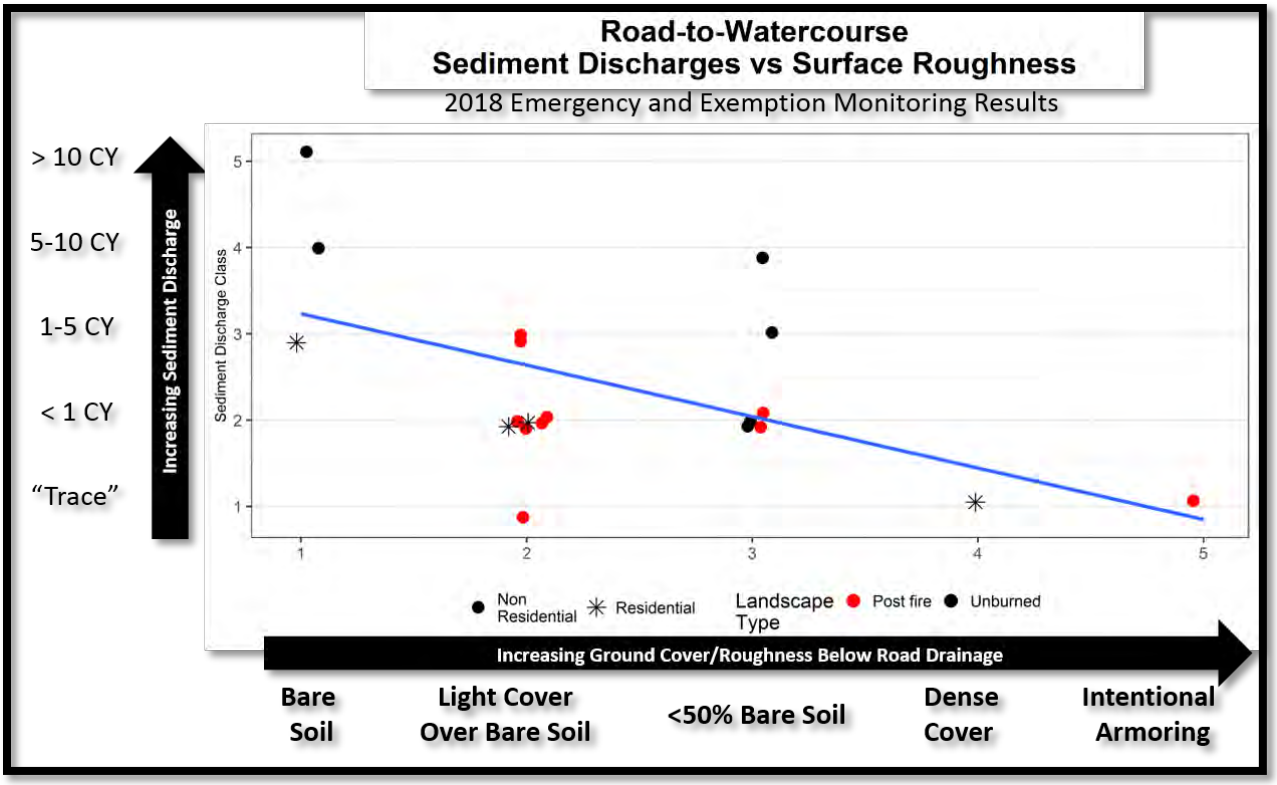

Figure 57. Harvest-related sediment discharges from surveyed EX-EM Notice road segments. Point shapes indicate if the segment was a non-residential access road, and colors indicate if the measurement was taken in a landscape that recently experienced wildfire. Generally, increasing surface roughness below sediment sources decrease the amount of sediment discharged to a watercourse, notwithstanding other critical aspects such as flow path length, road maintenance and construction, road slope, or hillslope steepness.

A traditional part of past implementation and effectiveness monitoring work has focused on assessing adequate road drainage spacing (Cafferata and Munn 2002, Brandow et al. 2006, Brandow and Cafferata 2014). While we did not explicitly focus on road drainage spacing in this pilot, our data allowed for an estimated calculation of this metric, using the number of observed drainage features and the total road length sampled. For non-residential roads, the mean calculated drainage spacing was 120 feet on 1038(k) Drought Mortality Notices, 137 feet on 1038(j) Forest Fire Prevention Pilot Notices, and 234 feet on 1052.1 Emergency Notices. One 1038(j) Notice is excluded from these means; while the full 1,320 sampled feet of road had no drainage structures, the road was flat and crossed a flat grass pasture. For the residential access roads, which were found only on 1038(k)'s, the mean drainage spacing was 134 feet. In 17 instances, there were no drainage structures found on the sampled road segments. Of the 44 field-sampled notices, 17 road segments also served essentially as driveways to residential structures.

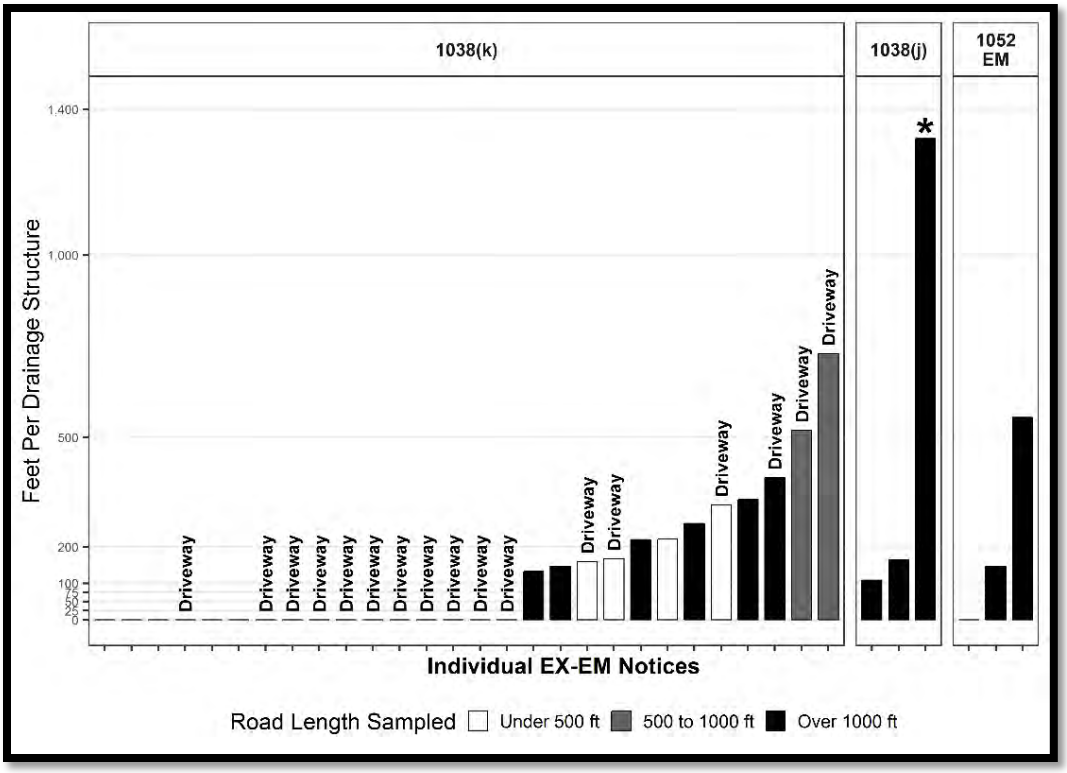

Figure 58. Feet per drainage structure on the sampled Exemption and Emergency Notices, with bar colors corresponding to road length sampled (binned values), and road segments that served as residential access roads identified as "Driveways". The "" indicates the excluded 1038(j) Forest Fire Prevention Pilot Notice.*

4.2.7 Emergency and Exemption Notice Mapping Quality

For the maps provided with the Emergency or Exemption Notice indicating where watercourses were present on the landscape, there were 12 occurrences where watercourses were also not mapped (Table 15). In some cases, basic maps may have omitted all watercourses, while in other situations watercourses may not have been comprehensively mapped. There is also a possibility, due to the rapid nature of the assessment, there may have been additional watercourses present that were not mapped and not observed by the field team.

Table 15. Assessment of Exemption and Emergency Notice watercourse mapping, and field verified outcomes of watercourse mapping

Notice Map Assessment	# Of Occurrences
Watercourses Present and **Not** Mapped	12 (46%)
Watercourses Present and Mapped	14 (54%)

All 12 instance in which watercourses were not mapped occurred on 1038(k) Drought Mortality Notices. Eleven of the 12 had a reported size of 20 acres or less, with the remaining notice having 205 reported acres. For the 14 occurrences where the team did

not identify any unmapped watercourses, three of the notices were 20 acres or less in reported size, while the other nine ranged from 61 to 432 acres.

Figure 59 is an example of the bare minimum mapping standard presented, and a case where watercourses were assessed in the field, but the map indicated an absence of watercourses. Figure 60 displays an improved mapping standard, albeit an example where watercourses were encountered by the field team that were not mapped. Figure 61, a 1038(k) Drought Mortality Exemption with 61 reported acres, had all watercourses encountered by the team included on the notice map; it also is an example of a higher mapping standard encountered on 1038(k) Notices.

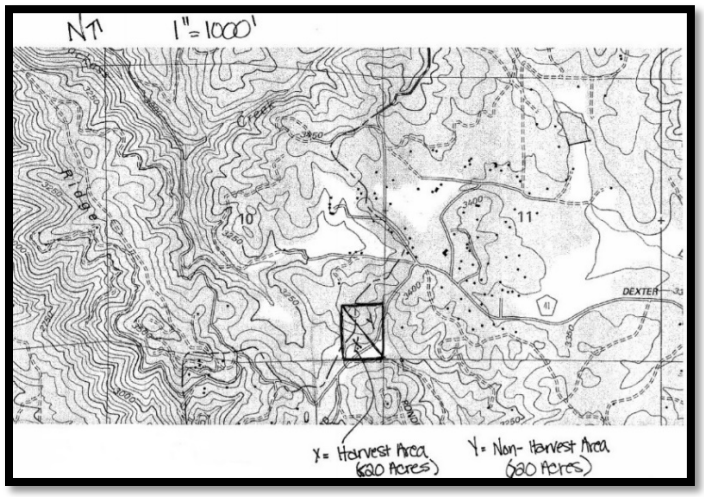

Figure 59. 1038(k) Drought Mortality Notice that had a field-assessed Class III watercourse, and the accompanying map from the notice; no watercourses are indicated on the map. The notice had a reported acreage of less than 20 acres

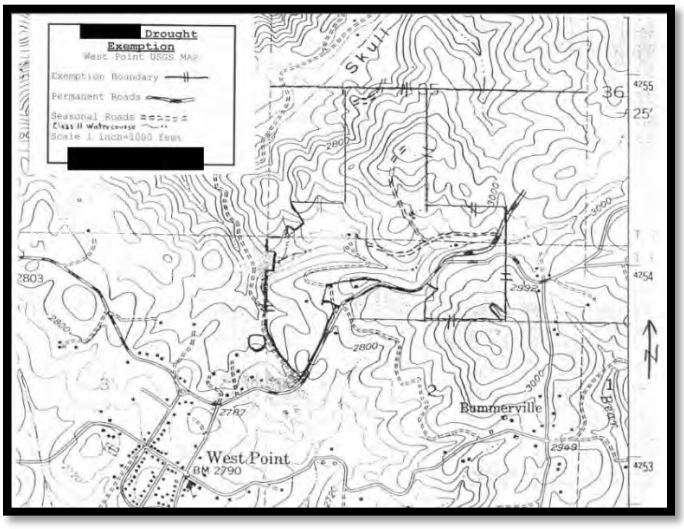

Figure 60. 1038(k) Drought Mortality Notice that had a field-assessed Class II watercourse, and it was noted that there were additional watercourses not mapped. The notice had 205 acres reported as the project size.

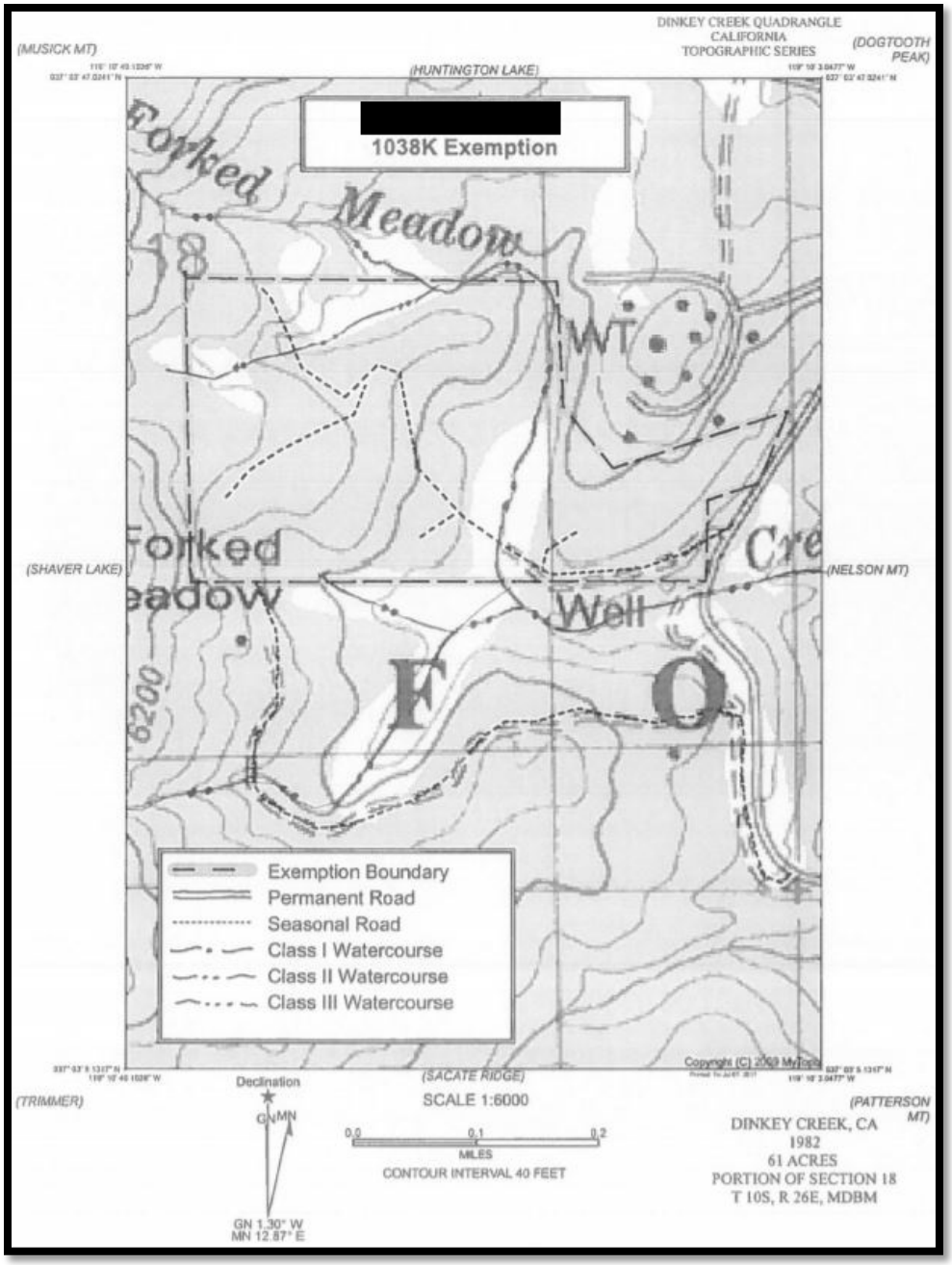

Figure 61. A 1038(k) Drought Mortality Notice map providing an example where all watercourses that the field team encountered were also mapped. This notice was 61 acres in reported size.

5 Broader GIS and Remote Sensing Analysis

5.1 1038(k) Notices in the Central Sierra Nevada

5.1.1 Background

Within the pilot project, there were no *significantly* large, on the order of 1,000 acres or larger, 1038(k) Drought Mortality Exemptions randomly selected. Acknowledging this, and given a landscape that has experienced extensive Exemptions repeatedly in

successive years due to prolonged tree mortality in the central and southern Sierra Nevada, we tested an approach to see if remote sensing could answer basic questions about Exemption usage within this region. This effort encompassed an area approximately spanning from El Dorado County south to Tuolumne County.

5.1.2 Methods

Two Landsat 8 images were downloaded from EarthExplorer (https://earthexplorer.usgs.gov/), a web-based platform that delivers free georectified imagery from a variety of aerial and space-based platforms, including the Landsat 8 satellite. For this initial assessment, the standard satellite imagery was downloaded, not the surface reflectance corrected data made available; the standard product was chosen due to the inclusion of the 15-meter panchromatic band that was used to enhance the spatial resolution of the imagery.

Two datasets were acquired, both from Landsat 8 path 43, row 33. One dataset was collected on August 21, 2015, and a second on September 30, 2018. Each dataset consists of files of different “bands”, which encompass spectral data for specific wavelengths. From each dataset, bands 6, 5, and 2, the shortwave infrared, near infrared, and blue bands, respectively, were combined for each date to produce an image that emphasized exposed bare soil and live ground cover. Each image was pansharpened from 30-meters by 30-meters, to 15-meters by 15-meters, using the panchromatic band 8. Pansharpening was done in order to better capture the edges of potential harvesting.

The 2015 image was subtracted from the 2018 image, or differenced, in ArcGIS, and the differencing results were classified using the ArcGIS ISO Unsupervised Classification tool; this classification process was constrained to occur only within mapped 1038(k) Drought Mortality boundaries, which helped to significantly reduce the total number of potential classes. This processing technique relies on established algorithms to identify similar pixels and group them into classes. Following the classification, we manually assessed the results in order to determine which classes corresponded to harvested areas.

One class was observed to correspond strongly to portions of forest that had extensive or complete canopy removal, which was referred to as “Intensively Harvested.” The other pertinent class we identified appeared to correspond to a mixture of areas with active tree mortality (captured on the second September 30, 2018 image) and areas where it appeared small group selection or multiple single tree removals in a single pixel occurred.

From these results, we used mapped timber harvest boundaries that were either active or completed between the two image dates to eliminate all areas that could have

potentially been harvested under an approved THP. As this process was not attempting to determine the actual date of harvesting, and there was no way to discriminate between harvesting under a THP and harvesting under an Exemption during the analysis period, we chose to exclude all THP boundaries. The next step was to use the CalVeg GIS layer to further eliminate any pixels that overlapped with non-forest WHR types. This was done due to observed errors where the classification process identified grass or shrubs that, due to several factors, had significantly changed greenness or abundance from 2015 to 2018. We did not perform a rigorous classification accuracy assessment for this approach or field verification. However, a manual assessment in Google Earth, using the available imagery that included different dates between 2015 and 2018, revealed a high level of accuracy, particularly for the larger areas of intensive harvesting and soil exposure.

5.1.3 Results

Within the area of interest, 314 1038(k) Drought Mortality Exemptions were mapped through December 2017 (Figure 62). The notices ranged from one acre to a maximum of 9,524 acres in reported size, with 30 notices exceeding 1,000 acres and seven exceeding 5,000 acres reported. Collectively, the Exemptions covered 119,600 acres, which includes areas placed under Exemption in repeat years. The physical footprint of the Exemption Notices, after dissolving all the mapped Exemption boundaries into a single boundary and removing the THP boundaries, covered 93,083 acres (Figure 62).

The remote sensing analysis indicated that 1,060 acres were intensively harvested during the time frame between the two images, while 3,482 acres had either low intensity harvesting or advanced tree mortality as of September 2018 (Figure 62). Approximately 1.1% of the footprint of Exemption Notices had intensive harvesting, and 3.7% had low intensity harvesting or advanced mortality, for a combined timber harvesting and mortality estimate of 4.8% within the Exemption boundaries.

At the planning watershed scale, four watersheds had 1-2% intensive harvesting occur within their boundaries, while another four were 0.5 to 1% intensively harvested. Within the area of interest, the remaining 69 planning watersheds had less than 0.5% of their area intensively harvested (Figure 63).

In the context of approved Timber Harvesting Plans that were active or completed at the same time as this analysis, many of the planning watersheds had no active THPs in their boundaries. Of those that did, the percent area under THPs ranged from 0.2% to 17.3%, inclusive of all silvicultural treatments and excluding areas identified in the GIS data as “No Harvest” areas. For the four planning watersheds with the 1-2% intensive harvesting under Exemptions, the addition of THP boundaries increased the harvested area footprint to a maximum of 9.3%.

This methodology used a pixel by pixel approach to classify harvested areas of the forest, and within ArcGIS we were able to identify areas of contiguous pixels that were identified as intensively harvested. These contiguous areas were treated as “units”, roughly the equivalent of traditional timber harvesting units. Of the units identified, 20 were 10 acres or larger, and of those units nine exceeded 20 acres (Figure 64). The largest contiguous patch of intensively harvested pixels represented about 81 acres, total (Figure 65).

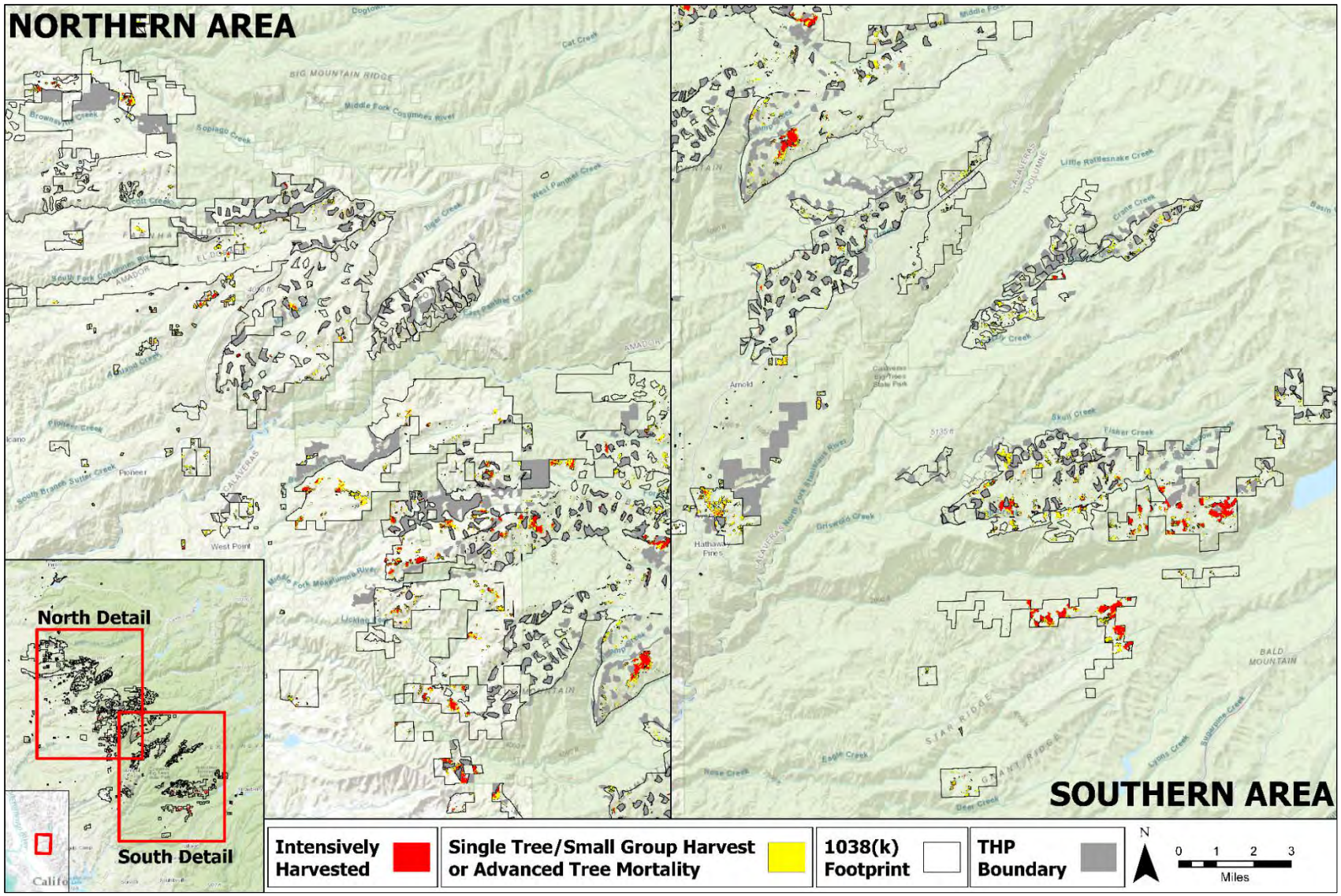

Figure 62. 1038(k) Drought Mortality footprint in the study area, with THP boundaries, intensively harvested areas, and areas where single tree, small group, or advanced tree mortality were identified..

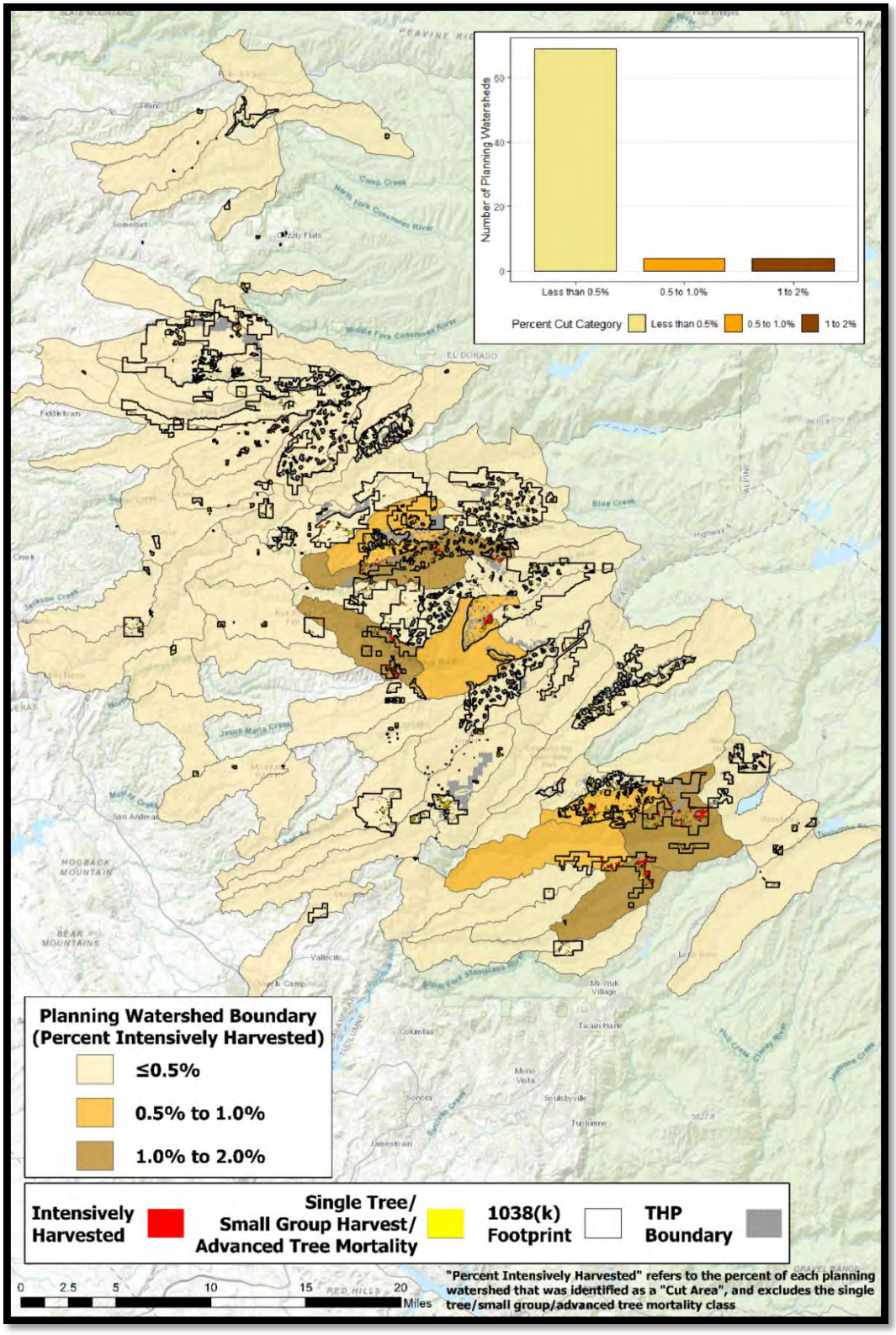

Figure 63. Percent area of each planning watershed with intensive harvesting within the planning watershed boundary.

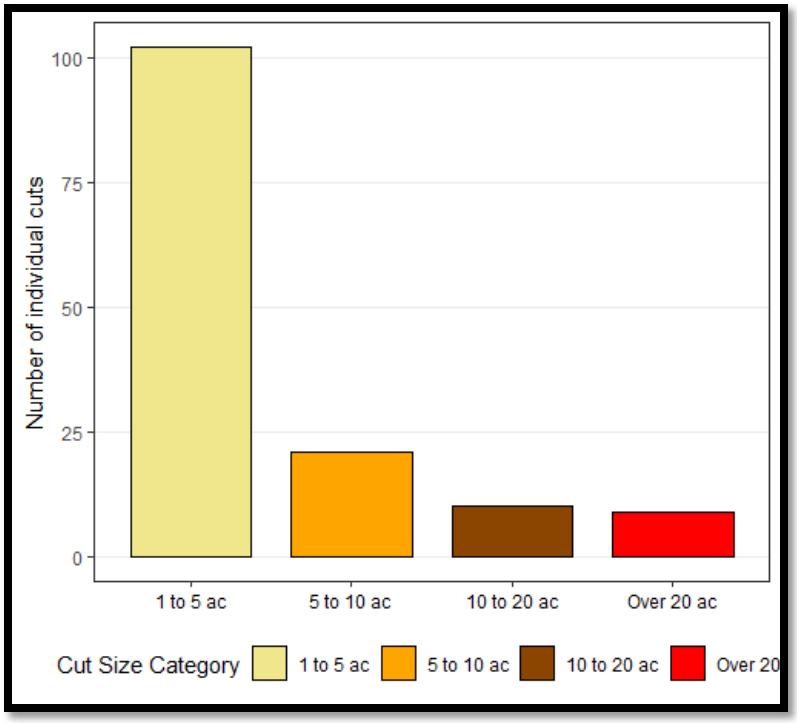

Figure 64. Distribution of contiguous patch size for the intensively harvested areas in the remotely sensed 1038(k) Drought Mortality Notice analysis.

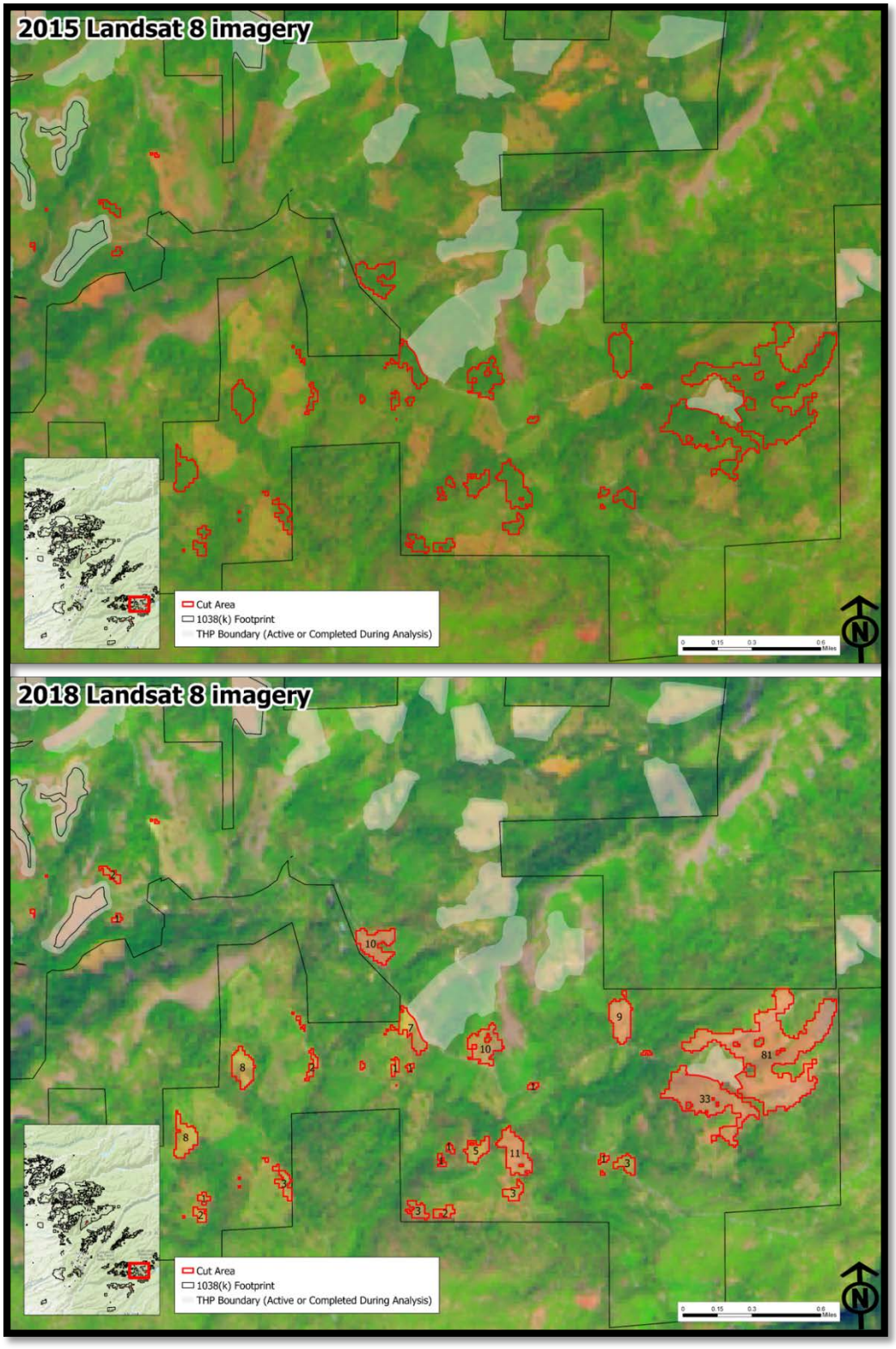

Figure 65. August 2015 imagery, top, before any drought mortality harvesting, and September 2018, bottom, after harvesting of drought mortality. The numbers within the red units in the bottom image represent the size in acres for each "unit".

5.2 FRAP Fire Hazard Severity Zone Analysis within 1038(i) Forest Fire Prevention and 1038(j) Forest Fire Prevention Pilot Exemption Notices

5.2.1 Methods

In ArcGIS, we used the mapped boundaries of 71 1038(i) Forest Fire Prevention and 1038(j) Forest Fire Prevention Pilot Exemption Notices and CAL FIRE's Fire Resource and Assessment Program's (FRAP) Fire Hazard Severity Zone (FHZ) data to assess Exemption usage relative to wildfire hazard. For each Exemption, we determined the percent of the notice that fell into the moderate, high, and very high categories, to assess if the 1038(i) and 1038(j) Exemptions were generally being used in areas where wildfire was of greater concern.

5.2.2 Results

For the majority of these notices that had been filed and mapped at the time of analysis in the Cascade area, the FHZ in the notices was overwhelmingly "Very High" (Figure 66). Similarly, in the Sierra/South areas, the Exemptions fell almost entirely in the "Very High" category, albeit fewer in occurrence than in the Cascade area. In the Coast area, the Exemptions were largely in the "High" category, with a minority of notices having a portion of their area in the "Very High" category, and one notice in an area mapped entirely as "Moderate" FHZ.

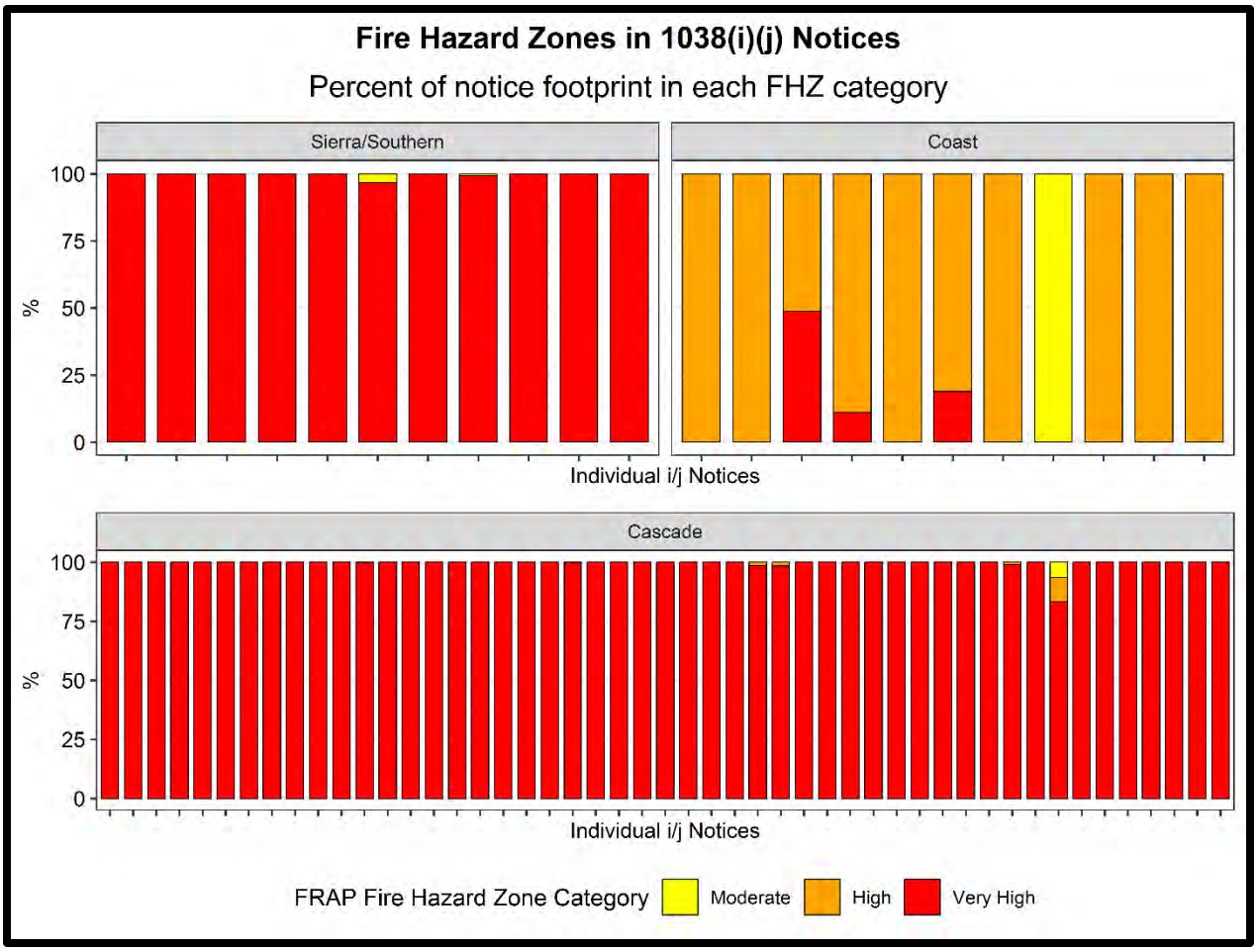

Figure 66. Fire Hazard Zones found in each mapped 1038(i) Forest Fire Prevention and 1038(j) Forest Fire Prevention Pilot Exemption Notice boundaries, displayed by Forest Practice area.

5.3 Remote Sensing Post-Fire 1052.1 Emergency Analysis

In this section, we use the RAVG Canopy Cover Loss data, to view the spatial patterns of both the fire severity and salvage logging following the wildfire. We first use imagery from one of the sampled Emergency Notices as proof of concept that remote sensing imagery can supplement field observations that green trees remained, unharvested, and that residual dead trees were also present. This concept is then applied to a broader population of 1052.1 Emergency Notices.

Figure 67A shows 2016 NAIP (National Agriculture Imagery Program) pre-fire imagery, the 2016 Cascade-2 Emergency Notice boundary, and the random centroid we used to establish the variable radius plots. Figure 67B shows Sentinel-2 satellite imagery captured immediately after the wildfire and before any salvage logging. The imagery shown is a false-color infrared band combination, such that red indicates healthy forest cover, light red and browns indicate damaged or dying vegetation, and the gray indicates areas of total canopy consumption and loss. Figure 67C shows the subsequent RAVG Canopy Cover Loss data, overlaid on post-salvage base map

imagery from ArcGIS. Within the notice boundary, there is a clear pattern of high severity patches, moderate-to low severity patches, and swathes of unburned forest. Figure 67D shows post-salvage imagery, minus the RAVG data.

The location for plot sampling was randomly located within an area of the Emergency that experienced moderate-to-severe canopy loss, illustrated in Figure 67B and C, while the surrounding areas of the Emergency had noticeably lower fire damage. The post-salvage imagery visually indicates that the salvage logging followed fire-mortality patterns. The RAVG data, being the initial immediate assessment, also would not capture delayed mortality occurring, or tree damage that was more apparent during field observations, potentially explaining harvest of some moderately burned areas. Figure 68 illustrates a detailed view of the random plot locations and the subsequent salvage activity, with several tractor roads, green trees, and standing snags visible.

This small case study on the 2016 Cascade-2 Emergency Notice helps to illustrate the varying nature 1052.1 Emergencies can potentially have following fire effects. RAVG data can help indicate where timber will be harvested, following the intent of a 1052.1 Emergency Notice. These harvest patterns may reflect fire behavior, topography, and constraints imposed by watercourses or unstable slopes. Figure 69 shows post-salvage and initial assessment RAVG data for the other two Emergencies; despite much greater basal area and canopy loss predicted by the RAVG data, salvage activities were visually different. The Coast area Emergency visually (both in the imagery and in the field) appeared to have been more intensively harvested, while the Cascade-1 Emergency had very limited harvesting; each has abundant residual snags remaining on the Emergency Notice. These patterns likely reflect not just fire severity patterns, but also the goal of individual landowners.

While the RAVG data are not comprehensive nor a substitute for field measurements, this approach appears to be a way to assess expected harvesting in 1052.1 Emergency Notices, and to understand notice usage following wildfires. Figure 70 shows the initial-assessment RAVG Canopy Cover Loss in 282 mapped 1052.1 Emergency Notices that intersected the RAVG dataset. Figure 70 A splits these notices between those that were only partially in a fire footprint or had unburned patches (via the RAVG data), and those that were assessed as being 100% burned at some severity. As the amount of a notice is assessed as burned, there is a trend for increasing canopy cover loss at the 75-100% loss category. Similarly, for notices 100% burned, this trend also holds true, along with increasing footprints of the 50-75% loss category in each notice. When the data are broken down by reported acreage size classes (Figure 70 B), those notices that are five acres or less were split between near total canopy loss, and patchy canopy cover loss. In the 20 to 100-acre category, and 100 to 1,000-acre classes, the data again indicate that about half of the notices experience extensive canopy cover loss in the most severe category. At a reported size of 1,000 acres or greater, of which there were four notices

in the data set, one notice had nearly 50% of its area showing as unburned, while the other three had incrementally increasing area burned, both total and by the 75-100% category.

Similar to findings in the remote sensing case study for the 1038(k) Drought Mortality Exemptions in the central Sierra Nevada, this quasi-remote sensing case study for the 1052.1 Emergency Notices indicates that many boundaries and reported acreages for notices may not reflect the actual area harvested. While there are notices in Figure 70 that clearly experienced complete tree mortality, and under a 1052.1 Emergency Notice could be harvested in a clear-cut equivalent salvage, this does not always happen. While limited, the pilot project field observations coupled with the RAVG/satellite imagery shown in Figure 67 and Figure 69 indicate that timberland owners and/or foresters may opt to employ group selection, single tree selection, clear-cut equivalent patch removal, or leave large areas unharvested.

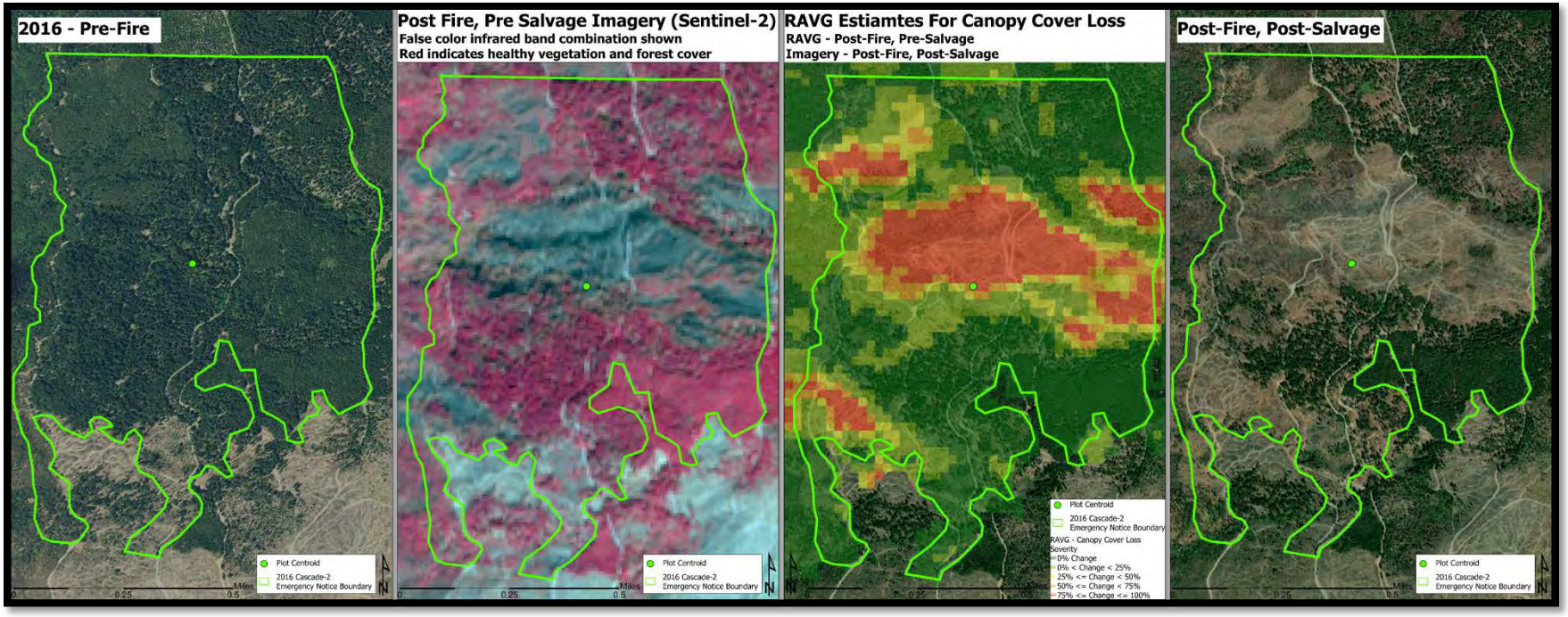

Figure 67. Pre- and post-fire and salvage imagery, RAVG data, and variable radius plot centroid used for initial sampling in the 2016 Cascade-2 Emergency Notice. From left to right, the maps are pre-fire imagery (A), post-fire and pre-salvage Sentinel-2 satellite imagery where red highlights healthy vegetation and forest cover and gray indicates burned vegetation or exposed soil (B), initial-assessment RAVG Canopy Cover Loss data overlaid on post-salvage imagery (C), and post-fire/ post-salvage imagery of the Emergency Notice (D).

Figure 68. Cascade-2 Emergency, with post-salvage imagery from the ESRI ArcGIS base map, as a detailed view of the random plot locations within the Emergency. Skid trails, seasonal roads, and residual green trees and snags can be seen.

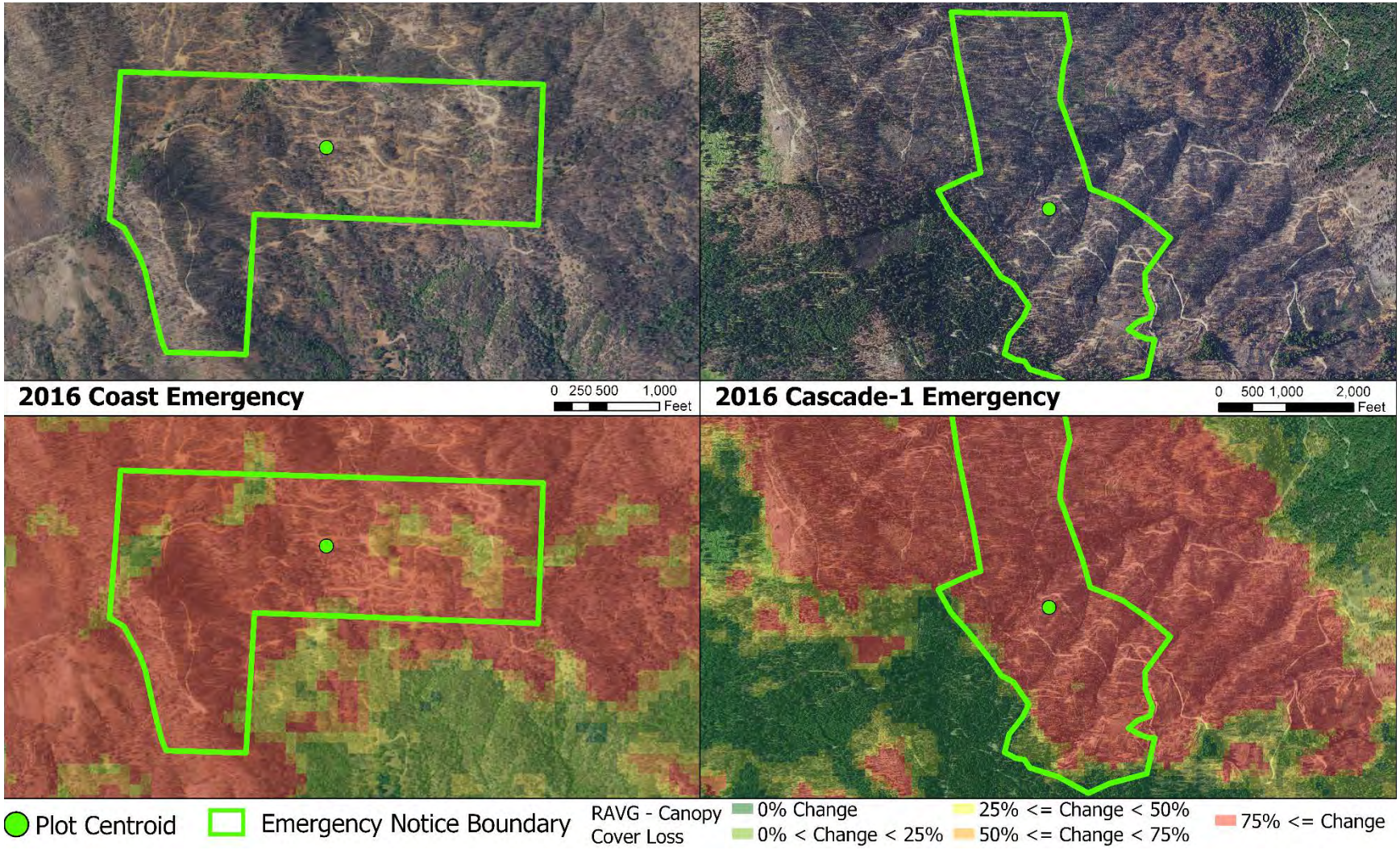

Figure 69. ESRI ArcGIS basemap imagery showing post-salvage harvesting extent (top), and initial assessment RAVG data for the Coast and Cascade-1 Emergencies (bottom).

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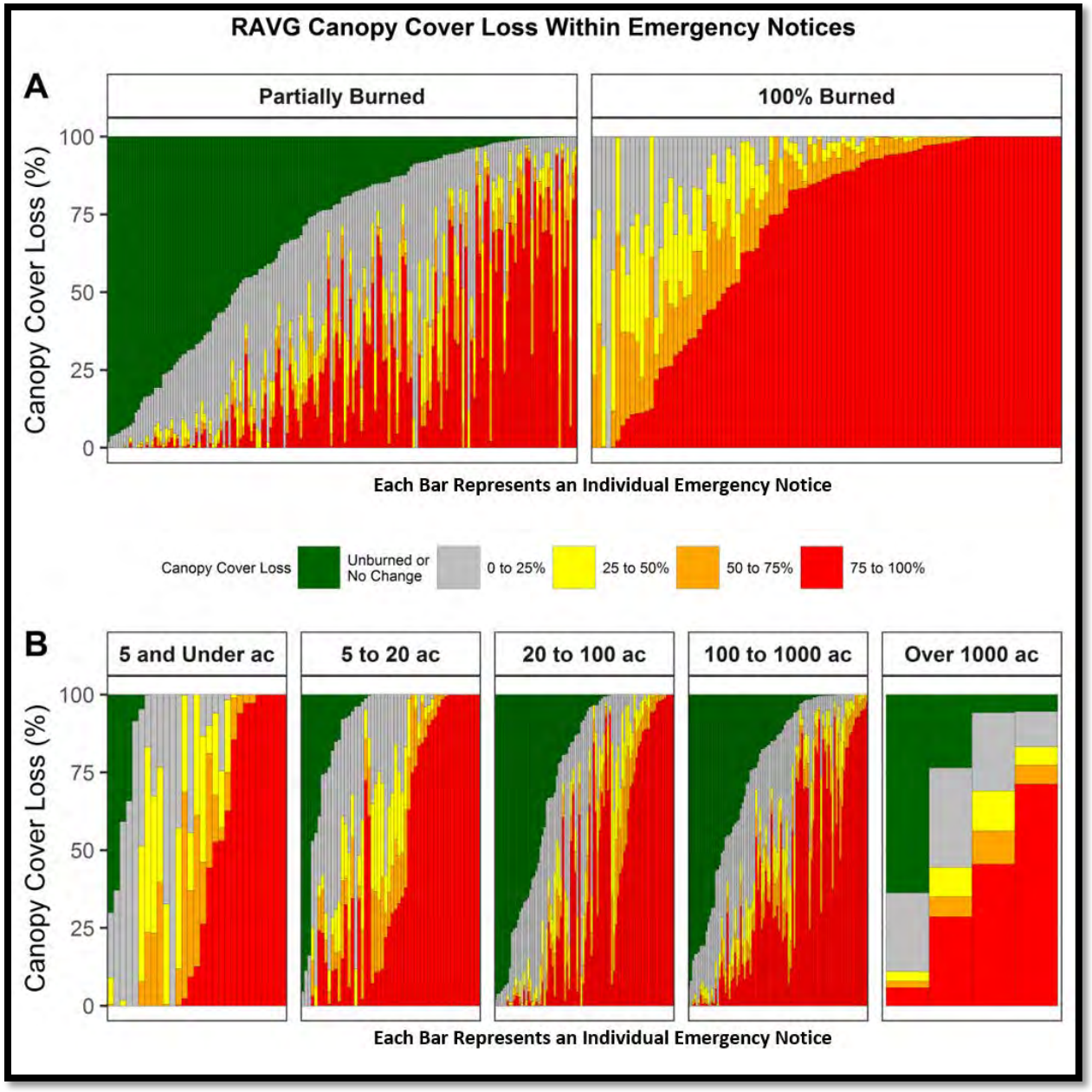

Figure 70. RAVG Canopy Cover Loss data across 282 mapped 1052.1 Emergency Notices, based on initial assessment data. Top, A, shows the percent area of each Emergency Notice boundary in each Canopy Cover Loss category, with the left panel showing notices that were only partially within a fire footprint or had unburned areas, and the right panel showing notices that were 100% burned at some severity, with both panels ordered by increasing footprints of the 75-100% category. Bottom, B, shows the same data with breakdowns by reported acreage size classes

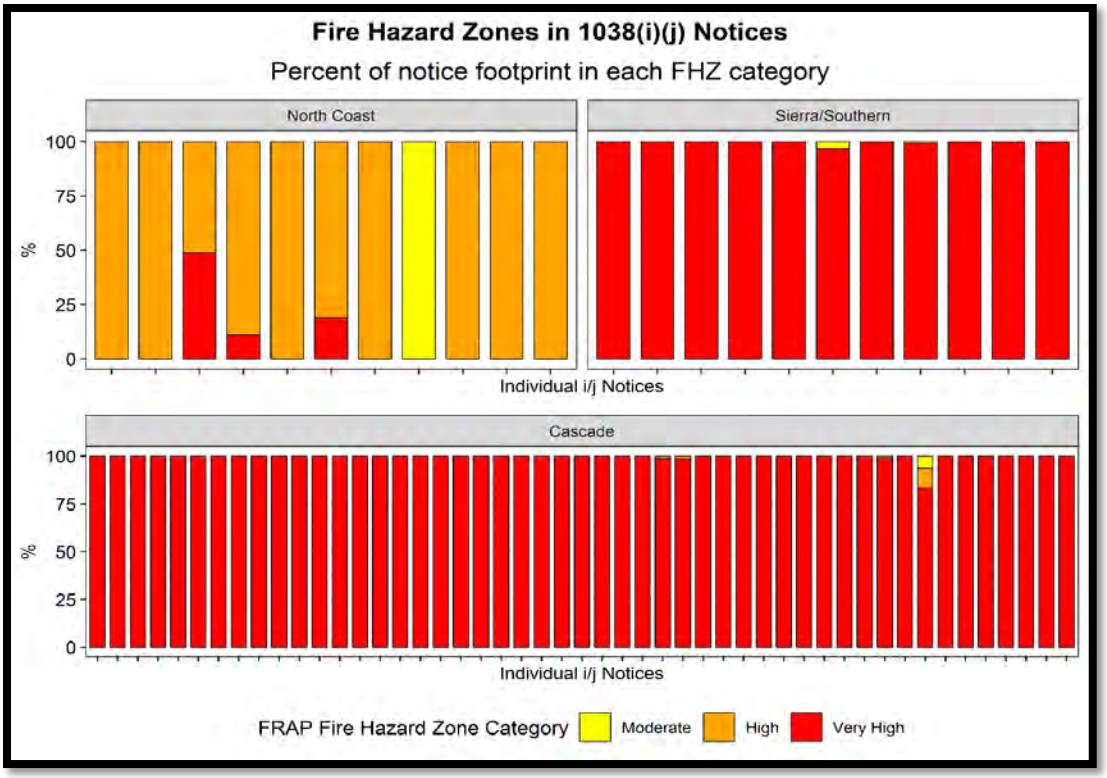

Figure 71. Fire Hazard Zones found in each mapped 1038(i) Forest Fire Prevention and 1038(j) Forest Fire Prevention Exemption boundary, displayed by Forest Practice area.

5.4 Wildlife Species

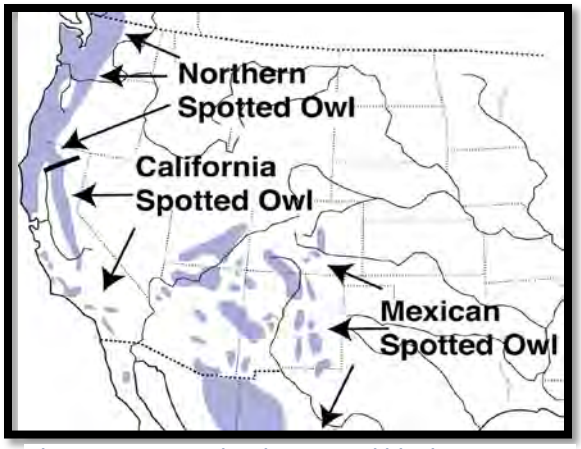

Figure 72. Spotted owl ranges within the western United States

For Emergency and Exemption Notices, fish and wildlife protections are inferred through the requirement for compliance of all operational provisions of the Forest Practice Act and Rules. Emergencies and Exemptions do not require submittal of work proving the avoidance of take[5] of species listed under the federal or California Endangered Species Acts as these are ministerial documents. However, by signing and submitting Emergencies and Exemptions, the submitter and/or RPF is certifying that take of any listed species will be avoided.

[5] Per the Endangered Species Act §3(18): For federally listed species, the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.
Per Fish and Game Code, §86: for State listed species, the term "take" means to hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill.

Northern and California spotted owls are species commonly associated with California forests (Figure 72). The Northern spotted owl (*Strix occidentalis caurina*) (NSO) is listed as threatened under the federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA). California spotted owl (CSO) (*Strix occidentalis occidentalis*) is a candidate for federal ESA listing and not listed under CESA, but is considered a Species of Special Concern.

The same NSO/CSO analysis method used for the randomly selected notices were applied to the all Exemption and Emergency Notices, excluding 1038(b) Dead, Dying, or Diseased Trees Notices, from the years 2015 to 2018. Table 16 shows the number of Exemption and Emergency Notices within the range of NSO and CSO, as well as notices proximal to NSO/CSO activity centers.

Table 16. Number of Exemption and Emergency Notices (excluding 1038(b)) within NSO and CSO range and Activity Centers.

	Within the Range	Within ¼ - mile of an AC	Within ½ - mile of an AC	3 acres or less within ¼ / ½ - miles of an AC
NSO	1347	78	206	48/153
CSO	2996	136	276	6/50

It is important to note that if Emergency or Exemption Notices are located within these distances of an AC, take of the species is not automatically inferred. Many factors could preclude take, such as absence of spotted owl detections over a period of time, proximity of the project to the AC (Figure 73), absence of nesting/roosting/foraging habitat (as in the case of high fire severity Emergency salvage), the project was conducted outside of the owl's critical period. The project may also have been minor in scale or not operated on, among others.

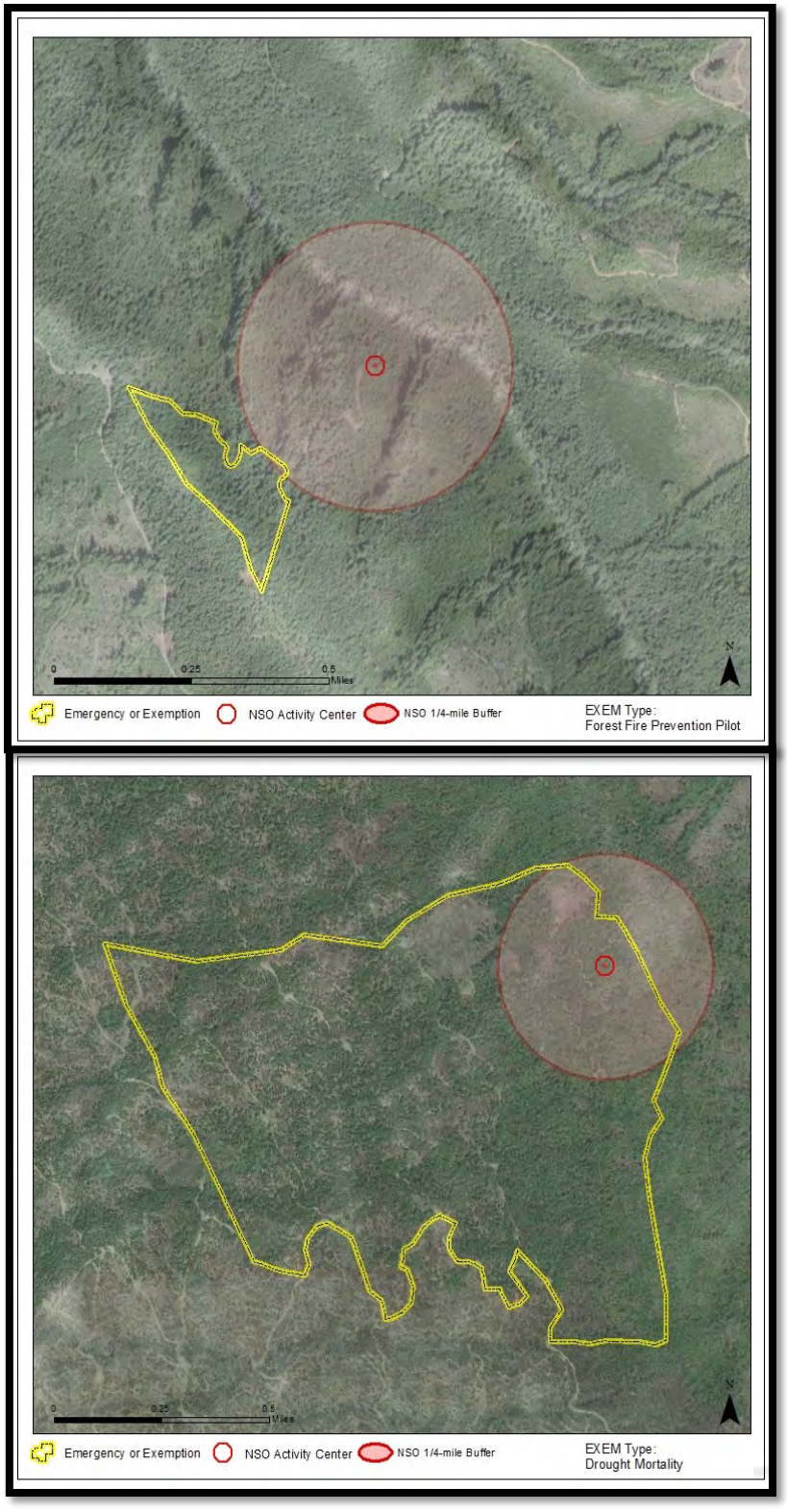

Figure 73. Examples of the two Exemption Notice footprints within 1/4-mile of an NSO activity center. Note that the upper example is just on the outside buffer of 1/4-mile

The same CNDDB method used for the randomly selected notices were applied to the all Exemptions and Emergencies, excluding 1038(b) Dead, Dying, or Diseased Trees Notices, from the years 2015 to 2018. Table 17 shows CNDDB detections and elements for all non-1038(b) Exemption and Emergency Notices from 2015 to 2018.

Table 17. CNDDB detections and elements by family for all EX-EM Notices (excluding 1038(b)) from 2015 to 2018.

	Number of Detections	Number of Elements
Insects	7	5
Reptiles	6	2
Amphibians	32	6
Crustaceans	4	2
Fish	12	6
Birds	69	10
Mammals	45	5
Botanical Species (CRPR 1A-B, 2A-B)	387	199

6 Discussion

6.1 Compliance, Implementation, and Effectiveness

The EX-EM Notice monitoring pilot project was not intended to explicitly address FPR compliance, implementation, and effectiveness in a manner consistent with previous CAL FIRE studies (e.g., FORPRIEM, Modified Completion Report Monitoring, Hillslope Monitoring Program; Table 1). Several lines of evidence and field observations, however, suggest similarly high levels of compliance, implementation, effectiveness when compared to previous studies that addressed water quality-related FPRs.

For instance, compliance metrics suggest that Forest Practice violations are low relative to the number of compliance inspections. While there were ELZ/WLPZ equipment encroachments on four out of 44 notices (i.e., nine percent), only one of the notices had an observable sediment discharge (i.e., < three percent). Road-related discharges greater than 1 yd^3 that were associated with EX-EM Notice timber operations were only documented for four of the 44 notices (i.e., <10 percent of Notice), indicating relatively high rates of effectiveness.[6]

6.2 Reported Acreage, Harvested Acreage, Occurrences of Operations

A theme through almost all of the notices sampled was that the reported acreage and boundaries on the notice documents rarely matched the actual on-the-ground harvested

[6] The Hillslope Monitoring Program and Modified Completion Report Monitoring Program reported 8-15% of road erosion features delivered sediment to stream channels, usually when FPRs were incorrectly implemented.

area (i.e., the physical footprint of harvesting activity associated with a notice). A small minority of notices had over 75% of the mapped timber harvest boundary operated on, with most notices having 50% or less of the area harvested. Further, even in our small sample of 50 random notices, a total of six were never operated on, despite filing of the notice with CAL FIRE. We randomly selected notices from a total population of over 2,000 eligible Exemptions and Emergencies, and the harvested/unharvested results may be purely stochastic. However, if we assume it to be representative of the population as a whole, that would imply that almost 250 notices of that population were never harvested, and no timber removed. Currently, CAL FIRE does not have a direct way of assessing either the status of harvest for a notice, or the degree to which harvesting occurred, outside of on-the-ground field inspections.

6.3 1038(j) Forest Fire Prevention Pilot Exemptions

It is inconclusive whether the Forest Fire Prevention Exemption Notices (1038(i) and 1038(j)) result in decreased fire hazard with respect to catastrophic crowning, resiliency to fire, and tree mortality. Within our limited sample size for Forest Fire Prevention Pilot Exemptions, the three-treated forest stands consisted of an early seral pine plantation, a mid-seral mixed conifer forest with biomass shrub removal, and a mid-seral second-growth redwood coastal forest stand. These three examples serve somewhat as case studies for different forest trajectories and ecologies, and issues possibly facing timberland owners. Likewise, the remote sensing exercise indicated that while most 1038(i) Forest Fire Prevention Exemptions and the more current 1038(j) Forest Fire Prevention Pilot Exemptions occurred in very high fire hazard zones in the Cascade, Sierra, and South areas, the Coast area was mixed between moderate and high fire hazard severity, indicative of a different fire cycle.

Several published studies provide information on fire resiliency in forest stands of varying ages. In dry, mid-elevation conifer forests, Stephens and Moghaddas (2005) used field data from the University of California's Blodgett Forest Research Station in the north central Sierra Nevada to simulate wildfire effects on different forest stand types under different fire behavior percentiles. The study found that among plantations, whether treated with pre-commercial thinning, mastication, or left untreated, fire behavior in the 80th, 90th, and 97.5th percentiles produced in excess of 90% tree mortality in almost all cases (Stephens and Moghaddas, 2005). Similarly, the study found that for plantations under five years of age, wildfire resulted in 100% tree mortality. Within stands that underwent single tree selection, thinning from below, or were reserve patches of young or old growth timber, rate of spread and tree mortality was less than in plantations, but not significantly.

More importantly, the amount of surface fuel present, both as logging slash and understory vegetation, controlled tree mortality, especially as tree diameter decreased

towards younger, more dense plantation style forests. In a study of the 2002 Biscuit Fire in southern Oregon and northern California, plantations of varying age within the fire footprint were assessed with aerial photography for canopy damage, analogous to tree mortality. Damage peaked in plantations between 15 and 25 years old, and was nearly uniformly over 90% in all plantations 25 years and younger (Thompson et al., 2011). While prescribed fire can effectively treat a forest stand to increase resiliency to fire, typically it is only an option in mature stands, and is a far more challenging tool to employ on young stands without widespread mortality. Mastication, thinning, and fuel reduction in young, dense stands may allow the use of prescribed fire in an earlier phase of the stand with minimal mortality (North et al., 2019). The general theme for intensively managed timberland, however, may be that outright fire exclusion is necessary for a quarter century, otherwise a stand may experience 100% mortality in a wildfire.

In wet forests, such as those found in the central and northern California Coast Ranges, fire return intervals are higher, with climate-limited as opposed to fuel-limited conditions. One study indicated that outside of anthropogenic fire ignitions, coastal redwood forests may have a natural fire return interval in excess of 500 years, decreasing with distance inland from the coast and with distance towards the southern border, into more mixed forest stands (Oneal et al., 2006). With the inclusion of anthropogenic ignitions, that is Native American and early settler use of intentionally set fire, fire return intervals were likely much shorter in pre-settlement eras (<20 years), although focused more so on grasslands and oak woodlands (Stephens and Fry, 2005; Brown and Baxter 2003). Steel et al.; (2015) used fire frequency and departure data and found that high severity patch size is likely to increase on the North and Central Coast with time since the last fire for mixed evergreen and conifer forests, but for red fir and coast redwood forests fire severity was not affected by the fire return interval. Halofsky et al. (2018) emphasize the disparity of options available in climate-limited wildfire regimes (e.g., wet, dense forests found on the California Coast), in the face of changing climate and naturally high fuel and biomass loads. In their summary of research, the authors highlight the benefits of natural or prescribed fire, as allowable; the benefits of anthropogenic fire exclusion where it limits catastrophic stand replacing fire occurrences; and the need to retain forest stand elements that prove the most resilient to current disturbances (Halofsky et al., 2018).

While very limited, it is possible to apply this research to our single case study 1038(j) Forest Fire Prevention Pilot Exemption from the Coast area. Vertical fuel continuity and crown bulk density may be decreased with forest management, but with inherent increases in fuel loads transferred to the forest floor, and remaining biomass in the forest stand inherent with the bioregion, Exemption harvesting may not be able to act as

a standalone treatment for forest fire resiliency, particularly in light of a changing climate.

In our three 1038(j) Forest Fire Prevention Pilot Notice monitoring cases, we observed a thinned early seral young plantation, a mid-seral mixed conifer forest with additional surface fuel removal through biomass operations, and a mid-seral second-growth redwood forest stand. In all three, overall tree density and fuel loads were likely decreased by harvest operations, but under a fire event the outcomes may be different. With our limited sample, in regard to surface fuels we can emphasize the need for whole-tree yarding, as opposed to the lopping of limbs that remain at the stump location. Research likewise indicates that in young stands, where historic fire return intervals are shorter, fire exclusion, whether through firebreaks, active suppression, or multiple landscape treatments, may be the most effective approach to allow such a stand to reach maturity. In more developed dry-forest stands, thinning of younger, more flammable trees, in addition to landscape treatments such as mastication, biomass removal, and, ideally, prescribed fire together can increase forest resiliency to wildfire. In forests with a climate-limited wildfire regime, where stand replacing severe wildfires may be more common, the use of natural or prescribed fire may help build resiliency, while the use of thinning techniques adapted from dry-forests may be most effective when applied in a way to build resiliency and retention of forests elements if a landscape-scale wildfire event does occur.

In moving forward with monitoring of EX-EM Notices intended to increase forest resiliency to wildfires, protocols to better assess fuel loads at both the surface and canopy level are needed, and relative to both harvest-related slash generation and residual vegetation. Potential monitoring of projects over time, rather than in a single snapshot, to track regrowth, maintenance, or additional treatments, either through a field-work oriented approach or desktop remote sensing approach, will increase our understanding of the effectiveness of these projects. Additionally, at a broader landscape scale, monitoring should emphasize assessment of project placement relative to other fuel reduction and fire prevention projects, and pre-existing forest stand features and disturbances. Monitoring currently under development for CAL FIRE's Climate Change Program should be able to address some of these issues, providing a better understanding of the effectiveness of the fuels reduction projects.

6.4 1052.1 Emergency Notices – Post-Fire Salvage

Research on the impacts of post-fire salvage logging on soil erosion and water quality have produced varied results throughout the western United States and in California, dependent on scale, timing, and locations. While increasing disturbance at the hillslope scale, such as ground based skidding, can result in significantly higher sediment yields downslope (Wagenbrenner et al., 2015), research at larger scales such as small

catchments has indicated that salvage logging may increase, decrease, or have no effect on soil erosion and sediment delivery to the drainage network (Chou et al., 1994; McIver and Starr, 2001; Wagenbrenner et al., 2015; Slesak et al. 2015; James and Krumland, 2018; Olsen et al., in preparation). At the larger watershed scale, the varied results indicate important factors may be location, precipitation regime, harvesting style, and fire effects (Silins et al. 2009; Smith et al., 2012; Stone et al., 2014; Lewis et al., 2018).

Our limited sample of post-fire Emergency Notices emphasized the issue of forest roads in the post-fire environment, with all three 1052.1 Emergency Notices having sediment discharges from the forest road to the drainage network. The degree of those discharges was dependent on effort made to reduce discharges, from standard BMP use in one case, to intentional armoring of slopes below water breaks and the use of straw mulch on road approaches, to a lack of any road drainage. Sosa-Perez and MacDonald (2017) found in a study in Colorado that at all fire severity levels, road-stream connectivity occurred, due to increased runoff and decreased surface cover following a wildfire, emphasizing the need for proper road construction and maintenance in the post-fire environment. Based on the use of the recently created FORPRIEM 2 erosion risk rating system, an evaluation of 65 submitted and mapped 1052.1 Emergency Notices submitted in the 2018 Carr, Delta, and Hirz fire footprints in Shasta and Siskiyou counties indicated that 49% of the notices were rated as “Moderate” erosion risk, and 43% fell into the “High” risk rating, without accounting for the effects of the fire.

Acknowledging that a post-fire landscape is more prone to increases in runoff and erosion underscores the need for continued emphasis to understand how the standard Forest Practice Rules apply in such a setting. Potential future monitoring could increase monitoring on road segments, and include increased monitoring of watercourse segments for harvest activity-watercourse connectivity issues. This would increase our understanding of Forest Practice Rule effectiveness, as well as expand our knowledge of processes in burned and logged settings. Improved outreach and education could then be provided for RPFs and LTOs.

Our small case study using USFS RAVG data to assess tree mortality and expected harvesting patterns can be further pursued as a future tool for post-fire logging monitoring, in addition to field-based monitoring. Future monitoring in the field will likely need to make use of this approach to help direct field efforts, allowing data to be captured on both harvested and unharvested portions of a 1052.1 Emergency Notice.

6.5 Scaling from Individual Notices to Watersheds – Exemption and Emergency Use, and Timber Harvesting Plans

As found in the remote sensing study with 1038(k) Drought Mortality Exemptions (section 6.1), densities of Exemption Notices at the planning watershed scale may be generally low, particularly in regard to actual harvested area, with isolated occurrences of large harvest boundary footprints. One complication to understanding any larger watershed effects from the usage of these notices is a general inability to know exactly where timber harvesting occurred within each footprint. While our ability to understand the effects of these timber harvests and the effectiveness of Forest Practice Rules at even small drainage scales may be difficult, future monitoring may combine field measurements and geospatial models to help understand and test hypotheses to better direct field efforts.

Concern has been raised over the cumulative impacts of traditional and Emergency and Exemption timber harvests, wildfires, climate change impacts, and increased pressure from human development into wildland areas on watersheds, water quality, water yield, and habitat (e.g., Lewis et al. 2018). These large-scale, complicated questions may not have simple, binary answers in terms of potential impacts, and may bring in issues outside of the realm of timber harvest monitoring. Advanced remote sensing analysis that may couple satellite imagery, LiDAR, project boundaries, and field measurements may be useful to illuminate aspects of these questions, but will require substantial, advanced research and development. Research from Washington and Oregon published by the USFS Pacific Northwest Research Station has suggested that effects/changes from stressors diminish with increasing basin size. For example, at the 4 mi^2 scale and less, once approximately 20% of a watershed has undergone change (i.e., timber harvest), peak flow changes may occur, producing subsequent effects from those peak flow changes (Grant et al., 2008). Acknowledging that these studies occurred in Washington and Oregon, and do not necessarily reflect the wide complexity of California forests, it serves as a starting point to discretize the landscape for either directing efforts towards current conditions, or identifying areas at risk under changing future conditions.

6.6 Conclusions

Some key findings from this report include:

1) Results of this pilot study are primarily hypotheses-generating rather than conclusive.
2) There are relatively few statistically significant trends in use for Exemption and Emergency Notices. However, the data indicates that the availability of grant monies can lead to rapid increases and decreases in Exemption and Emergency submittals, particularly in the southern portion of the state.

3) Twelve percent of randomly selected Notices were not harvested. Given the small sample size of the pilot study, the number unharvested Notices can be as high as 21 percent.
4) Reported acreage under Notice rarely matched the harvested area observed within the mapped boundary, and many of the Drought Mortality Exemption (1038(k)) Notices had relatively low levels of harvest relative to the area placed under the Exemption Notice.
5) Observations and data suggest a relatively high level of compliance, implementation, and effectiveness for water quality-related operational FPRs.
6) Mapping quality was lowest for Notices that did not require an RPF for submittal.

Considerably more detailed data collection is required in 2019 and beyond to fully determine if the primary purposes of the revised Exemption or Emergency types are meeting the intent of the new rule language.

The EX-EM Notice monitoring program will be modified to incorporate examination of existing Forest Practice Rules for Emergency Notices and new rules for Exemptions in the winter and early spring of 2019. It will be necessary to modularize monitoring so that notice types share some of the same monitoring protocols, but the different intent of the various EX/EMs necessitate different protocols to answer different types of questions.

7 Exemption and Emergency Notice Pilot Project Report Recommendations

Based on the field work and results compiled from the Exemption and Emergency Notice pilot project during 2018, we recommend the following items categorized as internal refinements, training and outreach, and substantive recommendations for future monitoring:

7.1 Internal Data Collection Refinements

- Improve the resolution for digital photos taken with tablets.
- Consider investing in accurate GPS units that can connect to tablets for sub-meter accuracy, instead of using tablet GPS that gives incorrect locations up to 100 feet (for accuracy in mapping erosion sites, wildlife habitat elements, etc.).
- Modify the Survey123 application to utilize required data entry screens prior to completing field data collection, reducing the need for paper field data entry, especially with well trained data collectors.
- Purchase a sufficient number of tablets and external batteries so that agency personnel do not have to use smart phones for data collection.

7.2 Training and Outreach

- Develop and update a Licensed Timber Operator training program based on Exemption and Emergency Notice monitoring results that can be used at logging conferences and posted on the CAL FIRE/BOF websites.
- Develop a training program for CAL FIRE Forest Practice Inspectors and Review Team personnel from CGS, DFW, and the RWQCBs on Exemption and Emergency Notice field monitoring protocols to accomplish 2019 goals.
- Identify and train key personnel (i.e., a core group) from each Review Team agency so that they have substantial data collection skills, producing consistently recorded digital data.
- Continue to provide presentations on Exemption and Emergency Notice monitoring results to the State Board of Forestry and Fire Protection, BOF Effectiveness Monitoring Committee, Governor's Forest Management Task Force, AB 1492 Leadership Team, California Licensed Foresters Association, and other interested groups.
- Create an EX-EM Notice monitoring Story Map with a dashboard specifically for the public, including some of the visuals from this report.

7.3 Future Monitoring

- Structure monitoring around clear questions and testable hypotheses. Questions and hypotheses will vary by Exemption and Emergency Notice types.
- Modularize monitoring so that monitoring related to common operational requirements can be consistent between Notice types, but Notice-specific questions (e.g., Notice intent) can be focused on the appropriate Notice types.
- Further explore remote sensing and GIS approaches to complement field data collection.
- Develop a stratified random sampling scheme for Emergency and Exemption Notices based on ownership size and type (e.g., rural residential, small nonindustrial, large industrial).
- Revising the sampling protocol to work successfully for very small parcels (i.e., less than 3 acres).
- Develop a methodology for collecting data for types of Exemption Notices that were not evaluated during the pilot project. This includes case studies for 1038(b) Dead, Dying, or Diseased Trees Emergency Notices covering entire ownerships or ownership areas, and 1038(c) Fire Hazard Reduction (150/300 feet) Notices. Mobile applications for digital data collection for case studies are to be produced.
- Modify the existing monitoring protocols to accommodate changes to the California Forest Practice Rules adopted by the State Board of Forestry and Fire Protection for Emergency and Exemption Notices, including road building.

- Determine if more numeric data should be collected instead of “binned data” (e.g., 0-5%, 5-10%, >15%), so that calculations and statistical tests can be performed on additional field data (i.e., fewer text fields).
- Obtain input from DFW for developing improved sampling protocols for wildlife habitat elements.

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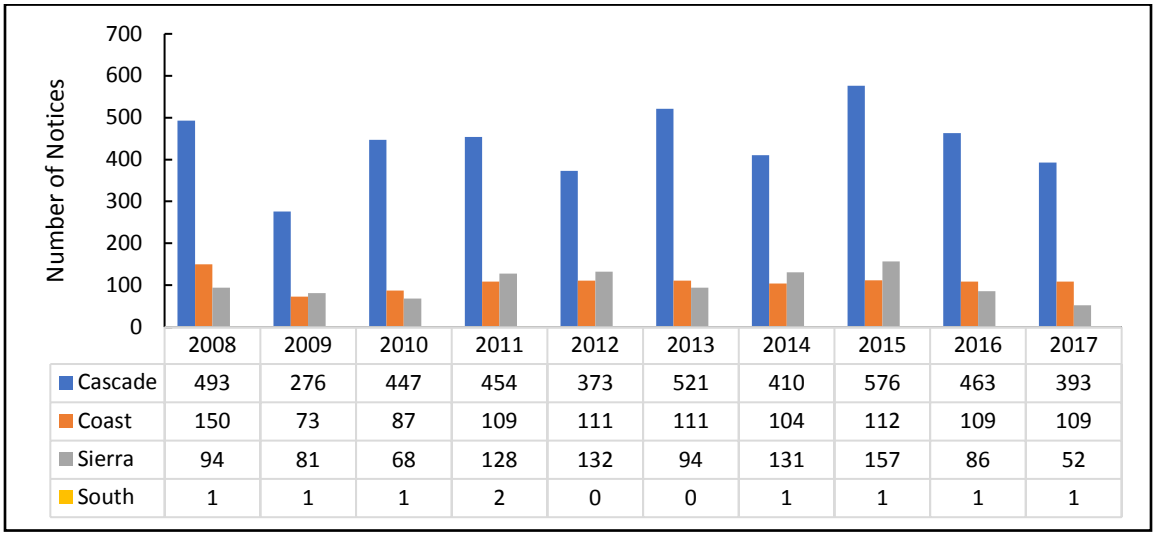
Appendix A. Detailed Exemption and Emergency Notice Trend Information

Exemption Notices

1038(a) and (b) Christmas Trees; Dead, Diseased, or Dying Trees



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	493	276	447	454	373	521	410	576	463	393
Coast	150	73	87	109	111	111	104	112	109	109
Sierra	94	81	68	128	132	94	131	157	86	52
South	1	1	1	2	0	0	1	1	1	1

Figure 74. Number of 1038(a) and (b) Christmas Trees; Dead, Diseased, or Dying Trees Notices from 2008 through 2017 by CAL FIRE area.

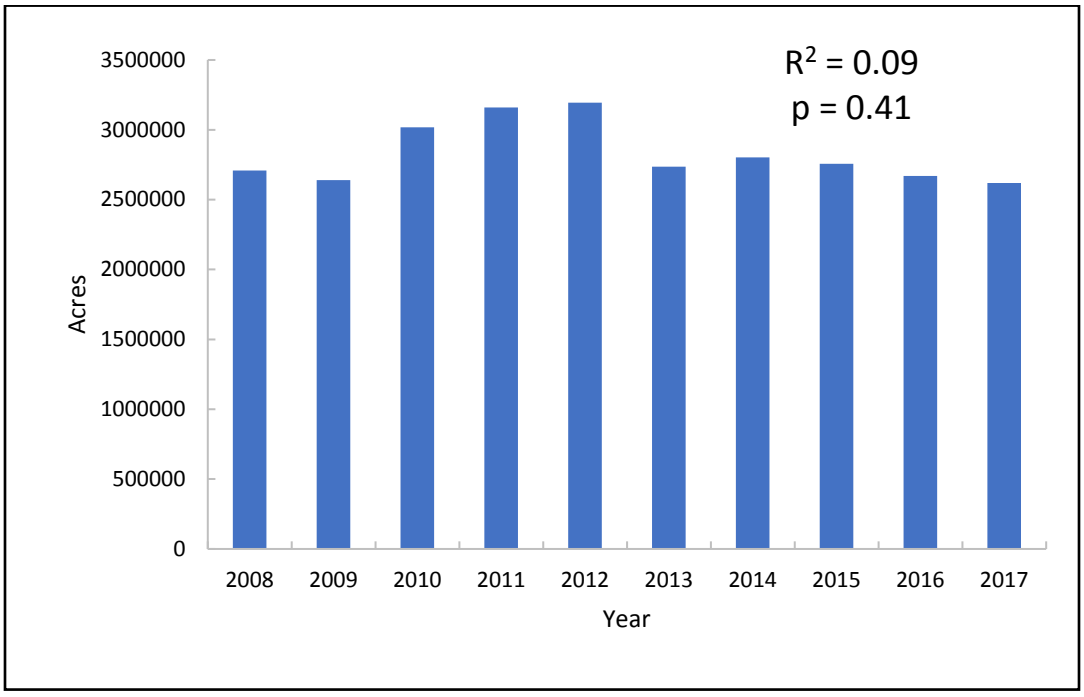
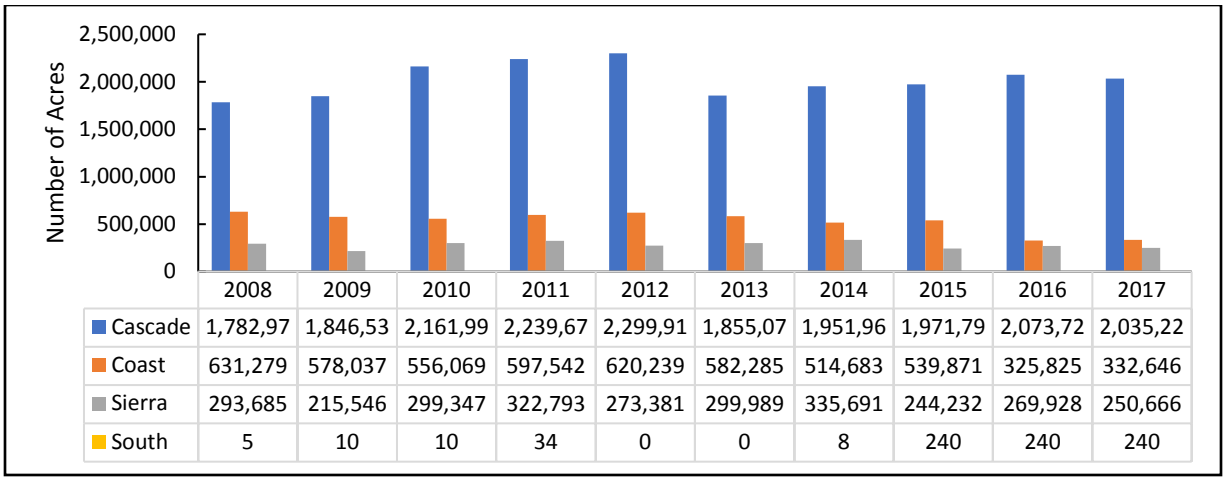


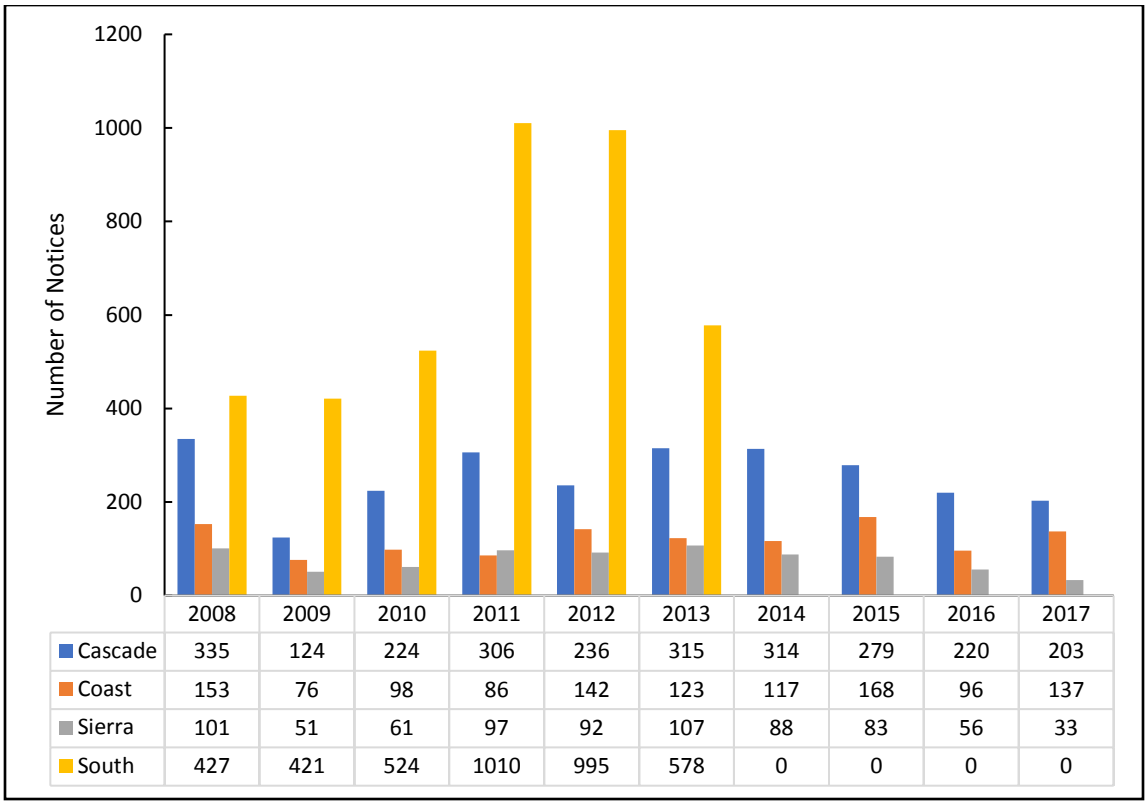
Figure 75. Total number of acres for 1038(a) and ,b) Christmas Trees; Dead, Diseased, or Dying Trees Exemption Notices submitted from 2008 through 2017.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	1,782,97	1,846,53	2,161,99	2,239,67	2,299,91	1,855,07	1,951,96	1,971,79	2,073,72	2,035,22
Coast	631,279	578,037	556,069	597,542	620,239	582,285	514,683	539,871	325,825	332,646
Sierra	293,685	215,546	299,347	322,793	273,381	299,989	335,691	244,232	269,928	250,666
South	5	10	10	34	0	0	8	240	240	240

Figure 76. Number of acres for 1038(a) and (b) Christmas Trees; Dead, Diseased, or Dying Trees Notices by CAL FIRE area and year.

1038(c) Fire Hazard Reduction (150 feet/300 feet)



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	335	124	224	306	236	315	314	279	220	203
Coast	153	76	98	86	142	123	117	168	96	137
Sierra	101	51	61	97	92	107	88	83	56	33
South	427	421	524	1010	995	578	0	0	0	0

Figure 77. Number of 1038(c) Fire Hazard Reduction (150 feet/300 feet) by CAL FIRE area.

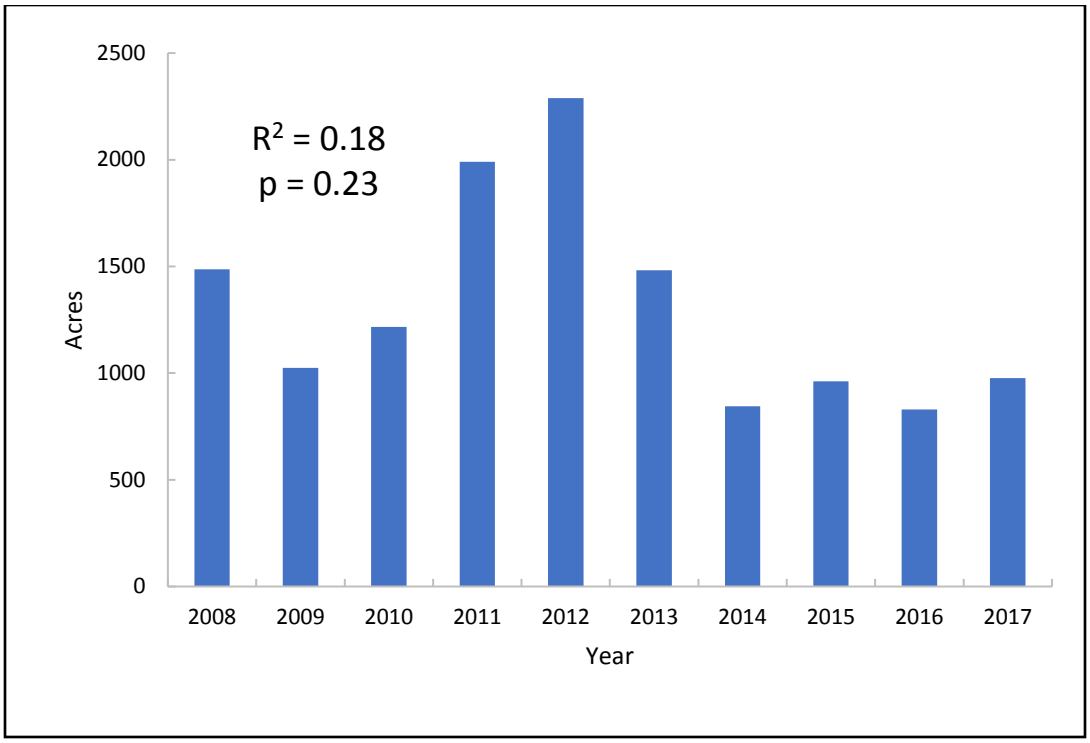
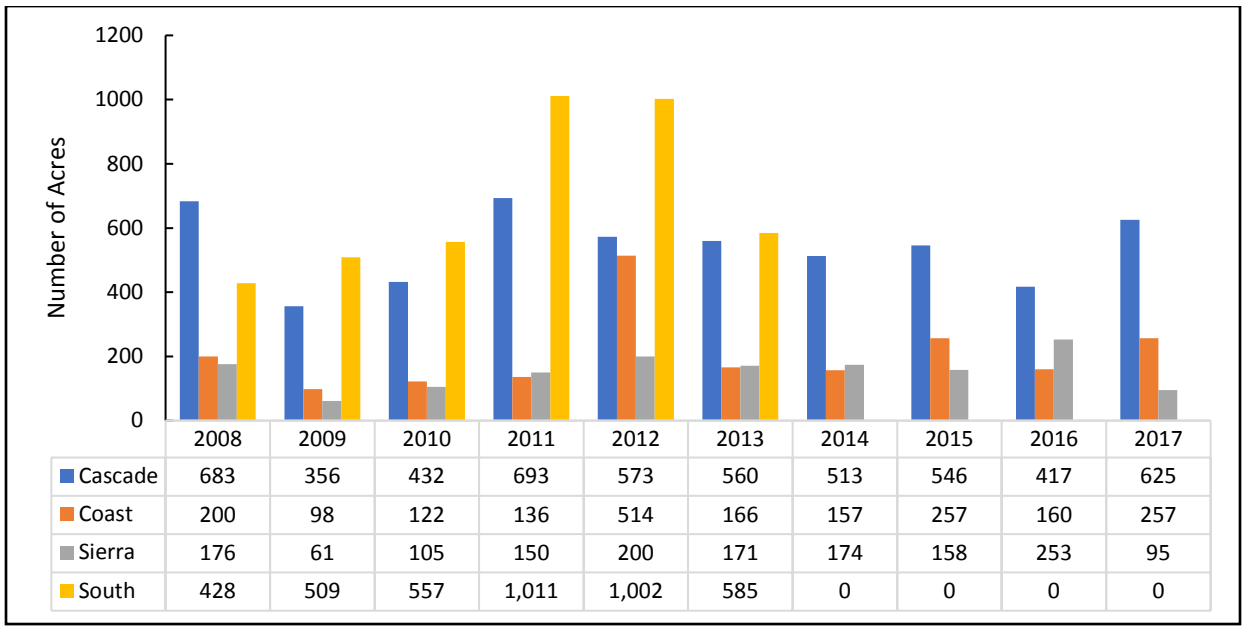


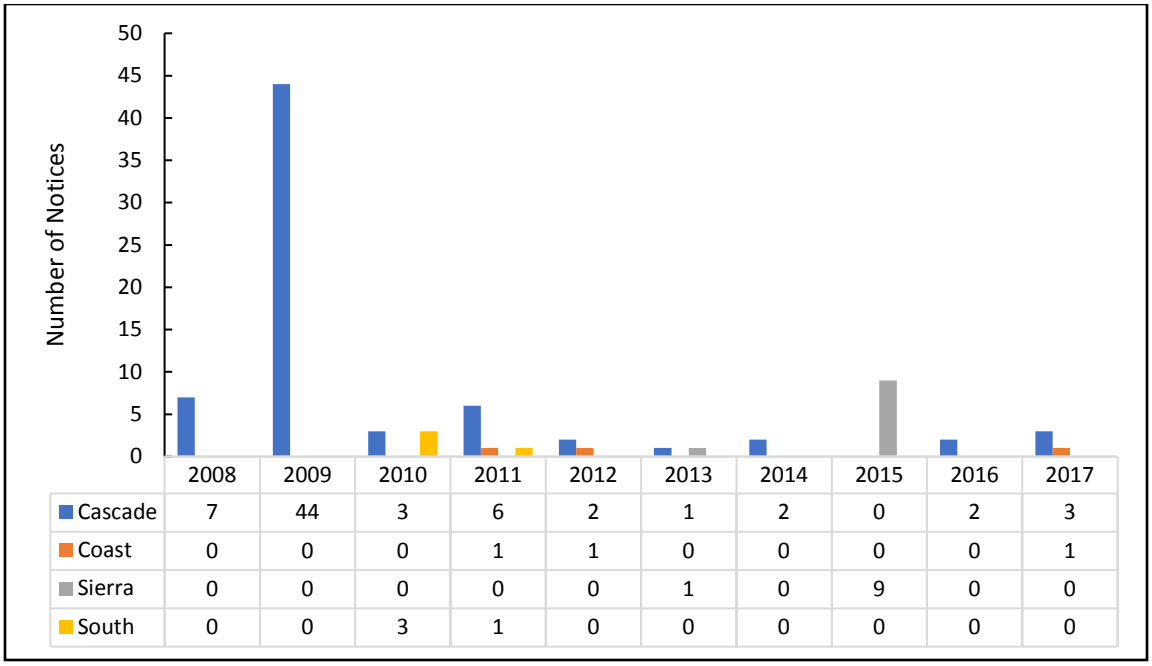
Figure 78. Total number of acres for 1038(c) Fire Hazard Reduction (150 feet/300 feet) Exemption Notices submitted from 2008 through 2017.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	683	356	432	693	573	560	513	546	417	625
Coast	200	98	122	136	514	166	157	257	160	257
Sierra	176	61	105	150	200	171	174	158	253	95
South	428	509	557	1,011	1,002	585	0	0	0	0

Figure 79. Number of acres for 1038(c) Fire Hazard Reduction (150 feet/300 feet) Notices by CAL FIRE area and year.

1038(d) Substantially Damaged Timberlands



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	7	44	3	6	2	1	2	0	2	3
Coast	0	0	0	1	1	0	0	0	0	1
Sierra	0	0	0	0	0	1	0	9	0	0
South	0	0	3	1	0	0	0	0	0	0

Figure 80. Number of 1038(d) Substantially Damaged Timberlands Notices by CAL FIRE area and year.

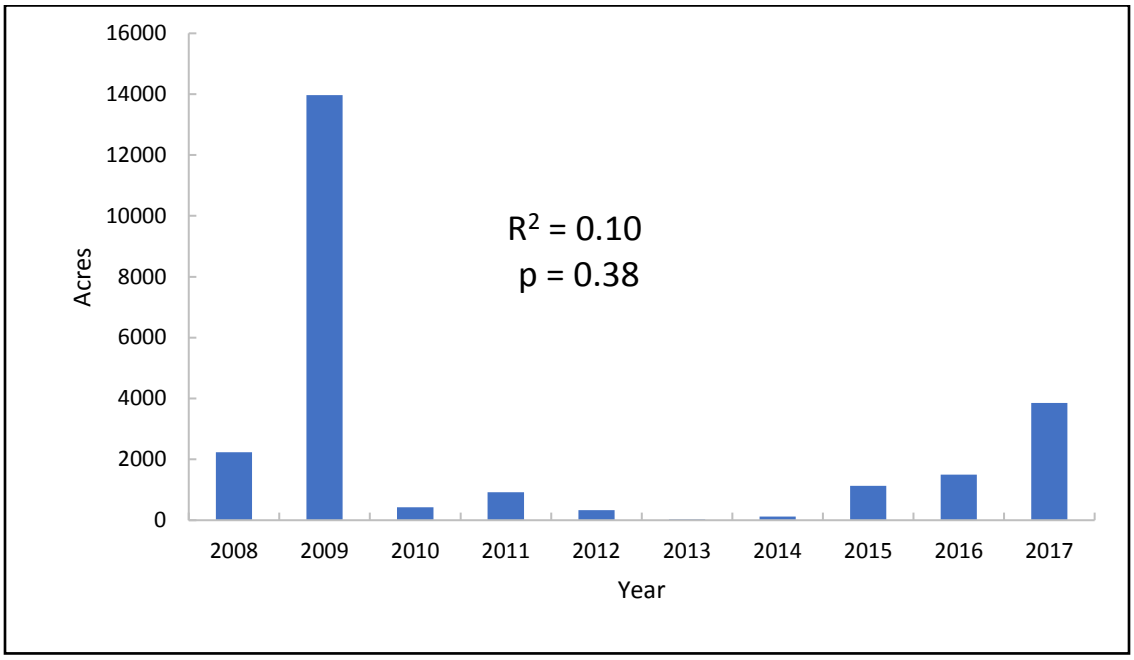
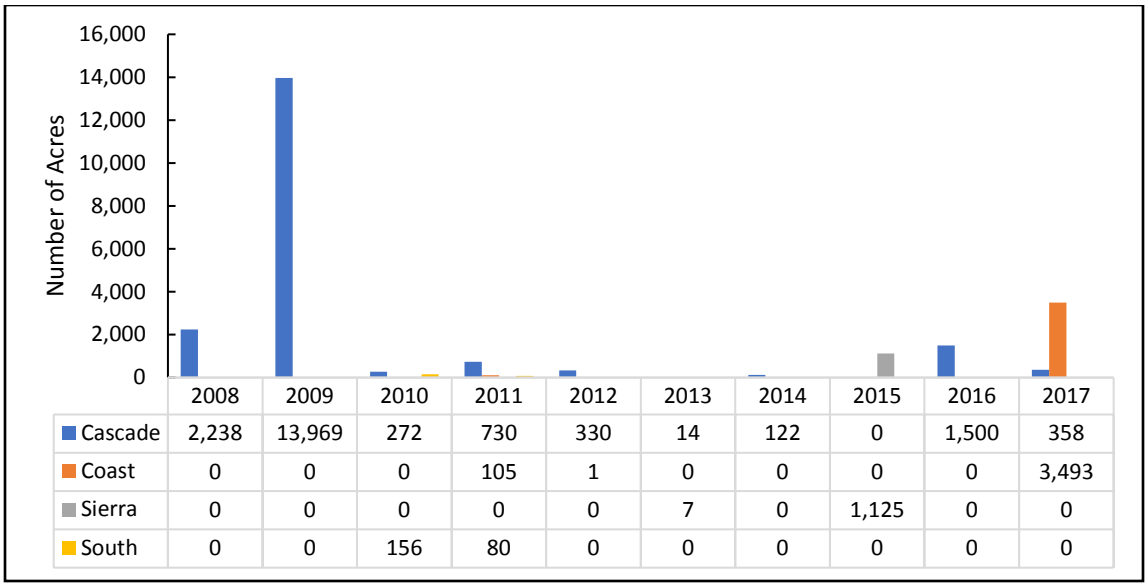


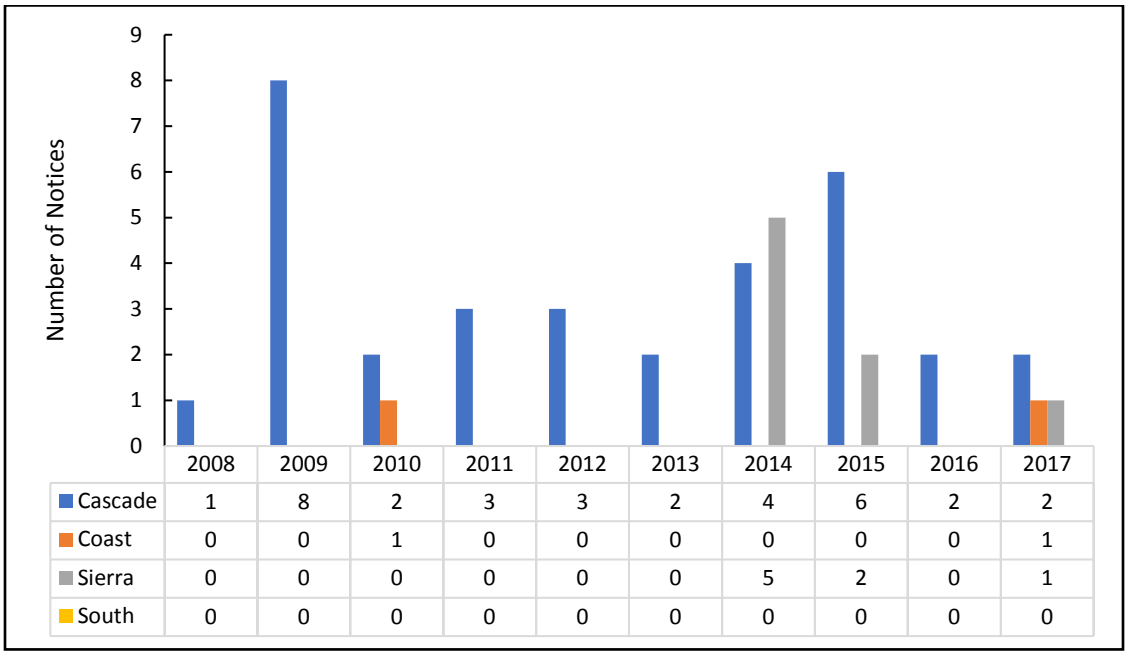
Figure 81. Total number of acres for 1038(d) Substantially Damaged Timberlands Exemption Notices submitted from 2008 through 2017.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	2,238	13,969	272	730	330	14	122	0	1,500	358
Coast	0	0	0	105	1	0	0	0	0	3,493
Sierra	0	0	0	0	0	7	0	1,125	0	0
South	0	0	156	80	0	0	0	0	0	0

Figure 82. Number of acres for 1038(d) Substantially Damaged Timberlands Notices by CAL FIRE area and year.

1038(g) Slash Removal/Biomass



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	1	8	2	3	3	2	4	6	2	2
Coast	0	0	1	0	0	0	0	0	0	1
Sierra	0	0	0	0	0	0	5	2	0	1
South	0	0	0	0	0	0	0	0	0	0

Figure 83. Number of 1038(g) Slash Removal/Biomass Notices by CAL FIRE area and year.

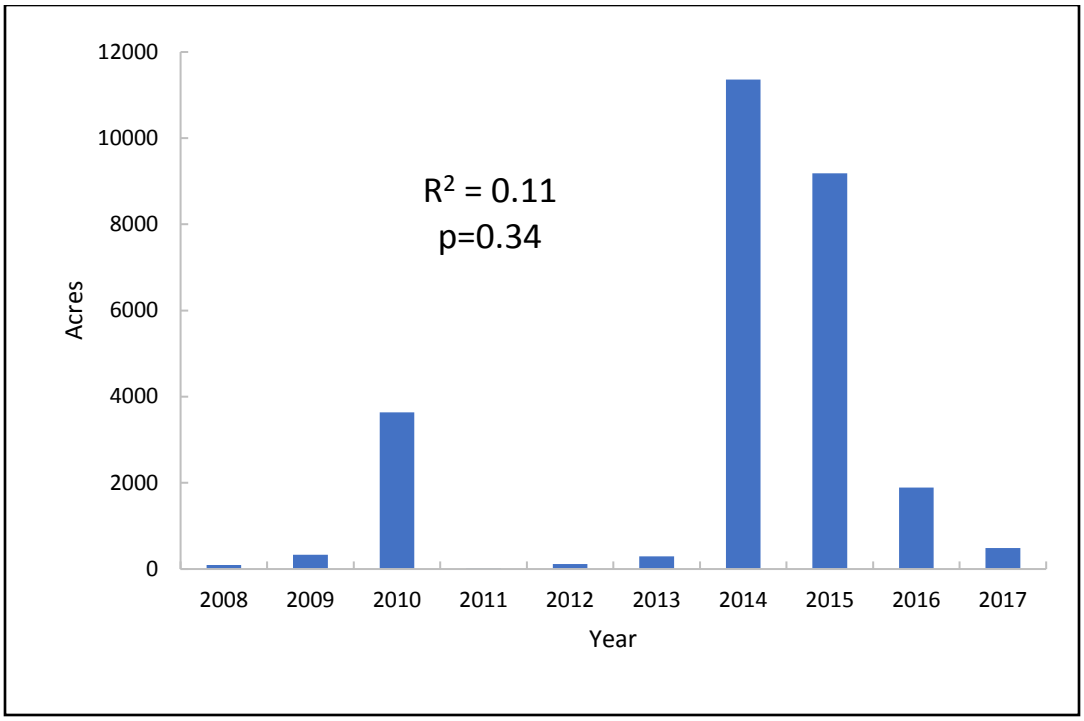
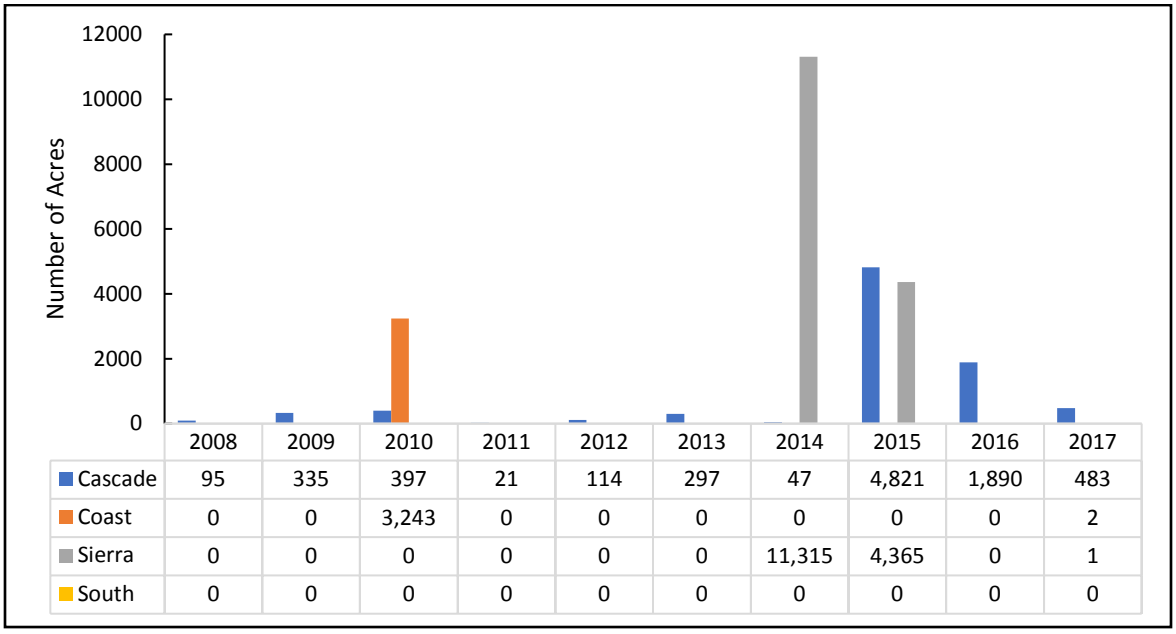


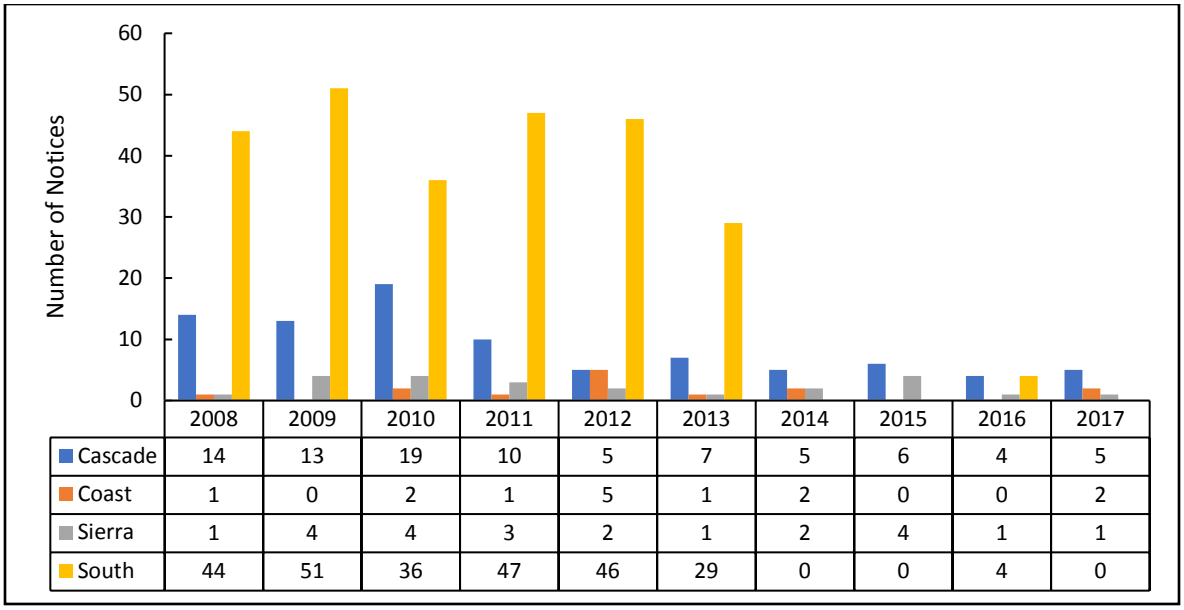
Figure 84. Total number of acres for 1038(g) Slash Removal/Biomass Exemption Notices submitted from 2008 through 2017.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	95	335	397	21	114	297	47	4,821	1,890	483
Coast	0	0	3,243	0	0	0	0	0	0	2
Sierra	0	0	0	0	0	0	11,315	4,365	0	1
South	0	0	0	0	0	0	0	0	0	0

Figure 85. Number of acres for 1038(g) Slash Removal/Biomass Notices by CAL FIRE area and year.

1038(i) Forest Fire Prevention



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	14	13	19	10	5	7	5	6	4	5
Coast	1	0	2	1	5	1	2	0	0	2
Sierra	1	4	4	3	2	1	2	4	1	1
South	44	51	36	47	46	29	0	0	4	0

Figure 86. Number of 1038(i) Forest Fire Prevention Notices by CAL FIRE area and year.

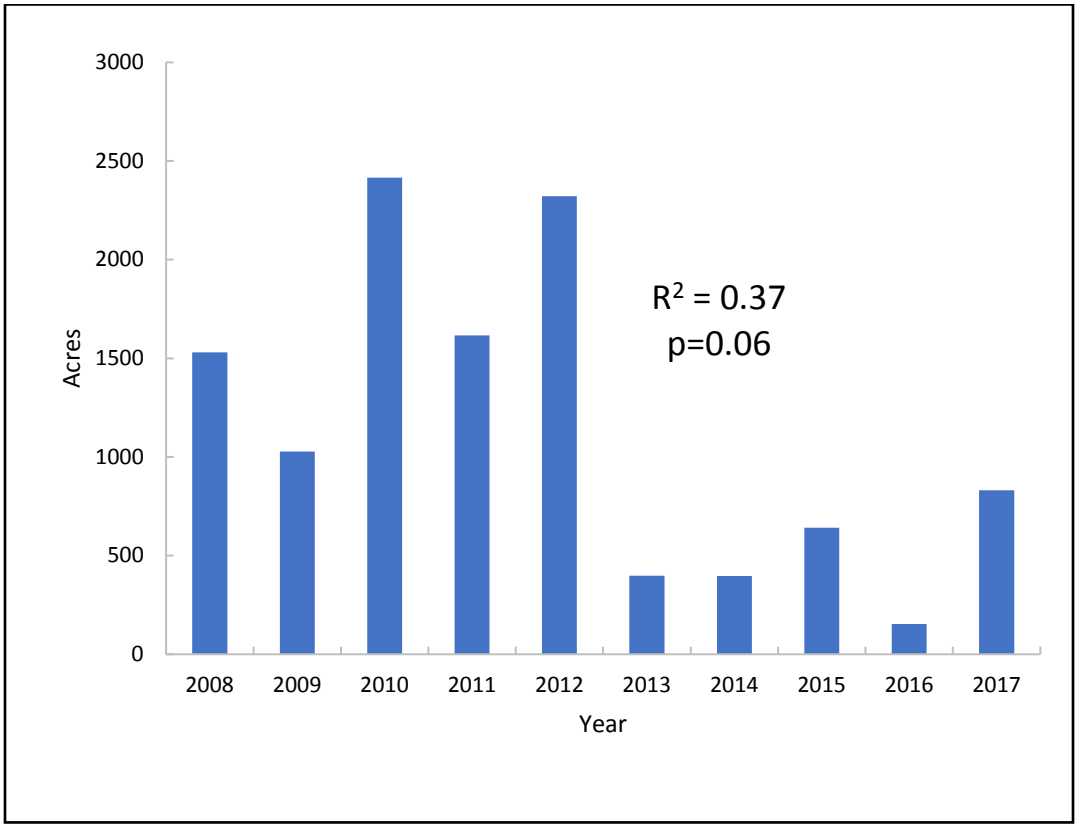
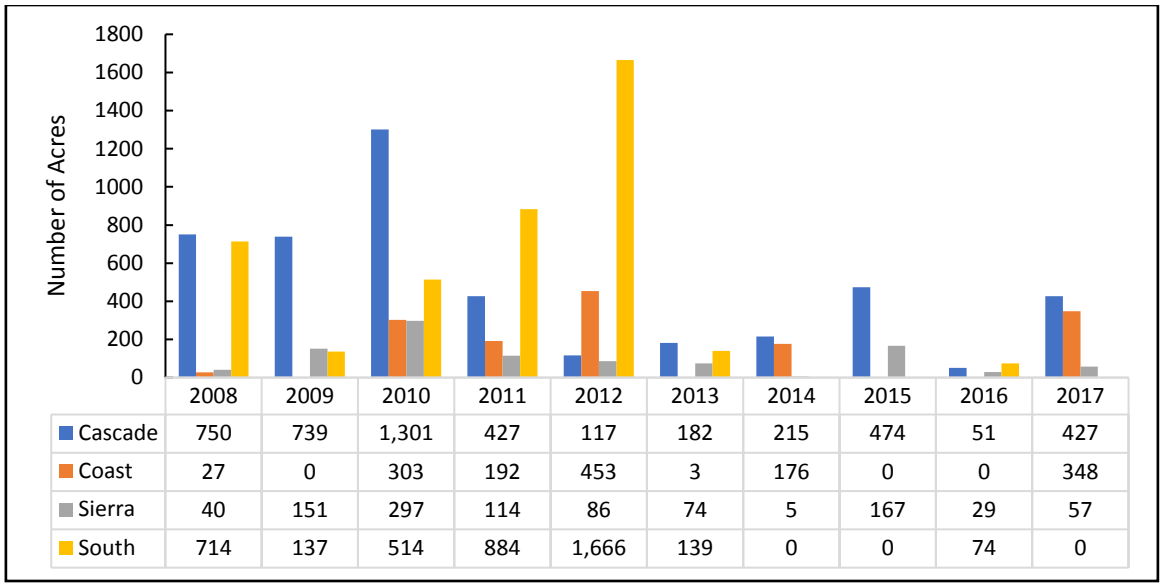


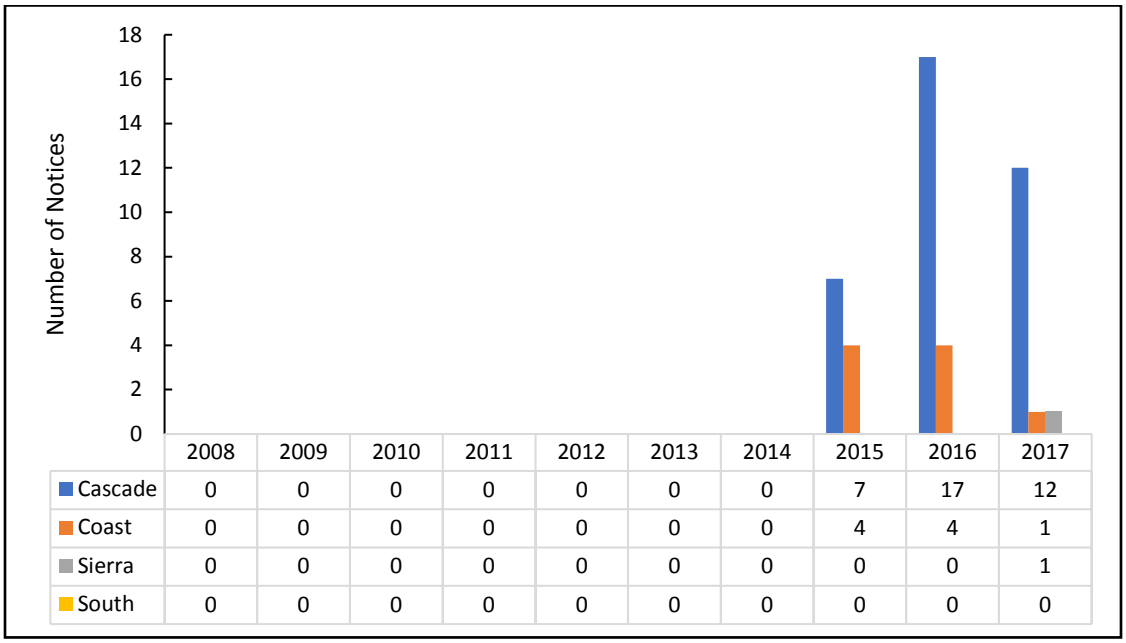
Figure 87. Total number of acres for 1038(i) Forest Fire Prevention Exemption Notices submitted from 2008 through 2017.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	750	739	1,301	427	117	182	215	474	51	427
Coast	27	0	303	192	453	3	176	0	0	348
Sierra	40	151	297	114	86	74	5	167	29	57
South	714	137	514	884	1,666	139	0	0	74	0

Figure 88. Number of acres for 1038(i) Forest Fire Prevention Notices by CAL FIRE area and year.

1038(j) Forest Fire Prevention Pilot



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	0	0	0	0	0	0	0	7	17	12
Coast	0	0	0	0	0	0	0	4	4	1
Sierra	0	0	0	0	0	0	0	0	0	1
South	0	0	0	0	0	0	0	0	0	0

Figure 89. Number of 1038(j) Forest Fire Prevention Pilot Notices by CAL FIRE area and year.

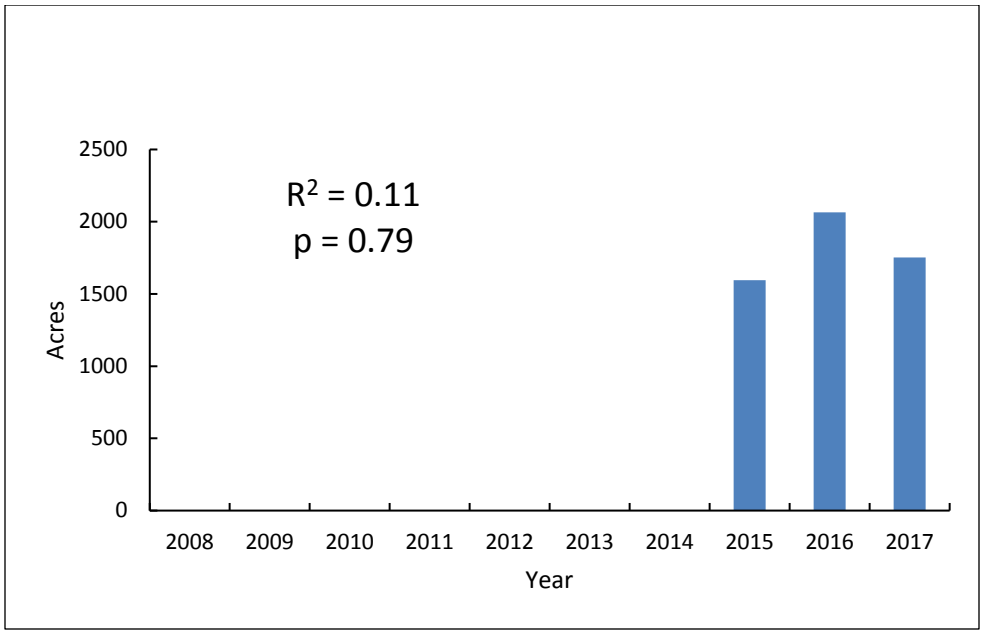
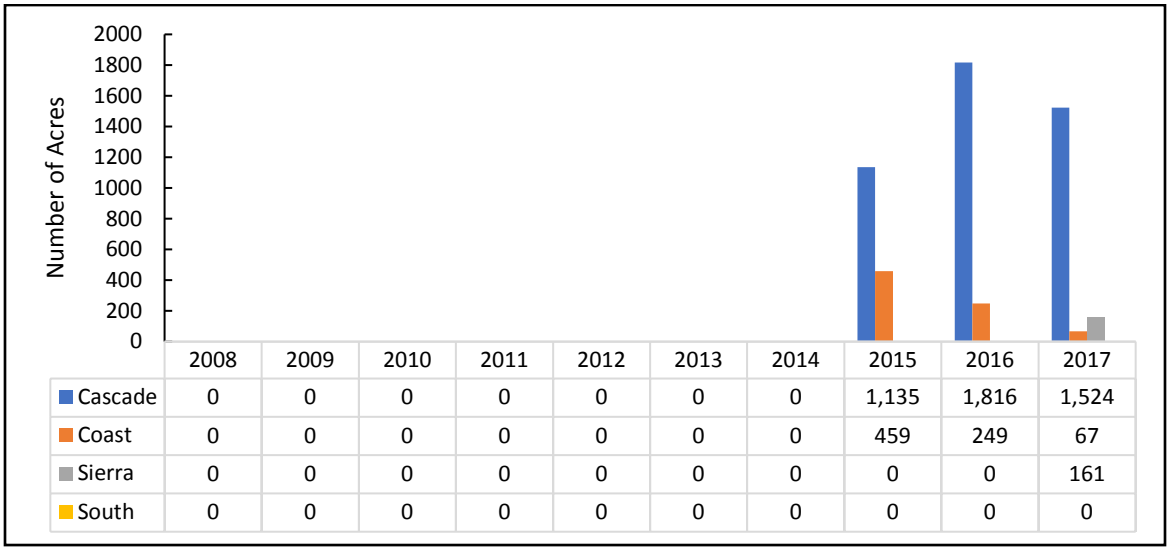


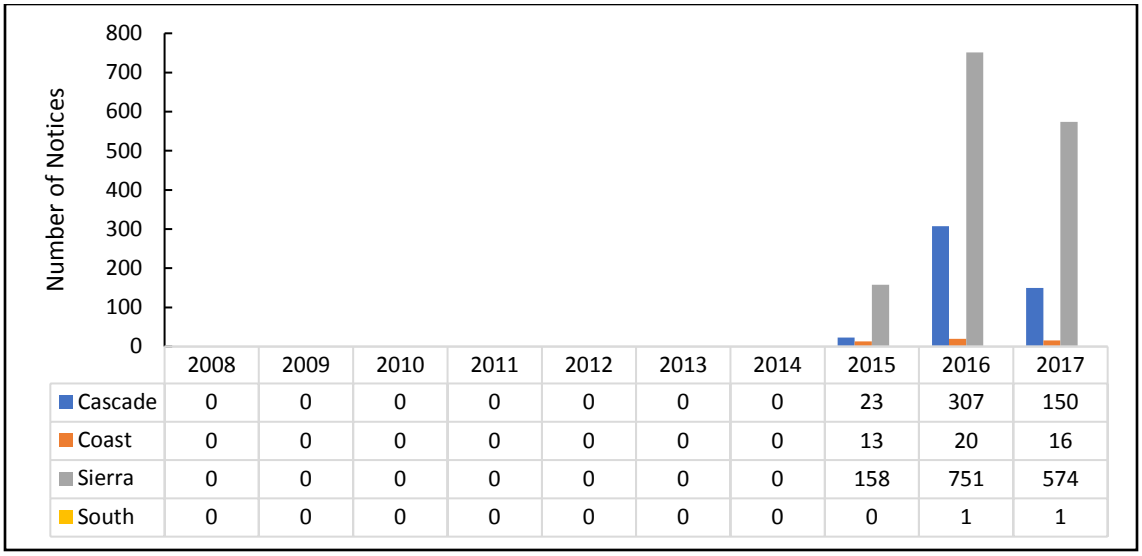
Figure 90. Total number of acres for 1038(j) Forest Fire Prevention Pilot Exemption Notices submitted from 2008 through 2017.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	0	0	0	0	0	0	0	1,135	1,816	1,524
Coast	0	0	0	0	0	0	0	459	249	67
Sierra	0	0	0	0	0	0	0	0	0	161
South	0	0	0	0	0	0	0	0	0	0

Figure 91. Number of acres for 1038(j) Forest Fire Prevention Pilot Notices by CAL FIRE area and year.

1038(k) Drought Mortality



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	0	0	0	0	0	0	0	23	307	150
Coast	0	0	0	0	0	0	0	13	20	16
Sierra	0	0	0	0	0	0	0	158	751	574
South	0	0	0	0	0	0	0	0	1	1

Figure 92. Number of 1038(k) Drought Mortality Notices by CAL FIRE area and year.

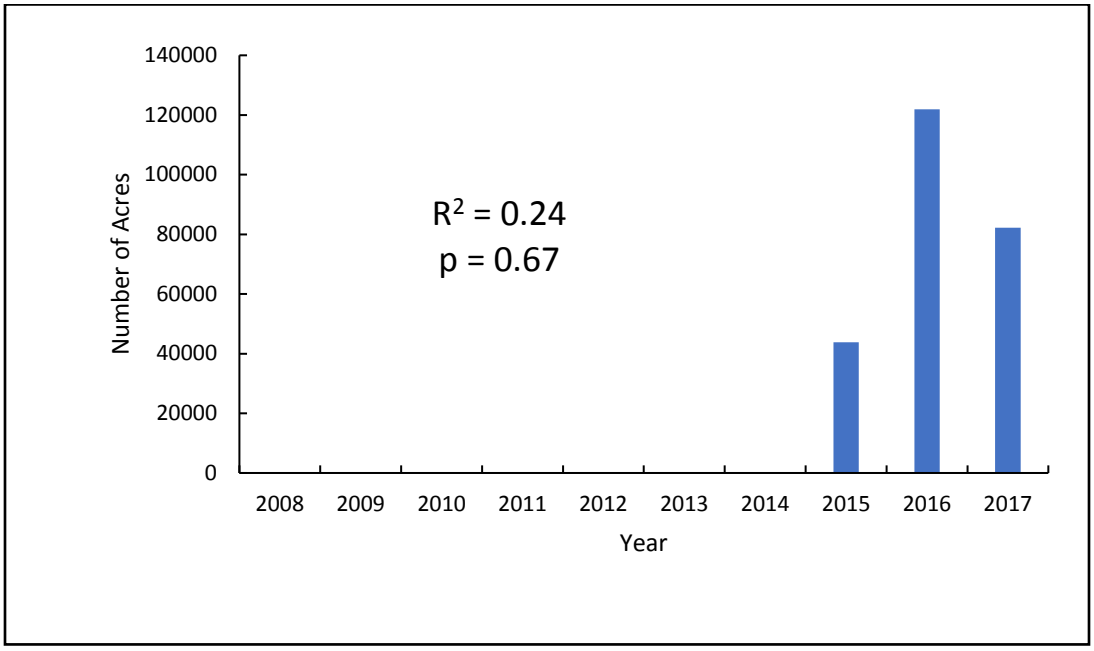
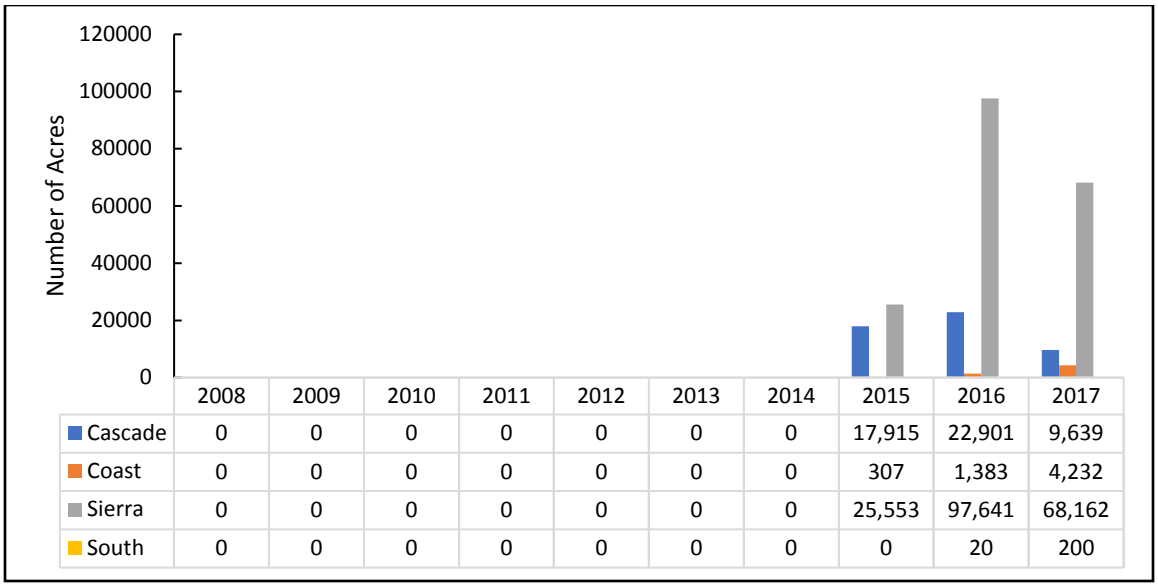


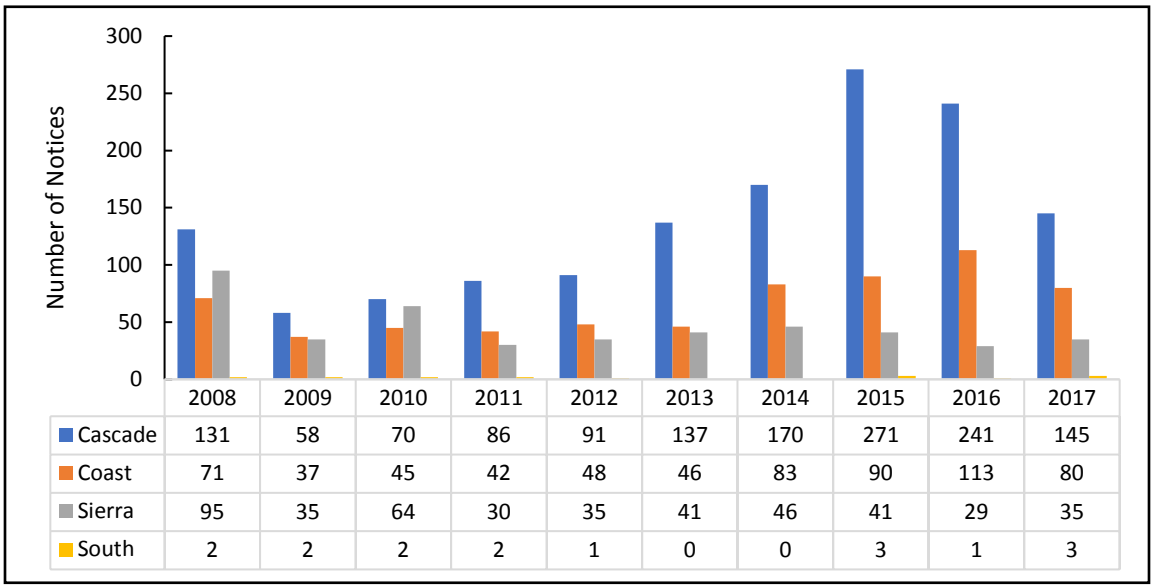
Figure 93. Total number of acres for 1038(k) Drought Mortality Exemption Notices submitted from 2008 through 2017.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	0	0	0	0	0	0	0	17,915	22,901	9,639
Coast	0	0	0	0	0	0	0	307	1,383	4,232
Sierra	0	0	0	0	0	0	0	25,553	97,641	68,162
South	0	0	0	0	0	0	0	0	20	200

Figure 94. Number of acres for 1038(k) Drought Mortality Notices by CAL FIRE areas and year.

1104.1.a Less than 3 Acre Conversion Exemption



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	131	58	70	86	91	137	170	271	241	145
Coast	71	37	45	42	48	46	83	90	113	80
Sierra	95	35	64	30	35	41	46	41	29	35
South	2	2	2	2	1	0	0	3	1	3

Figure 95. Number of 1104.1.a Less than 3 Acre Conversion Exemption Notices from 2008 through 2017 by CAL FIRE area.

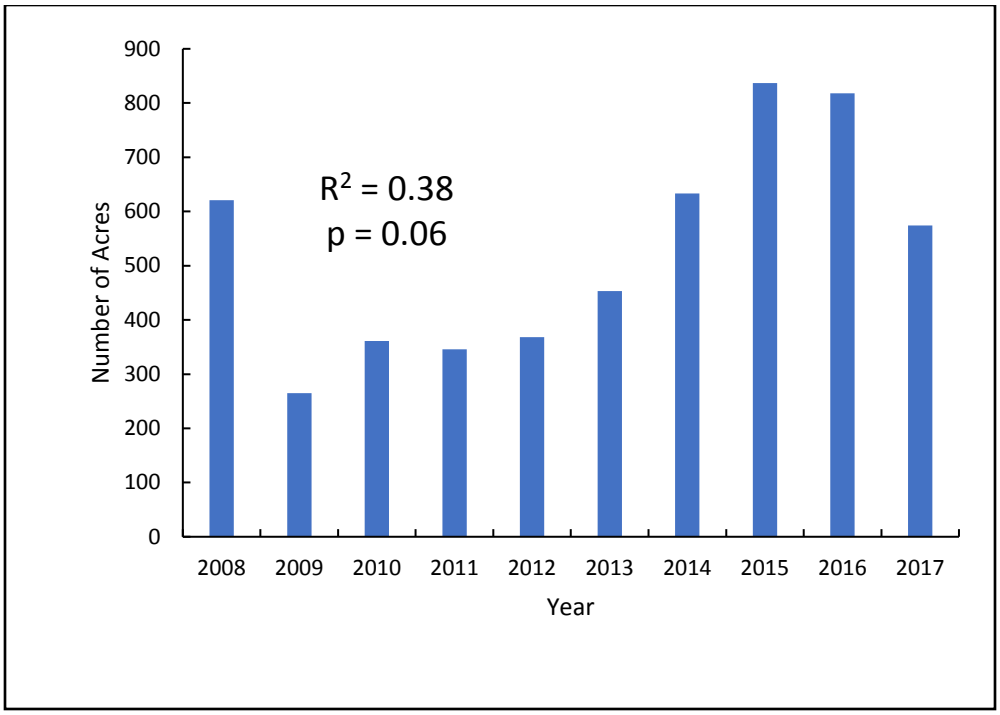
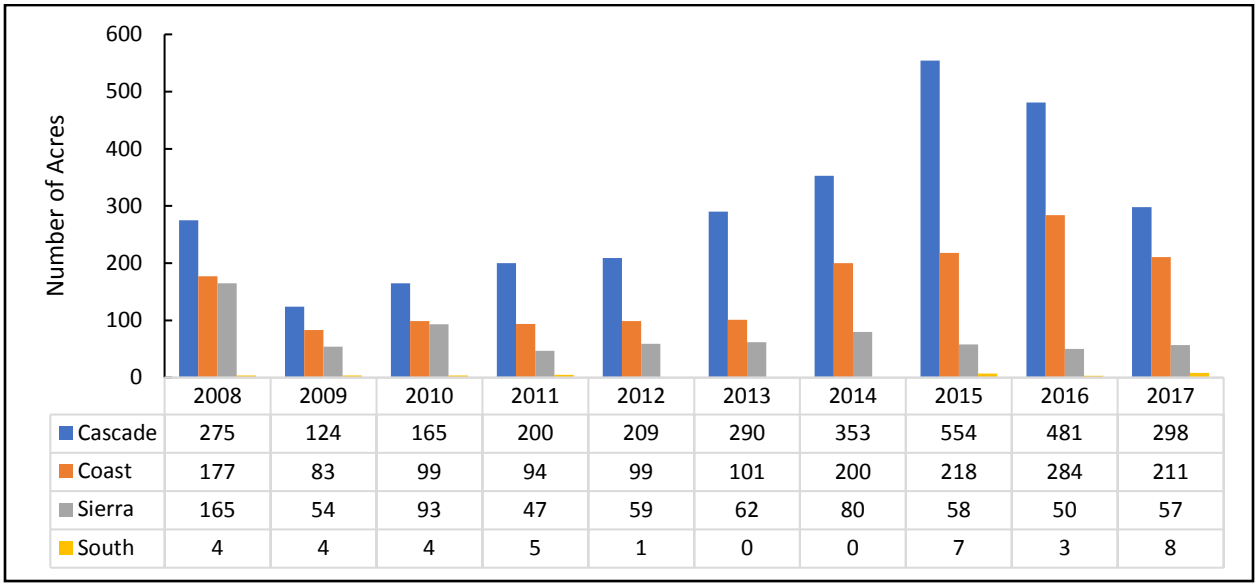


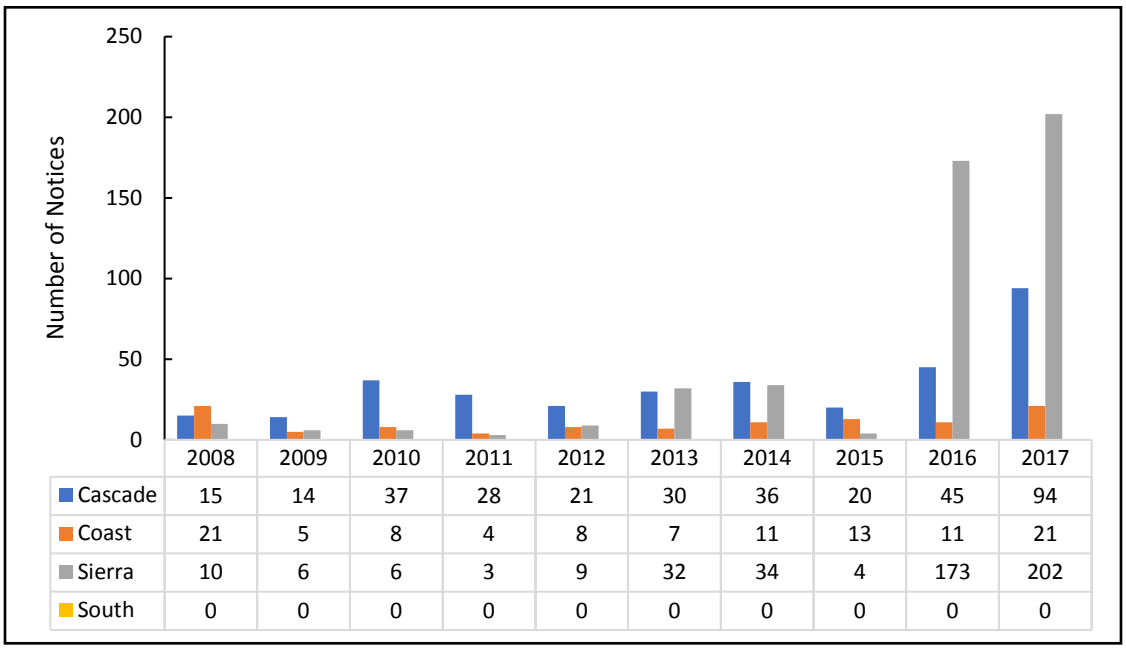
Figure 96. Total number of acres for 1104.1.a Less than 3 Acre Conversion Exemption Notices submitted from 2008 through 2017.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	275	124	165	200	209	290	353	554	481	298
Coast	177	83	99	94	99	101	200	218	284	211
Sierra	165	54	93	47	59	62	80	58	50	57
South	4	4	4	5	1	0	0	7	3	8

Figure 97. Number of acres for 1104.1.a Less than 3 Acre Conversion Exemption Notices by CAL FIRE area and year.

1104.1.c Utility Right-of-Way Conversion Exemption



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	15	14	37	28	21	30	36	20	45	94
Coast	21	5	8	4	8	7	11	13	11	21
Sierra	10	6	6	3	9	32	34	4	173	202
South	0	0	0	0	0	0	0	0	0	0

Figure 98. Number of 1104.1.c Utility Right-of-Way Conversion Exemption Notices from 2008 through 2017 by CAL FIRE area.

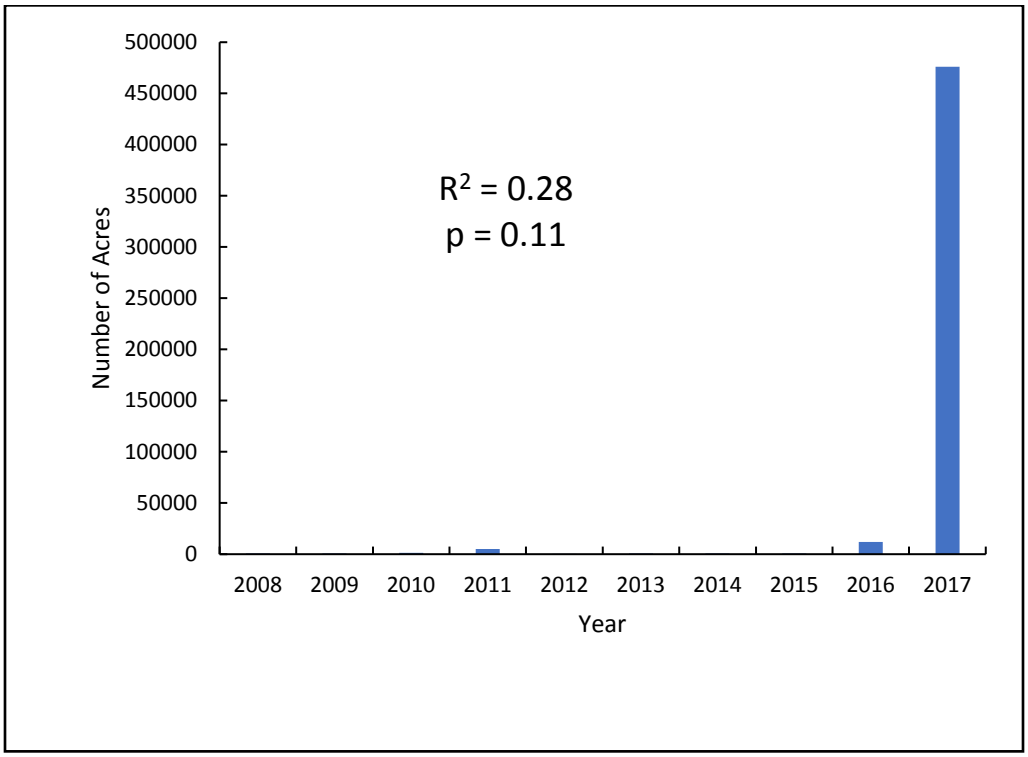
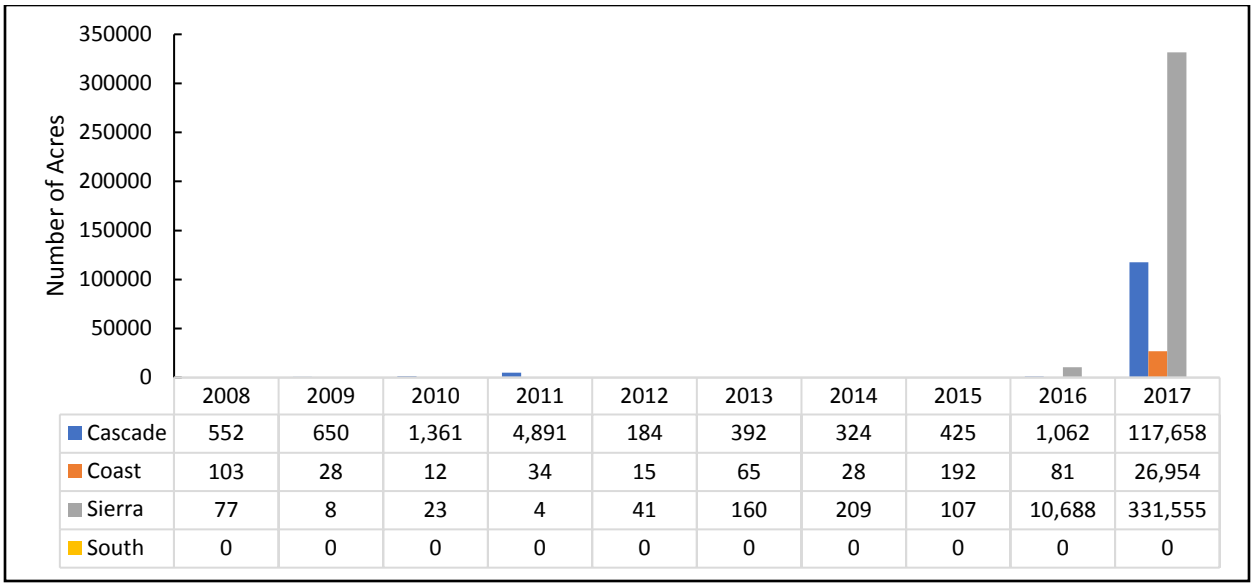


Figure 99. Total number of acres for 1104.1.c Utility Right-of-Way Conversion Exemption Notices submitted from 2008 through 2017.

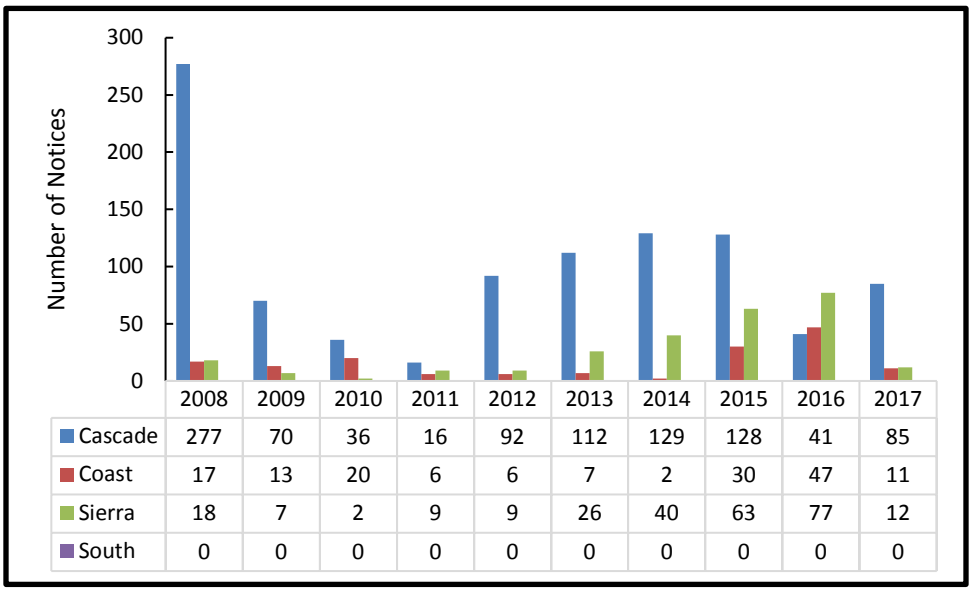


	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	552	650	1,361	4,891	184	392	324	425	1,062	117,658
Coast	103	28	12	34	15	65	28	192	81	26,954
Sierra	77	8	23	4	41	160	209	107	10,688	331,555
South	0	0	0	0	0	0	0	0	0	0

Figure 100. Number of acres for 1104.1.c Utility Right-of-Way Conversion Exemption Notices by CAL FIRE area and year.

Emergency Notices

1052.1(a) & (b) Dead or Dying from Insects, Disease, Fire, Drought, Wind and Flood



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	277	70	36	16	92	112	129	128	41	85
Coast	17	13	20	6	6	7	2	30	47	11
Sierra	18	7	2	9	9	26	40	63	77	12
South	0	0	0	0	0	0	0	0	0	0

Figure 101. Number of 1052.1(a) and(b) Dead or Dying from Insects, Disease, Fire, Drought, Wind and Flood Notices from 2008 through 2017 by CAL FIRE area.

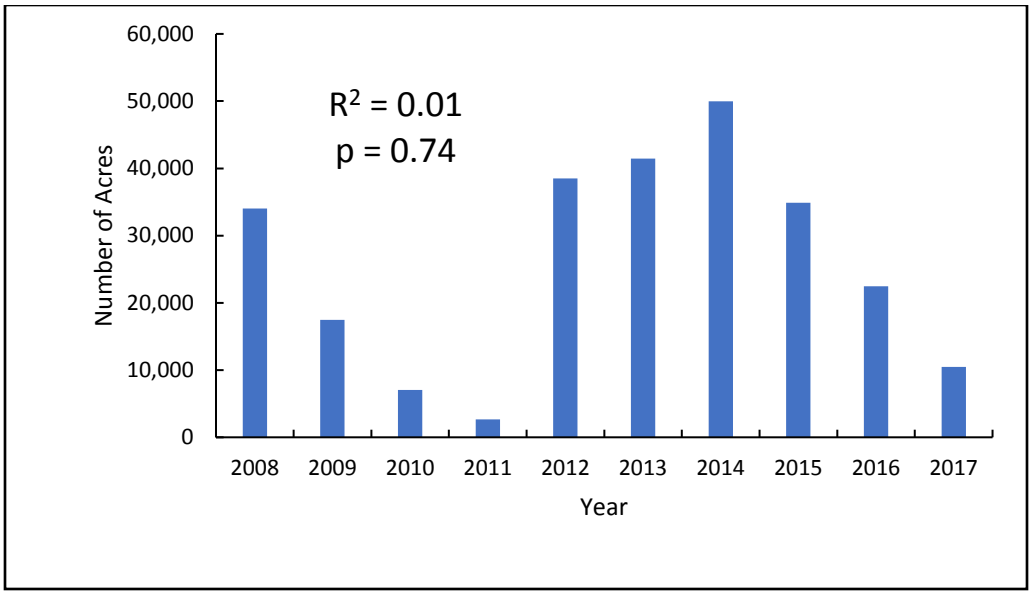
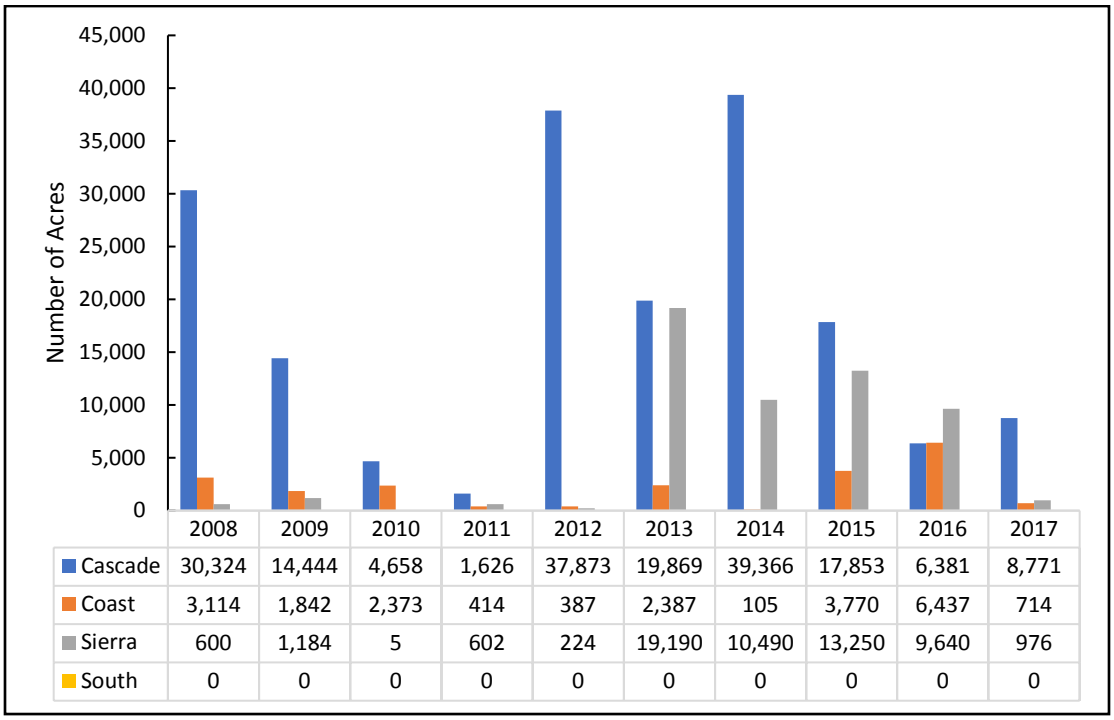


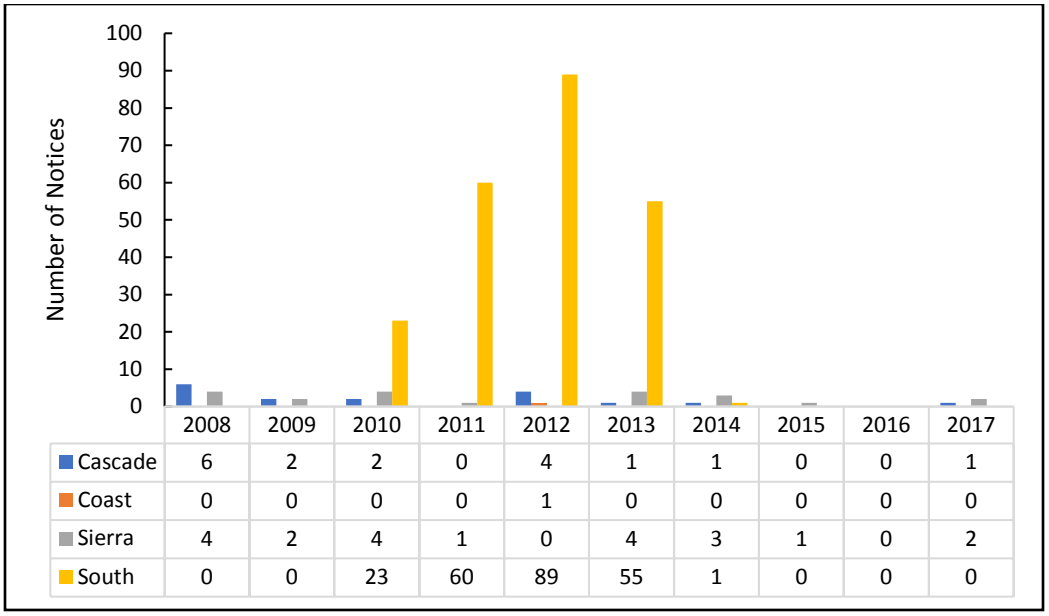
Figure 102. Total number of acres for 1052.1(a) and (b) Dead or Dying from Insects, Disease, Fire, Drought, Wind and Flood Emergency Notices submitted from 2008 through 2017.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	30,324	14,444	4,658	1,626	37,873	19,869	39,366	17,853	6,381	8,771
Coast	3,114	1,842	2,373	414	387	2,387	105	3,770	6,437	714
Sierra	600	1,184	5	602	224	19,190	10,490	13,250	9,640	976
South	0	0	0	0	0	0	0	0	0	0

Figure 103. Number of acres for 1052.1(a) and (b) Dead or Dying from Insects, Disease, Fire, Drought, Wind and Flood Notices by CAL FIRE area and year.

1052.1(e) High or Extreme Fuel Hazard Conditions



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	6	2	2	0	4	1	1	0	0	1
Coast	0	0	0	0	1	0	0	0	0	0
Sierra	4	2	4	1	0	4	3	1	0	2
South	0	0	23	60	89	55	1	0	0	0

Figure 104. Number of 1052.1(e) High or Extreme Fuel Hazard Conditions Notices from 2008 through 2017 by CAL FIRE area.

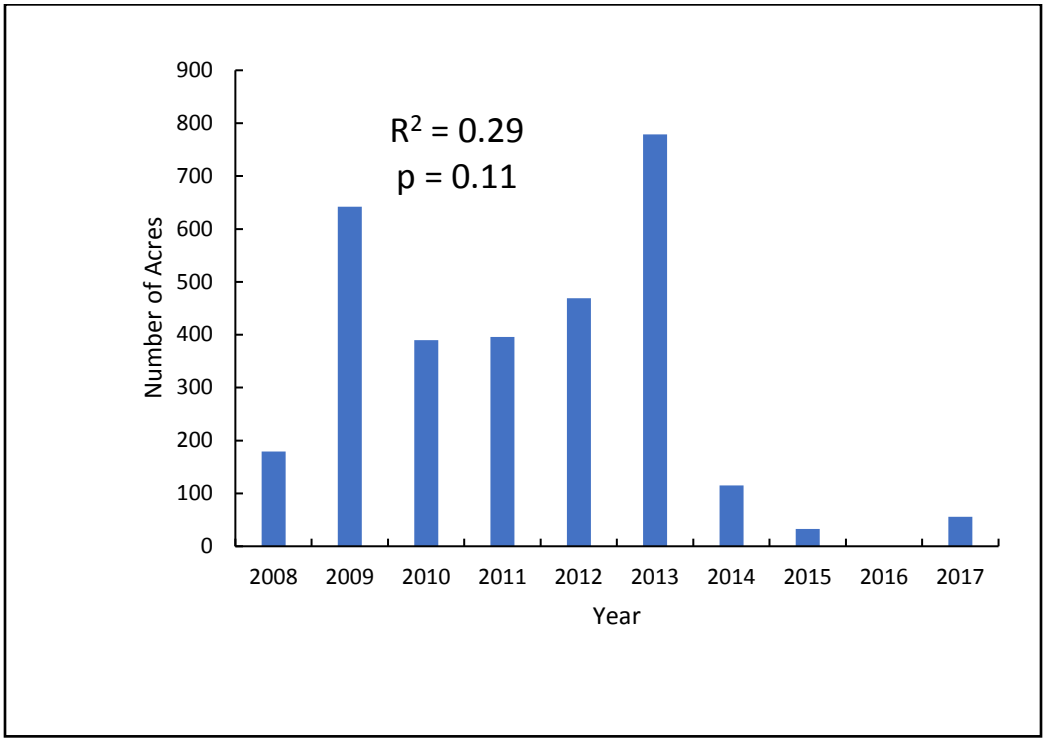
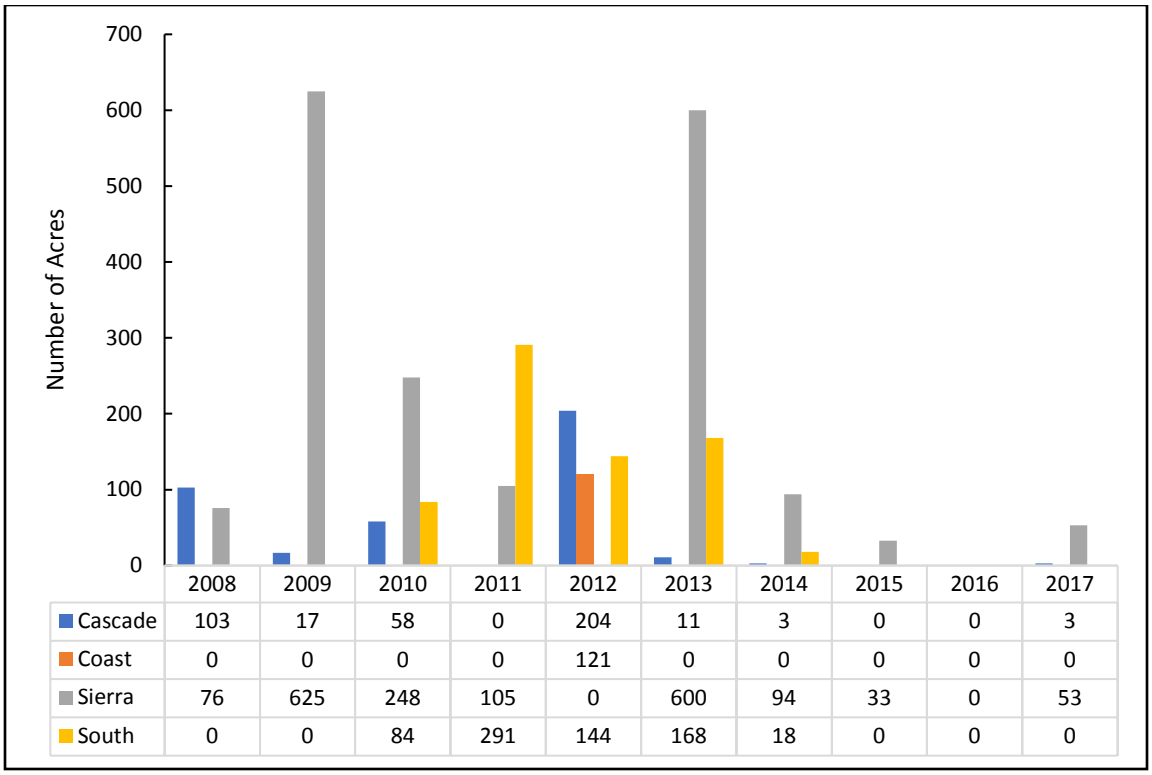


Figure 105. Total number of acres for 1052.1(e) High Fuel Hazard Conditions Emergency Notices submitted from 2008 through 2017.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cascade	103	17	58	0	204	11	3	0	0	3
Coast	0	0	0	0	121	0	0	0	0	0
Sierra	76	625	248	105	0	600	94	33	0	53
South	0	0	84	291	144	168	18	0	0	0

Figure 106. Number of acres for 1052.1(e) High or Extreme Fuel Hazard Conditions Emergency Notices by CAL FIRE area and year.

Appendix B. Exemption and Emergency Notice Pilot Project Field Sampling Protocols

Exemption-Emergency Effectiveness Monitoring Field Sampling Protocol

July 11th, 2018

Required equipment/documents

- A full copy of the Emergency-Exemption document including the notice map of the entire harvest area
- Paper field data form
- Cell phone or Tablet capable of running Survey123 and with a camera
- Field tape with units in feet
- D-tape and/or Biltmore stick
- Chain pin (or a survey stake/pin flag)
- Pocket tape measure/Logger's tape/Yard stick
- Hip chain with units in feet, extra string roll
- Clinometer
- Compass
- Set of timber cruising prisms (5,10, 15,20, 30, 40 BAF)

Overview

A portion of the survey will be an office based examination of the notice and potential associated data, while the majority of the survey is a field-based rapid assessment in order to gather baseline data. For this first year assessment, only 1038(i), 1038(j), 1038(k), and 1052.1(a)(b)(e) notices will be surveyed (Forest Fire Prevention, Forest Fire Prevention Pilot, Drought Mortality, and Emergency notices [e.g., fire killed tree harvesting]).

The rapid field assessment has been developed to easily gather field data for Emergency and Exemption notice effectiveness monitoring. The basis of the field sampling will be the centroid of the mapped exemption-emergency notice area (Figure 1), supplied by CAL FIRE GIS trained staff. Key aspects identified and surveyed will be watercourse road crossings, sediment discharges from road segments, sediment discharges from harvesting activity into watercourses, approximate fuel loads, habitat, and stand condition following treatment.

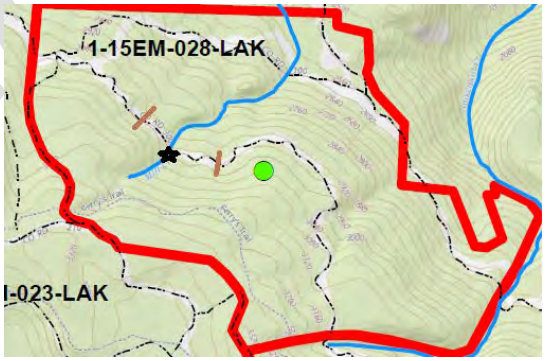
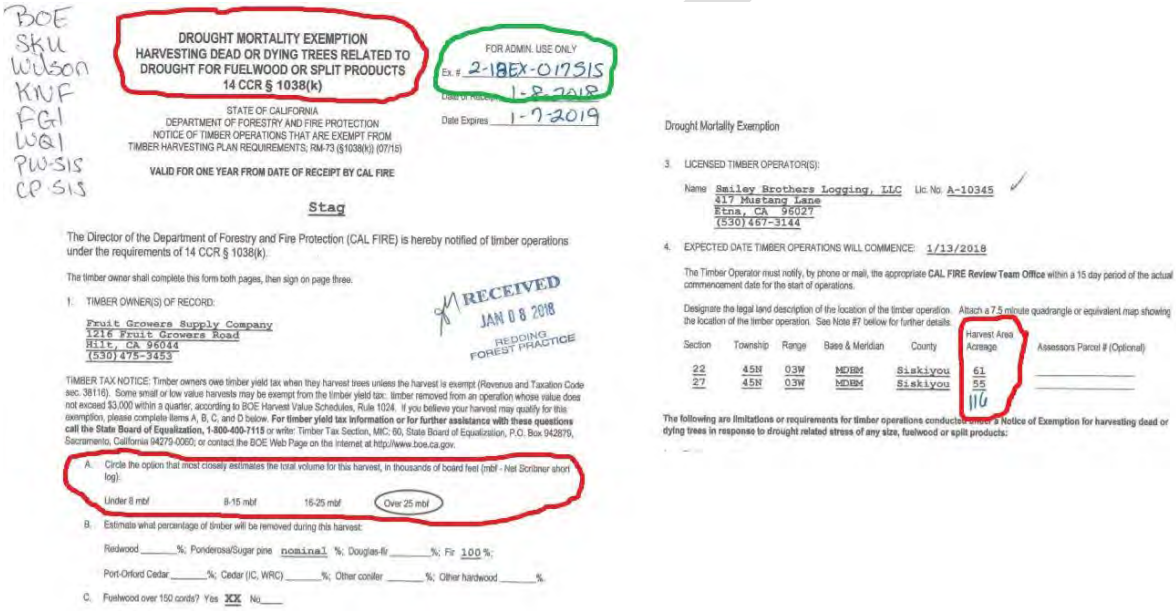


Figure 1: The centroid for the emergency notice is the green dot. The black star is the closest watercourse crossing to the centroid on the nearest road segment. The road segment to evaluate is 660 feet in each direction from the watercourse crossing.

Office assessment

In the office based assessment, please identify the following:

- Notice document type: **Emergency** or **Exemption**, and the specific rule being applied [1038(i)(j)(k), 1052.1(a)(b)(e)]
- The **region** (1, 2, 3, 4; North Coast, Cascade, Southern, Sierra), **county**, **year submitted, three digit plan number**, **total project acres**, and **volume harvested class** (< 8, 8-15, 16-25, >25 MBF)
- If any part of the document has been left blank, such as the **volume harvested class**, leave this data blank. Even when it may be clearly apparent, if the data has not been supplied by the RPF in the document, data will not be included.



DROUGHT MORTALITY EXEMPTION
HARVESTING DEAD OR DYING TREES RELATED TO DROUGHT FOR FUELWOOD OR SPLIT PRODUCTS
14 CCR § 1038(k)

FOR ADMIN. USE ONLY
Ex. # 2-18EX-017SIS
Date Expires 1-7-2019

STATE OF CALIFORNIA
DEPARTMENT OF FORESTRY AND FIRE PROTECTION
NOTICE OF TIMBER OPERATIONS THAT ARE EXEMPT FROM TIMBER HARVESTING PLAN REQUIREMENTS; RM-73 (§1038(k)) (07/15)

VALID FOR ONE YEAR FROM DATE OF RECEIPT BY CAL FIRE

Stag

The Director of the Department of Forestry and Fire Protection (CAL FIRE) is hereby notified of timber operations under the requirements of 14 CCR § 1038(k).

The timber owner shall complete this form both pages, then sign on page three.

1. TIMBER OWNER(S) OF RECORD:
Fruit Growers Supply Company
1216 Fruit Growers Road
Hilt, CA 96044
(530) 475-3453

RECEIVED JAN 08 2018 REDDING FOREST PRACTICE

TIMBER TAX NOTICE: Timber owners owe timber yield tax when they harvest trees unless the harvest is exempt (Revenue and Taxation Code sec. 38116). Some small or low value harvests may be exempt from the timber yield tax: timber removed from an operation whose value does not exceed $3,000 within a quarter, according to BOE Harvest Value Schedules, Rule 1024. If you believe your harvest may qualify for this exemption, please complete items A, B, C, and D below. **For timber yield tax information or for further assistance with these questions call the State Board of Equalization, 1-800-400-7115** or write: Timber Tax Section, MIC: 60, State Board of Equalization, P.O. Box 942879, Sacramento, California 94279-0060; or contact the BOE Web Page on the Internet at http://www.boe.ca.gov.

A. Circle the option that most closely estimates the total volume for this harvest, in thousands of board feet (mbf - Net Scribner short log):
Under 8 mbf | 8-15 mbf | 16-25 mbf | Over 25 mbf

B. Estimate what percentage of timber will be removed during this harvest:
Redwood _____%; Ponderosa/Sugar pine nominal %; Douglas-fir _____%; Fir 100 %;
Port-Orford Cedar _____%; Cedar (IC, WRC) _____%; Other conifer _____%; Other hardwood _____%.

C. Fuelwood over 150 cords? Yes XX No____

Drought Mortality Exemption

3. LICENSED TIMBER OPERATOR(S):
Name Smiley Brothers Logging, LLC Lic. No. A-10345
417 Mustang Lane
Etna, CA 96027
(530) 467-3144

4. EXPECTED DATE TIMBER OPERATIONS WILL COMMENCE: 1/13/2018

The Timber Operator must notify, by phone or mail, the appropriate **CAL FIRE Review Team Office** within a 15 day period of the actual commencement date for the start of operations.

Designate the legal land description of the location of the timber operation. Attach a 7.5 minute quadrangle or equivalent map showing the location of the timber operation. See Note #7 below for further details.

Section	Township	Range	Base & Meridian	County	Harvest Area Acreage	Assessors Parcel # (Optional)
22	45N	03W	MDBM	Siskiyou	61	
27	45N	03W	MDBM	Siskiyou	55	
					116	

The following are limitations or requirements for timber operations conducted under a Notice of Exemption for harvesting dead or dying trees in response to drought related stress of any size, fuelwood or split products:

Figure 2: In this example, the Exemption document is a 1038(k) Drought Mortality exemption, indicating ">25 BMF" being harvested, with 116 acres reported under the notice (circled in red). In the green circle, the "2" indicates Region 2 (Cascade), the "18EX" indicates the year 2018, "017" is the three digit plan number, and "SIS" indicates Siskiyou county.

- Identify from the notice map the presence or absence of the following details:
    - Non-public permanent roads, seasonal, temporary, and unclassified roads
    - Class 1, 2 or 3 watercourses, other identified watercourses
    - Watercourse crossings
    - Springs or wetlands, lakes or ponds
- The following items area also to be identified, when present, in the office assessment; these may be found within the notice document or on the notice harvest map, or via database research:
    - Unstable areas
    - Archaeology sites
    - California Natural Diversity Database (CNDDB) detections
    - Northern Spotted Owl (NSO) activity centers and buffers

- Any previously completed timber harvest, or exemption/emergency notice within the notice area boundary (a timber harvest must have occurred in the last 10 years to be included)
- Any concurrently active exemptions within the boundary of the notice being surveyed

Field Assessment

Note: For the field assessment, one surveyor will be recording data on the paper field data sheet, while another will be recording inputs on the Survey123 app. It is critical that only *one* person record data for a particular notice on the Survey123 app.

Also not that the field assessment is based only upon the data provided within the Emergency-Exemption Notice document.

Centroid Location

Walk or drive to the centroid of the notice, as supplied by CAL FIRE GIS specialists. In the case where a centroid is deemed to be on or near a road, such that it is within the zone of influence of the road, the surveyors can move the centroid 2 chains (132 feet) away from the road. If the centroid is in a location deemed to be unsafe or inaccessible, a new centroid is chosen by:

- Using a random number generator to pick a random azimuth between 0-360 degrees, drawing a line on the notice map from the centroid in the direction of the azimuth, determining where the line first intersects a non-public road, and using a new centroid 2 chains from the road in the direction of the original centroid
    - This process will be repeated until an azimuth intersects a non-public road
    - In the case of a notice with no non-public roads to base a new centroid off of, a random azimuth from 0-360 will be chosen and a new centroid found 3 chains (198 feet) from the original centroid in the direction of the random azimuth
    - The surveyors will record in the app/data sheet when a substitute centroid is used
- Within the Survey123 app, use the included map to collect a geopoint of either the original or substitute centroid

Yarding and harvesting methods

For the entire area harvested under the notice, determine the method used for yarding trees, using the categories of “Tractor”, “Cable”, “Tractor and cable”, or “Other”. “Tractor” includes tracked and rubber tired skidders, and shovel logging, for this survey. “Cable” include cable yarding, skyline, and high lead, while “Other” includes helicopter and livestock, or being unable to tell. This assessment is based off of the notice document itself, and observations made in the field while traveling through the harvest area.

For the determination of percent area harvested, surveyors determine for the entire notice area the percent amount harvested in categories of 0-25%, 25-50%, 50-75%, and 75-100%. The silviculture treatment is also assessed for the entire notice area, based on the notice document and/or field observations, and is considered to be the most representative or dominant treatment for the notice (“Clear cut”, “Seed tree”, “Shelterwood”, “Group selection”, or “Single tree selection”) (Figure 3). This assessment is based on **ecological silviculture treatment**; not mechanical. For example, in a recently

burned forest, if sub-merchantable trees and hardwoods have been left behind, but functionally all the merchantable timber has been removed leaving none behind, this would be identified as a clear cut.

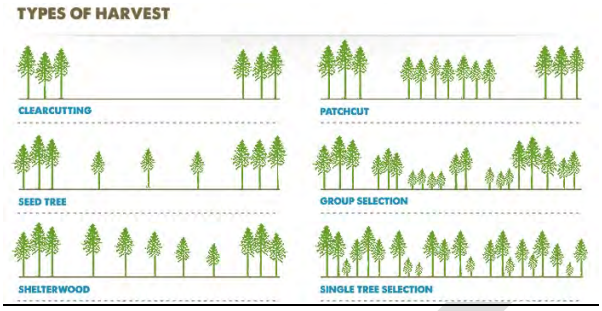


Figure 3: Approximate illustrations of silviculture treatments. Image courtesy of oregonforests.org

Fuel and wildlife plots – 3 plots

For assessing the fuel and wildlife plots, the basis is the notice centroid, and two subsequent plots based off of the centroid. If a plot falls into an unharvested/untreated area, the survey will be conducted anyway with a note made. If a plot falls into the WLPZ or channel itself, the survey will be conducted anyway as safety allows. If the first plot (using the centroid can not be used, follow the protocol previously described to find a new centroid.

This portion of the assessment will includes photos taken for each plot in the cardinal directions of North, East, South, and West. Within an 11.8 foot (1/100th of an acre) circular plot from the centroid, hardwood cover and live ground cover percentages will be recorded (0%, < 10%, 10-40%, 40-75%, > 75%), along with the number of downed large wood piece >12" DBH and 10 feet in length that intersect the plot. All decay classes of large wood are counted.

Additionally, in order to record stand structure metrics and data on habitat and potential fuel behavior, a variable radius plot will be used. The appropriate basal-area prism factor will be chosen that will yield 5-7 trees within the variable radius plot, and this prism factor will be used on all three plots. Every "in" tree will be counted, and every other "borderline" tree will be counted. For each counted tree, surveyors will record the tree species and condition ("Green", "Dead – red phase", "Dead – gray phase", or "Snag"), and if it is a den or nest tree. Nest trees must be >16" diameter at breast height (DBH) and 20 feet in height, while den trees must be alive with a cavity in the trunk or limbs. For each tallied tree, the DBH will be recorded along with a depth of surface fuel (slash from timber operations only) halfway between the plot center and tallied tree.

The next two additional plots will be found by using a random number generator to generate an azimuth from 0-360 degrees, and pacing 2 chains in the direction of the azimuth for Plot #2, and 2 chains in the opposite direction for Plot #3 (e.g., from Plot #1 center surveyors go 2 chains in the direction of a 90 degree azimuth, Plot #3 would be 2 chains from the Plot #1 center in the direction of 270 degrees). In the case that the 2nd or 3rd plot falls into an area that can't be used (e.g., a road or within influence of the road, in a flowing watercourse, on an outbuilding in developed areas), the plot can be moved 1 chain (66 feet) and reestablished. If Plot #3 can't be placed in a direction 180 degrees from Plot #2 (e.g., Plot #3 lands outside the Notice area or within the influence of roads, structures), then choose another random azimuth to place Plot #3. Place Plot #3 two chains from centroid along newly selected azimuth. Plot #3 shall not be within 45 degrees azimuth of the first random azimuth used to locate Plot #2.

Finally, for the three fuel and wildlife plots combined, determine the appropriate seral class ("Early", "Mid", "Late", or "Non-timber") and site prep treatments that would be the average of the three plots.

Road segment assessment

For assessing the road segment, a non-public road segment with a watercourse crossing that is closest to the centroid will be used (Figure 1). In the case that all roads are public, there will be no road segment assessment. In the case non-public roads being present, and no watercourse crossings, a substitute road segment will be found by generating a random number from 1-8, and identifying the first public road intersected by the corresponding azimuth (Reference 1, Figure 4). This process will continue until a road is identified.

Reference 1: Compass direction relating to random numbers 1-8

315* NW (8)	0/360* North (1)	45* NE (2)
270* West (7)	**Random compass direction from centroid**	90* East (3)
225* SW (6)	180* South (5)	135* SE (4)

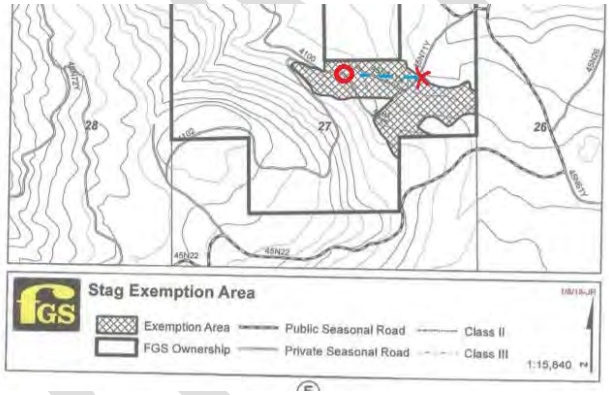


Figure 4: In a case where no watercourse crossings were present, from the centroid a 3 was the random number, indicating that in the direction of 90 degrees a line was made, and where it intersected the road, the road segment was identified (x).

Road segments will be evaluated from the starting point to 660 feet in each direction (1,320 feet, or 0.25 miles total), or until the segment ends or leaves the notice area. At forks and intersections, a coin flip will be used to determine the direction of travel. For roads segments starting at a watercourse crossing, data recorded will include the crossing type ("Bridge", "Culvert", "Ford", "Open bottom arch", "Other") and watercourse classification, if the crossing can be determined to be pre-existing or newly constructed, the diameter or width, if the potential for diversion exists, and if the watercourse crossing is adequately sized (based on professional judgement). One note of consideration is that if the crossing used is found to be a pulled and abandoned crossing, it will be considered a crossing and recorded (Using "Other" for type, and using comments to indicate it was removed after harvest).

Figure 5: No potential for diversion (Left), and potential for diversion (Right) (Images from Furnis et al., 1997)

The road segment survey will also rapidly assess road drainage and construction. Presence/absence will be recorded for surface rill, gully, and ponding features. Rills will be defined as incision into the road surface that is at least 1" deep, while a gully is 6" or more (Longstreth et al., 2007), while for the purpose of this study ponding will be standing water that covered 50% of the roadway or more and was at least ½" in depth.

Figure 6: Rills on a road surface (left) and a gully formed on a road surface (right)

Additionally, the presence and absence of rill/gully features at road drainage points will be recorded, the presence of cut or fill bank failures, and the number of waterbars, rolling dips, lead-outs, and other **constructed** road drainage features encountered. Finally, the number of Class 1, 2, or 3 watercourse crossings, including the crossing used to start the survey, will be counted.

Sediment delivered from a road segment to a watercourse will be recorded. In the case of using a watercourse crossing to initiate the road survey, sediment delivery will be recorded within the road segment portion of this assessment (as applicable), using the approach length for the flowpath length (see below for explanation on the flowpath length). When sediment delivery from the road to a watercourse is not readily apparent, but possibly occurred, a field investigation should be undertaken if the watercourse is not visible from the road **and** the sediment flow path terminus is not visible from the road.

If identified, a sediment discharge will have the following data recorded with it:

- Source ("Crossing", "Ditch failure", "Road failure", "Rolling dip", "Surface sheetwash", "Waterbar", "Other")
- A GPS point at the point of discharge from the road and a photo
- The "Flowpath Length" category (0-50, 50-100, 100-200, >200 feet)
- Flow path "Roughness Class (Reference 2)

- Estimated volume discharged (“Trace”, “<1 CY”, “1-5 CY”, “5-10 CY”, “>10 CY”, “Significant event”)
    - Trace indicates sediment was delivered but the volumetric estimate can’t be determined, while Significant Event indicates sediment delivered exceeds 10 CY and is closer in magnitude to a mass movement/landslide
- The receiving watercourse classification
- If the discharge is episodic (only following heavy rain, road traffic, etc) or chronic (ongoing)
- The erosional feature by which sediment is transported (e.g., rill or gully)
- Other pertinent information, such as “Road segment was below a severely burned hillslope”

Additionally, context will be given to the road segment, with the road surface, class, shape, topographic position, hillslope gradient, and road gradient recorded.

Reference 2: Roughness class to assess cover on flowpaths that sediment is delivered along [adopted from Litschert and MacDonald (2009)]

Class	Description
1	Bare mineral soil, little to no surface roughness
2	Over 50% bare soil, live vegetation absent on > 50% of flowpath, some presence of litter, coarse wood, rocks, light slash cover
3	Less than 50% bare soil, live vegetation present on > 50% of flowpath, litter, duff, coarse wood, rock, light slash cover
4	Dense cover of vegetation, litter, duff, coarse wood, rock, and/or heavy slash that interrupts downslope surface runoff pathway.
5	Intentionally armored road surface

Watercourse WLPZ/ELZ survey

If there are watercourses present in the notice area, and one is used for the start of the road segment survey, that is the watercourse to be sampled; if there are watercourses present, but no crossings, the same process as outlined in the road survey will be used to identify a segment (using a random number of 1-8 (Reference 1), finding the first watercourse intersected in the azimuth direction, and starting from that point of intersection).

In the case that no watercourses are mapped, but surveyors find that once in the mapped notice area, watercourses are present, this will be noted and professional judgement will be used to select a segment within a harvested area of the notice.

From the starting point, watercourse WLPZ/ELZ’s will be surveyed for 200 feet in the upstream and downstream directions, or until the watercourse ends or leaves the notice area. At any watercourse forks, the dominant class and tributary will be followed. The focus of the survey on the WLPZ/ELZ is to assess for any sediment discharges from harvest-related activity (while not duplicating any sediment discharges found in the road segment survey), while also recording the number of road crossings (including the one used on the road segment survey, as applicable), and equipment encroaches. Similar to the road survey, sediment sources are recorded (“Road”, “Skid trail”, “Tractor operations”,

"Crossing", "Other"), geopoints at the source, a photo, flowpath lengths (0-10, 10-50, 50-100, and >100 feet), the flow path Roughness class (Reference 2), volumetric discharge estimate, discharge status, and the erosion feature by which sediment was delivered. Last, for the entire watercourse segment assessed, an estimate will be given for the percent WLPZ canopy cut under the EX-EM notice (0%, 0-33%, 33-66%, >66%), excluding canopy lost due to natural effects such as fire or insects.

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Exemption-Emergency Notice of Timber Operations Effectiveness Monitoring Field Sampling Protocol
Step by step guide to complete an EX-EM effectiveness monitoring assessment

July 11, 2018

Office assessment

Requirements: A printed copy of the EX-EM Notice in full, including the harvest area map.

1) Identify from the Notice document the type: **Emergency** or **Exemption**, and specific rule being applied [1038(i)(j)(k), 1052.1(a)(b)(e)]
2) Identify the Region and County where the notice took place
3) Identify the year submitted
4) Identify the three digit plan number
5) Identify the total project acres as listed on the notice
6) Identify the volume harvested class (< 8, 8-15, 16-25, > 25 MBF)
7) Identify if the included EX-EM Notice has in the harvest area map the following details:
    a. Non-public permanent road(s)
    b. Seasonal road(s)
    c. Temporary road(s)
    d. Unclassified road(s)
    e. Class 1, 2, or 3 watercourse(s)
    f. Other identified watercourse(s)
    g. Watercourse crossing(s)
    h. Spring(s) or wetland(s)
    i. Lakes or pond(s)
8) Further identify the following details, via the EX-EM Notice document/map, or office based research:
    a. Unstable area(s)
    b. Archaeology site(s)
    c. California Natural Diversity Database (CNDDB) detection(s)
    d. Northern Spotted Owl (NSO) activity center(s)
    e. Northern Spotted Owl (NSO) buffer(s)
    f. Previously completed timber harvest, emergency/exemption notices within the notice area boundary (a timber harvest must have occurred in the last 10 years to be included)
    g. Any concurrently active exemptions within the boundary of the notice being surveyed

Field assessment

Requirements:

- A printed copy of the EX-EM Notice in full, including the harvest area map
- Cell phone/tablet
- A method to choose a random number (ranging from 1-8, 1-360) such as a cell phone app (e.g., Random Number Generator by UX Apps)
- Field tape with units in feet
- Pocket tape measure
- Hip chain with units in feet, extra roll of string
- Clinometer
- Compass
- Set of timber cruising prisms (5, 10, 15, 20, 30, 40 BAF)
- Pocket tape measure/Logger's tape/yard stick
- D-tape and/or Biltmore stick
- Chain pin (or a survey stake/pin flag)

1) List the participating agency staff involved with the effectiveness monitoring
   Centroid location
2) Drive or walk to the centroid of the EX-EM Notice
    a. If the centroid is deemed to be on/near a road, such that it is within the zone of influence of the road, the surveyor can move the centroid 2 chains (132 feet) away from the road. The centroid can be located in a channel/watercourse, as long it is safe (e.g. absence of flowing water).
    b. If the centroid is deemed inaccessible or unsafe, a new centroid will be located by the following:
        i. Use a random number generator to pick a random azimuth from 0-360 degrees
        ii. Draw a line on the notice map from the centroid in the azimuth direction
        iii. Determine where this line first intersects a non-public road
        iv. From the azimuth-road intersection, establish a new centroid for sampling **2 chains (132 feet)** from the road in the direction of original centroid
            1. If the above steps i, ii, iii, and iv do not yield a substitute centroid, repeat the process until a random azimuth intersects a non-public road
                a. In the case that there are no non-public roads to base a new centroid off of, choose a random azimuth, and establish a centroid **3 chains (198 feet)** from the original centroid in the direction of the random azimuth.
    c. Once the centroid or substitute centroid is located, use the Survey123 app to record a geopoint at that location
    d. Record on the app and data sheet if a substitute centroid is used
3) Determine the method used for yarding, either via the EX-EM Notice, or from field observations of the harvested area
    a. Categories are "Tractor", "Cable", "Tractor and cable", "Other"
        i. "Tractor" includes tracked skidder, rubber-tired skidder, and shovel logging

   ii. "Cable" includes cable yarding, skyline, and high lead
   iii. "Other" includes helicopter, forwarder, livestock, or unable to determine
4) Determine the approximate percent area harvested (binned values used), for the entire Notice area. The determination is not only for the area sampled, but the entire Notice area
   a. Categories are 0-25%, 25-50%, 50-75%, 75-100%
5) Determine the closest silviculture treatment, for the entire Notice area.
   a. This determination would be the treatment that is considered to be the most representative or dominant type within the Notice area
   b. This is viewed from an ecological standpoint, not strictly mechanical; if harvest removes all merchantable trees, and the intent was to leave none behind, even if small diameter non-merchantable timber is left, this would be considered a clear cut.
   c. Categories are "Clearcut", "Seed tree", "Shelterwood", "Group selection", "Single tree selection" (Figure 1)

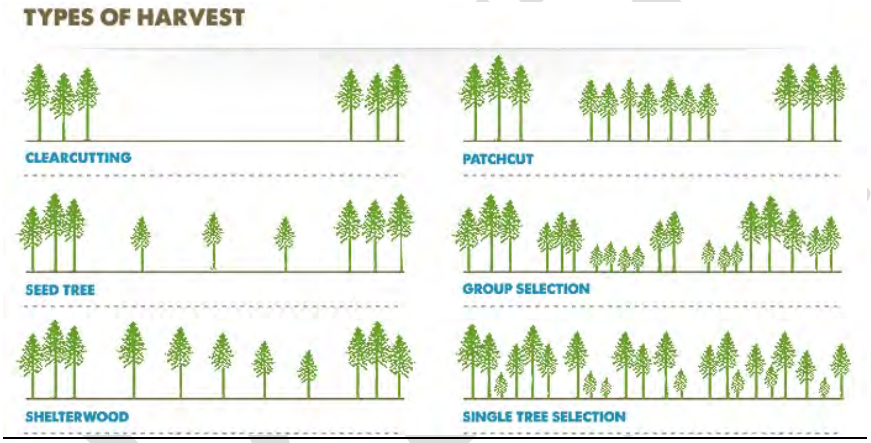

Figure 1: Approximate illustrations of silviculture treatments. Image courtesy of oregonforests.org

Fuels and Wildlife Plots – 3 Plots

6) **Plot #1 is the Centroid.** Mark the plot center (e.g., pin flag, stake, ground marker, etc).
   a. Note on the app/data sheet if the plot falls into an untreated/unharvested area. The survey will still be done in each plot regardless of harvest status
7) Take 4 photos from the centroid, one in each cardinal direction (N, E, S, W)
8) Use compass to ensure each photo is oriented in the correct direction
9) Establish an 11.8 foot radius plot (1/100th acre size) from plot center
   a. Record the percent hardwood cover present in the 1/100th acre plot (0%, < 10%, 10-40%, 40-75%, > 75%)
   b. Record the percent **live** ground cover – measured as **live** ground or brush cover (0%, < 10%, 10-40%, 40-75%, > 75%)
   c. Record the number of pieces of Downed Large Wood within the 1/100th acre plot
      i. Downed LWD pieces must be > 12" DBH and 10 feet in length, and some part of that piece needs to intersect the 11.8 foot plot. All decay classes of large wood are included.
10) Determine the appropriate prism factor to use in order to obtain 5-7 trees within the variable radius plot

a. Choosing the appropriate basal-area prism factor (BAF) to use will be based off of the surrounding stand structure
b. The prism factor chosen should allow you to sample 5-7 trees ideally, dependent upon stand conditions
c. The prism factor chosen **will be used for all three plots**
    i. Hold the prism out such that it falls directly over the centroid sampling point
    ii. Hold the prism upright with your line of sight
    iii. Move in a 360 degree circle, keeping the prism over plot center, noting each tree that is "in" (see Figure 2). Every other "borderline" (see Figure 2) tree will be counted

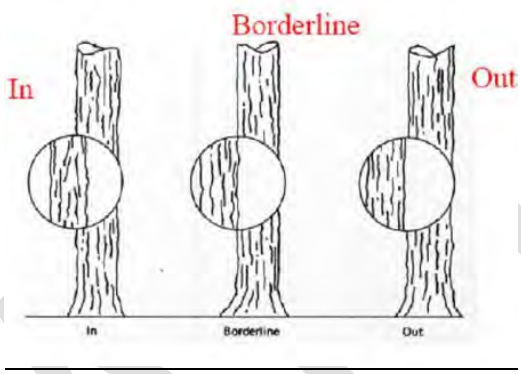

Figure 2: "In", "Out", and "Borderline" trees using timber cruising prism

d. For each "in" tree and every other "borderline" tree, record the tree species, tree condition ("Green", "Dead – red phase", "Dead – gray phase", or "Snag"), and if it is a den tree or nest tree
    i. Den trees must be alive with a cavity in the trunk or limbs
    ii. Nest trees must be > 16" DBH and 20 feet in height
e. For each "In" tree and every other "Borderline" tree, record the diameter at breast height (DBH) in inches
    i. Use a D-tape to measure the tree diameter at approximately 4.5 feet off the ground
f. Half way between the plot center and the "In"/"Borderline" tree, measure the surface fuel depth (**slash from timber operations only**) in inches using a Biltmore stick or ruler
    i. Record the surface fuel depth (slash from timber operations only) at the plot center, in the case that **no trees are recorded in the variable radius plot**
    ii. If a plot was not harvested/treated, then fuel depth will be 0" if there is no harvest-related slash/fuel.

11) Establish **Plot #2**.
a. Use a random number generator to determine a random compass azimuth between 0-360
b. Pace **2 chains** (132 feet) from the center of plot 1 in the direction of the random azimuth
c. Mark the plot center (e.g., pin flag, stake, ground marker, etc)

i. A second plot that falls into an unsafe location, on a road or within the influence of one, on built environment (building, crop) can be moved 1 chain (66 feet) and reestablished.

d. Note on the app/data sheet if the plot falls into an untreated/unharvested area. The survey will still be done in each plot regardless of harvest status

e. Repeat steps **7-9** from above to gather fuel and wildlife data

12) Establish **Plot #3**

a. Return to Plot #1, and pace **2 chains** (132 feet) from the Plot #1 center in the opposite direction of Plot #2 (e.g., Plot #2 was at 45 degrees, travel 2 chains at 225 degrees from the center of Plot 1). Repeat steps **7-9** from above to gather fuel and wildlife data

i. If Plot #3 cannot be placed 180 degrees opposite of Plot #2 due to being outside the Notice boundary or a high concentration of roads/structures, use a random number generator to select another azimuth that does not fall within 45 degrees of the first random azimuth. Travel 2 chains from centroid along selected azimuth to locate Plot #3.

b. Note on the app/data sheet if the plot falls into an untreated/unharvested area. The survey will still be done in each plot regardless of harvest status

13) Determine for all three plots the seral class present ("Early", "Mid", "Late, "Non-timber") and note if any general site prep work was done

a. These determinations fit into generalized broad categories, as the "average" seral class and site prep found across the sample plots

Road segment

14) Use the **EX-EM Notice map** to identify the closest non-public road segment that includes at least one watercourse crossing. If a crossing has been pulled, this will be treated as a crossing regardless and assessed. Record the crossing type as "Other" and include comments.

a. If all roads within the notice area are public roads, there will be no road segment assessment. Continue on to the **Watercourse survey**

b. If no watercourse crossings on non-public roads are present, a substitute road segment will be found by:

i. Use a random number generator to select a number between 1-8; the number refers to the compass direction (Reference 1).

Reference 1: Compass direction relating to random numbers 1-8

315* NW (8)	0/360* North (1)	45* NE (2)
270* West (7)	**Random compass direction from centroid**	90* East (3)
225* SW (6)	180* South (5)	135* SE (4)

ii. In the compass direction, identify the first non-public road intersected by the line. This will be the sample road segment

iii. If there is no compass direction/road intersection, pick a second number. Continue as needed to find a road segment.

15) Make note within Survey123and Data Sheet if the sampled road also serves as residential access
16) From the intersection of the road and watercourse (or road and compass direction line), road sampling will be conducted **660 feet in each direction** (1,320 feet or 0.25 miles total)
    a. If the road segment ends, or leaves the Notice area, the sampling stops at that point
    b. At road forks and intersections, flip a coin to determine travel direction
17) If the watercourse survey starts at a road crossing, record the **crossing type** ("Bridge", "Culvert", "Ford", "Open bottom arch", "Other"). Additionally:
    a. Record (if it can be determined) if the crossing was pre-existing, new with the EX-EM Notice; if it can't be determined, record as such
    b. Record the diameter (if a culvert, open bottom arch, or other circular feature) or the width (if ford or bridge)
    c. Assess the potential for diversion from the initial watercourse crossing (as applicable)

Figure 3: No potential for diversion (Left), and potential for diversion (Right) (Images from Furnis et al., 1997)

    d. Assess (using professional judgement) if the watercourse crossing is adequately sized (Yes/No, as applicable)
    e. Record the watercourse class at the crossing (Class 1, 2, 3, or 4).
18) Start the survey in one direction, walking 660 feet, noting the following (make notes only – this data will be entered in as a summary for the entire segment at the end):
    a. Rill, gully, or ponding features on the road surface ("Yes" or "No" for presence)
        i. A rill is defined as incision into the surface of at least 1" (IMMP, 2007)
        ii. A gully is defined as incision into the surface of 6" or more (IMMP, 2007)
        iii. Ponding for this protocol is defined as standing water of at least ½" that covers 50% of the roadway or more

Figure 4: A road surface with rills (Left) and a gully formed (Right).

b. Cut bank and fill bank failures ("Yes" or "No" for presence)
c. Rill or gully features at road drainage points ("Yes" or "No" for presence)
    i. These features do not need to connect to a watercourse. These are general observations to determine the construction and nature of runoff and drainage along the road segment
d. Count the number of Class 1, 2 or 3 watercourse crossings encountered (including the crossing used to start the survey, as applicable)
e. Count the number of waterbars, rolling dips, lead-outs, and other **constructed** road drainage features encountered.
f. The total length surveyed out of the possible 660 feet for that portion.
g. Note points of sediment delivery to watercourses from the road segment; this data will be collected as you return to the starting location

19) **Road sediment delivery data**
    a. Sediment delivered from the initial starting point at the crossing (as applicable) will be recorded as a sediment delivery
    b. If sediment delivery from the road to a watercourse is not readily apparent, but possibly occurred, a field investigation should be undertaken if the watercourse is visible from the road **and** the sediment flow path terminus is not visible from the road
    c. Determine the road sediment source, i.e., where did the sediment come from ("Crossing", "Ditch failure", "Road failure", "Rolling dip", "Surface sheetwash", "Waterbar", "Other")
    d. Collect a GPS point at the point of discharge from the road
    e. Collect a photo of the erosional feature
    f. Determine the "Flowpath Length" category (measured as from the point of discharge from the road to the watercourse; or at a crossing, the longest approach length)
        i. In the case of a crossing, it is the cumulative length of the approaches
    g. Determine the "Roughness Class" along the flow path (**see Reference 2**)

Reference 2: Roughness class to assess cover on flowpaths that sediment is delivered along [adopted from Litschert and MacDonald (2009)]

Class	Description
1	Bare mineral soil, little to no surface roughness
2	Over 50% bare soil, live vegetation absent on > 50% of flowpath, some presence of litter, coarse wood, rocks, light slash cover
3	Less than 50% bare soil, live vegetation present on > 50% of flowpath, litter, duff, coarse wood, rock, light slash cover
4	Dense cover of vegetation, litter, duff, coarse wood, rock, and/or heavy slash that interrupts downslope surface runoff pathway.
5	Intentionally armored road surface

h. Estimate the volume discharged to the watercourse
    i. "Trace" indicates sediment was delivered, but a volumetric estimate can't be readily determined
    ii. "Significant Event" indicates the volume of sediment delivered exceeds 10 cy and is closer in magnitude to a mass movement/landslide scale
i. Determine the classification of the receiving watercourse
j. Determine if the sediment discharge is a chronic feature, or episodic only in nature
    i. This determination implies that a chronic feature is an ongoing issue, while an episodic discharge may only occur during heavy rain events, following heavy road traffic, rain on snow events, etc.
k. Determine the erosion feature, or what is the mechanism by which sediment was delivered downslope to the watercourse (e.g., by rill or gully)
l. Add any additional comments within the App/Data sheet that will help to clarify the sediment discharge point (i.e., "Occurred below a severely burned hillslope)

20) Repeat **step 17**, traveling in the opposite direction from the starting point for 660 feet or until the road segment ends or leaves the notice area
21) Repeat **step 18** for the second segment, while traveling back to the starting point, collecting data on any road sediment delivery
22) At the end of the second 660-foot segment, enter in the total length sampled, number of Class 1/2/3 watercourse crossings, and the number of drainage features encountered, and the presence ("Yes"/"No") of road surface rill/gully/ponding features, cut/fill bank failure, and road drainage rill/gully features
23) Determine the road surface for the segment, road shape, road class, topographic position, road gradient, and hillslope gradient (using the categories in Survey123)
    a. Surface categories are "Native", "Gravel/Rocked", "Oiled/Chip Sealed", "Paved", "Other"
    b. Road class categories are "Permanent", "Seasonal", "Temporary", "Abandoned/Deactivated"
    c. Road shape categories are "Crowned", "Flat", "Insloped", "Outsloped", "Throughcut"
    d. Topographic position categories are "Ridgetop", "Mid-slope", "Valley Bottom"
    e. The road gradient class is representative of both the entire segment sampled (0-5%, 5-10%, 10-15%, >15%)
    f. The hillslope gradient class is representative of the entire road segment (0-30%, 30-50%, >50%)

Watercourse WLPZ/ELZ survey

24) Determine if there is a watercourse within the notice area; if **no**, then record this information on the app/data sheet, and the watercourse survey is complete
    a. Based on the EX-EM Notice and field observations, note if there are watercourses present within the notice area that are **not** included on the document map
25) If there is **watercourse crossing used for road segment evaluation**, the watercourse survey will be conducted upstream and downstream of the crossing on that watercourse
26) If there is no watercourse crossing but watercourses present, the following will determine the watercourse to survey
    a. Choose a number between 1-8 using a random number generator. The number picked relates to the compass direction (Reference 1)
    b. Use the EX-EM Notice map to identify the first Class 1/2/3 watercourse intersected in the chosen compass direction, and sample upstream and downstream from the point of intersection
        i. If no watercourse is in the chosen direction, and there are watercourses present on the notice map, repeat the above 22(a) and 22(b) steps to pick a watercourse

Reference 1: Compass direction relating to random numbers 1-8

315* NW (8)	0/360* North (1)	45* NE (2)
270* West (7)	**Random compass direction from centroid**	90* East (3)
225* SW (6)	180* South (5)	135* SE (4)

ii.

27) If there are no mapped watercourses on the EX-EM Notice map, however **field observations indicate that watercourses are present in the Notice area**, the surveyors will use professional judgment to pick a watercourse segment within a harvested portion of the Notice area to survey; make note of this fact in the "Comment" section of the App/Data sheet
28) From the watercourse survey starting point, **200 feet** upstream and downstream (400 feet total) will be surveyed within the WLPZ/ELZ
    a. If the watercourse ends or leaves the Notice area in either direction. The survey stops. At forks, the dominant Class/Tributary will be followed.
29) **Upstream survey**: For 200 feet (or until the watercourse ends or leaves the Notice area), survey the watercourse WLPZ/ELZ. At any watercourse forks, remain on the dominant class and tributary.
    a. Make note of the watercourse Class(es) encountered along the segment
    b. Make note of the number of road crossings encountered, including the crossing at the starting point (as applicable)
    c. Make note of the number of equipment encroachments into the WLPZ or ELZ
    d. Identify any operational-related sediment delivery to the watercourse; sediment delivery is identified by dry season evidence of sediment being delivered to the high water mark of the channel. **These points are not to duplicate any identified sediment sources from the surveyed road segment, including the initial crossing used as the start of the survey (as applicable).**

i. Identify the sediment source (“Road”, “Skid trail”, “Tractor operations”, “Crossing”, “Other”)
ii. Collect a geopoint at the sediment source (e.g., sediment is delivered to the watercourse from a waterbar on a skid trail, a geopoint is collected at the waterbar exit)
iii. Take a photo of the sediment source in Survey123
iv. Determine the “Flowpath Length” category (measured from the sediment source to the high water mark of the channel)
v. Determine the “Roughness Class” along the flow path (see Reference 2)
vi. Record the erosion feature type (“Rill”, “Gully”, “Fillslope failure”, “Cutslope failure”, “Other”)
vii. Estimate the sediment discharge volume in cubic yards
    1. “Trace” indicates sediment was delivered, but a volumetric estimate can’t be readily determined due to limited discharge
    2. “Significant Event” indicates the volume of sediment delivered exceeds 10 cy and is closer in magnitude to a mass movement/landslide scale
viii. Determine if the sediment discharge is a chronic feature, or episodic only in nature
    1. This determination implies that a chronic feature is an ongoing issue, while an episodic discharge may only occur during heavy rain events, following heavy road traffic, rain on snow events, etc.
ix. Any additional comments as needed to clarify results

e. Make note of the total length surveyed (maximum of 200 feet)

30) **Downstream survey**: repeat all portions of Step 28 above
31) After completing the upstream and downstream survey, fill in on Survey123/Data sheet
    a. The total length surveyed upstream and downstream (200 feet each way, up to 400 feet total)
    b. The total number of road crossings along the watercourse segment (including the initial crossing used as the start, as applicable)
    c. All watercourse class(es) encountered along the segment
    d. An estimate of the WLPZ Canopy Cut category under the EX-EM Notice harvesting (0%, 0-33%, 33-66%, >66%)
        i. This estimation does not include canopy removal due to natural effects such as fire or insect kill
        ii. This estimate encompasses both the upstream and downstream segment together
    e. The total number of heavy equipment encroaches into the WLPZ or ELZ from the upstream and downstream segment

EX-EM Monitoring Protocol cheat sheet

Fuel/Wildlife assessment

1) Find centroid. Determine if plot was harvested.
2) Within the 11.8 foot radius (1/100th acre), determine live hardwood cover %, live ground cover %, and # of downed LWD pieces.
3) If there are no trees that will fall into variable radius plot (due to harvest or non-timber area), take a fuel depth (harvest related only) at plot center.
4) ID first "in" tree. Measure DBH, record species and condition, measure the depth of harvest related fuel at the half way mark between plot center and the tree.
5) Repeat for all "in" and every other "borderline" tree.
6) Get random azimuth, go to Plot 2, 2 chains (132 feet) away in the azimuth direction.
7) Repeat determination if plot was harvested, and steps 2, 3, 4, 5.
8) Return to plot 1, and pace 2 chains in opposite direction from plot 2 to find plot 3.
9) Repeat determining if the plot was harvested, and repeat steps 2, 3, 4, 5.
10) Based on observations from the 3 plots, determine the seral class and site prep used
11) Determine the yarding method used across the entire notice area
12) Determine the approximate area harvested for the entire notice area
13) Determine the silviculture treatment for the entire notice area, from the basis of an ecological (not mechanical) viewpoint.
14) **Moving plots**; for centroid, follow protocol about locating new centroid; for plots #2 and #3, if unsafe, in a road/road influence, or built structure, a plot may be moved 1 chain to a new location. For plot #3, if offsetting 1 chain does not work (e.g., you leave the Notice boundary; you encounter a high density of structures/roads), a new random azimuth can be selected from the centroid that is not within 45 degrees of the azimuth used to locate plot #2. Place plot #3 two chains from centroid along newly selected azimuth.

Roads

1) Using the map provided by the RPF in the notice document, determine the closest road and watercourse crossing to the centroid. Follow steps in detailed protocol if there are no private roads, or no watercourse crossings, to ID a road segment.
2) Start road survey at the watercourse crossing, filling out the "Crossing data" portion of the survey
3) Walk the road segment in one direction for 660 feet. Make notes about the surface, road class, shape, road slope, topographic position, hillslope gradient, presence of rills, gullys, ponding, cut/fill bank failures. Count the number of drainage features installed, and number of additional watercourse crossings
    a. Also look for any sediment discharges from the road to the watercourse. These will be recorded on the way back to the starting point at the crossing
4) For road sediment discharges: ID the source (where did runoff and sediment come from the road), the erosion feature (how was sediment delivered from the road to watercourse), receiving watercourse class, flowpath length (how far sediment is traveling from source to watercourse), roughness class (see protocol), and estimate of discharge in cubic yards. Also record if it is a chronic or episodic discharge, and take GPS point at point of discharge.

    a. For sediment discharge at crossings, especially rocked fords, the flowpath length is the longest approach length.
5) Add any comments that will help explain!
6) Repeat steps 3, 4, and 5 for the road segment going 660 feet in the other direction.
7) Once done, tally up the number of drainage features and crossings (including the one you started on).
8) Determine for the road as a whole (some averaging and professional judgment is used here) the road surface, class, shape, slope, hillslope gradient, and position.
9) Check the Yes/No boxes for the presence of surface and drainage rill and gully features, cut and fill bank failures, and surface ponding.

Watercourse survey

1) Start at the crossing used for initiating the road survey. Follow detailed protocols if there was no crossing, and you need to find another watercourse to survey.
2) Survey 200 feet upstream along the outer edge of the watercourse, looking specifically for signs of encroachment or harvest-related sediment discharge to watercourse. If found, investigate further and record as necessary. Do not duplicate any sediment discharges from the road network (such as the crossing or a drainage feature),
    a. Similar to roads, for a sediment delivery, record the source, flowpath length, roughness class, discharge volume, discharge status, erosion feature, and GPS point at discharge point.
    b. At forks in the watercourse, follow the dominant tributary and class.
3) Make note of what amount of the WLPZ canopy was cut under the notice; make note of the number of heavy equipment encroachments, and make note of any other road crossings encountered.
4) Repeat steps 2 and 3 for the downstream segment, for 200 feet.
5) Once done, tally the number of road crossings (including where you started), equipment encroachments, and the average WLPZ % canopy cut.
6) Add any comments to help explain results!

Make sure pertinent fields on the app/form are filled in. Then go home.