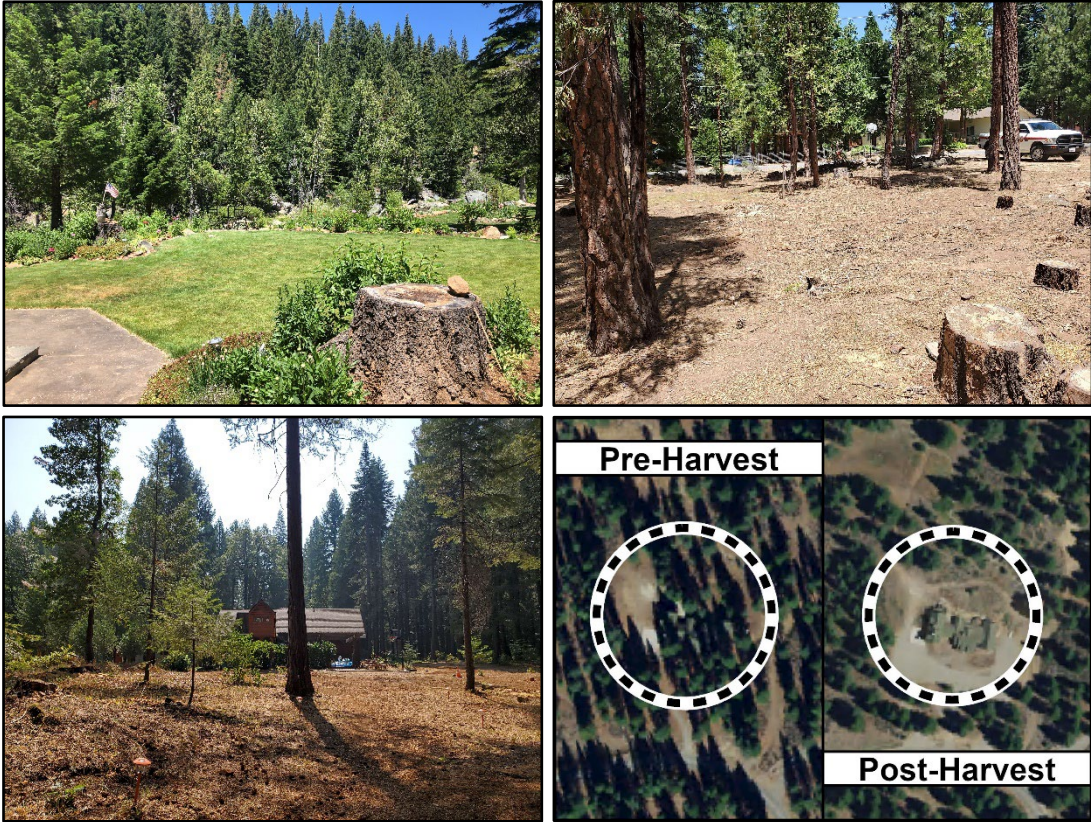


# Report on Exempt Timber Harvesting for the Reduction of Fire Hazard Within 150 Feet of Structures And Non-Discretionary Timber Harvest Notice Use and Rule Compliance



July 14, 2021



**Thomas W. Porter, Director**  
**California Department of Forestry and Fire Protection**

**J. Keith Gilles, Chair**  
**State Board of Forestry and Fire Protection**

**Wade Crowfoot, Secretary for Natural Resources**  
**California Natural Resources Agency**

**Gavin Newsom, Governor**  
**State of California**

A note for reading this report: The nature of monitoring complex regulatory frameworks and ecological variables involves detailed, sometimes complicated quantitative analysis. To help all readers, this report includes:

- A detailed [Executive Summary](#) of the full report and key findings
- **Gray text boxes** and **bolded text** within the main body of the report to highlight and summarize each section or important findings, followed by detailed analysis results for readers that wish to know more about the outcomes of the monitoring and findings

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# Executive Summary

## Report on Exempt Timber Harvesting for the Reduction of Fire Hazard Within 150 Feet of Structures And Non-Discretionary Timber Harvest Notice Use and Rule Compliance

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Assembly Bills 1958 and 2029, in addition to Senate Bills 92 and 901, require monitoring of non-discretionary Exemption and Emergency Notice timber harvesting in the state of California and the submission of reports to the Legislature. This is the second report detailing the use and effectiveness of Exemption and Emergency Notices. During the 2019 calendar year, 2,317 of the nondiscretionary documents accepted by CAL FIRE were Exemption Notices (91%), followed by 222 Emergency Notices (9%). For the 2020 calendar year, 1,972 Exemption Notices were accepted by CAL FIRE (88%), followed by 257 Emergency Notices (12%). During both calendar years, the 14 CCR § 1038(c) Structure Protection 0-150 Foot Fire Safe Exemption Notices (hereafter identified in the report as “1038(c)” or “1038(c)s”) were the most frequently submitted Exemption Notice comprising 22-24 percent of Notices, while Emergency Notices related to wildfire constituted 84-91 percent of the Emergency Notice submittals. The overwhelming majority of Exemption and Emergency Notices were submitted in the Cascade Forest Practice Area. Excluding acreage from <10% Dead, Dying, or Diseased, Christmas Tree, and Right-of-Way Exemptions, Exemption acreage was dominated by the Drought Mortality, Forest Fire Prevention, and 1038(c) Exemption Notices, respectively. Significant acreage was also submitted in 2019 under the Butte Post-Fire Recovery Exemption. Acreage submitted under the Emergency Notice of Timber Operations varied from approximately 29,800 to 54,200 for the 2019 and 2020 years, respectively.

Given that the 1038(c) was the most frequent type of Exemption Notice submitted in 2019 and 2020, the main body of this report summarizes field-based monitoring conducted in 2020 of 1038(c)s accepted by CAL FIRE between March and December of 2019. The intent of the 1038(c) is to allow the removal of commercial tree species within 150 feet of an approved and legally permitted structure to reduce the fire hazard when necessary to comply with PRC §§ 4290 and 4291. A total of 338 1038(c)s between March 1, 2019 and December 31, 2019 were eligible to be sampled. We randomly selected seventy-five (75) 1038(c)s, stratified by proportion of total 1038(c) Exemption Notices in each Fire Hazard Severity Zone (FHSZ), to achieve results with a ten percent (10%) margin of error and ninety-five percent (95%) confidence level. Sampling protocols were created to explicitly determine whether the implemented 1038(c)s achieved the intent of reducing the horizontal and vertical continuity of surface, ladder, and/or crown fuels, especially within the first 10 or 30 feet of the permitted structure as per 1038(c) and Technical Rule Addendum Number 4 (TRA #4). Emphasis was placed on measuring the diameter, height, crown characteristics, and spacing of the remaining residual trees, along



with the spacing and stump diameter of cut trees. Additional information regarding water quality protection and the economic cost of the activities was also collected.



Of the sampled 1038(c)s, almost half (49%;  $n=36$ ) of landowners reported the costs/profits associated with the Exemption, with seventy-five (75) percent of these landowners reporting a cost ranging from \$1000 to \$50,000, for an average cost of \$11,500. We found 1038(c)s typically treated 1-2 legally permitted structures, with the majority (95%) of the 1038(c)s treating at least one residential home. Relatively few (17%) of the sampled notices had a classified watercourse, and these were protected to a high standard, indicating that these Exemptions were protective of water quality. Slash treatment was similarly implemented at a high standard, with approximately half (51%) of the Notices additionally utilizing chipping or mastication to reduce fuel hazard. Surface fuels such as flammable grass and/or excessive duff accumulation ( $> 3$  inches in depth) were rarely present and/or not horizontally continuous in nature.

Most of the trees cut (82%) were 30 inches in diameter or less, with very few of the cut trees (3%) exceeding 40 inches. Thirty-eight percent of all stumps were found within 30 feet of the permitted structure, and 59 percent were within 50 feet. Increased tree spacing significantly decreased the degree of horizontal crown continuity found on 1038(c)s ( $p<0.001$ ). Tree removal beyond the required 150 feet, absent any other Exemption type, was only found on two Notices, and these were within an acceptable margin of error for a licensed professional. Contrary to the rule requirements, only one 1038(c) had complete removal of all commercial trees (i.e., a clearcut) within the specified distance of 150 feet. However, this specific Notice did not receive an inspection resulting in a violation.

In general, basal area of residual trees increased with increasing distance from a given structure, with the average minimum basal area increasing from 4 feet<sup>2</sup> to 15 feet<sup>2</sup> as distance from structure increased from 10 to 30 feet, respectively. Only 31 percent of the Notices met the intent of TRA #4, where only single specimen trees are supposed to be within 30 feet of a structure. In total, 51% of the 1038(c)s had 30 feet or more of mean geometric defensible space (i.e., geometric mean distance between trees and the structure) after operations, with small parcel size influencing whether that distance was

achieved or not. Even though trees weren't always removed proximal to structures, 84 percent of Notices eliminated surface to crown vertical fuel continuity.



**51% of Sample**  $\geq 30$  feet mean defensible space per permitted structure

**49% of Sample**  $< 30$  feet mean defensible space per permitted structure



30-122 Feet, 53 Feet on average



5-29 Feet, 19 Feet on average

Overall, the sampled 1038(c)s were effective in treating surface and ladder fuels, but not as effective in breaking up the horizontal continuity of crown fuels within 30 feet of permitted structures. Across the entire sample population, it appears as if the 1038(c)s are sometimes utilized for generalized tree removal near structures, rather than explicitly for fuel hazard reduction. When fuel hazard reduction is the primary objective, operational constraints on smaller parcels and shorter distances to adjacent structures can make it difficult to remove trees in a safe and cost-effective fashion. As such, a combination of landowner objectives, operational limitations, and economic constraints make it difficult to fully achieve the intent of 1038(c).

The effectiveness of 1038(c) in helping to prevent home ignition could not be rigorously evaluated. However, a limited case study of 1038(c) Exemption implementation on the 2020 North Complex Fire in Butte County indicates structures treated under 1038(c) were shown to be ineffective in preventing structure loss in the face of running crown fire. This indicates that the structure-centric 1038(c) Exemption should be considered as only one piece of an overall strategy, including home hardening and community-based fuels reduction, to reduce catastrophic losses during wildfires. Further work is needed to rigorously evaluate the effectiveness of 1038(c) across a range of fire conditions.

Based upon the results of the monitoring, the following recommendations are offered for consideration:

- **CAL FIRE should develop additional guidance for landowners and Licensed Timber Operators on the requirements of the 1038(c) to ensure that the intent of the Exemption is met. Focus should be placed on the need to adequately treat the area within 30 feet of the structure.**
  - CAL FIRE could consider integration of guidance with broader landowner and LTO education on fuels and home hardening treatments, as well as guidance for implementing these treatments based upon the best available science.
  - Consider revising the FPRs to provide clearer direction to landowners and LTOs on the required elements of 1038(c). This might include better integration of FPR 1038 language and TRA #4 with the requirements of PRC §§ 4290 and 4291.
    - Revisions might include better clarification on the requirements within Zone 1 of TRA #4.
  - Guidance is needed on how to treat hardwoods and/or ornamentals within 30 feet of structures.
- **Broader guidance should be given on Exemptions so that landowner objectives can be coupled with the appropriate Exemption type.**
- **CAL FIRE could consider integration of Forest Practice and Defensible Space inspections where 1038(c) Exemptions are utilized. The 1038(c) Exemption presents an opportunity for achievement of both Forest Practice and Fire Prevention objectives toward structure resilience to wildfire and should be noted in Defensible Space reporting in the future.**
  - If activities are explicitly identified and mapped, post-fire effectiveness of 1038(c) treatments could potentially be integrated into the incident Damage Inspection process.

**Acknowledgements:** Special thanks to CAL FIRE Exemption and Emergency Notice Monitoring Specialists' Dorus Van Goidsenhoven, Ross Mathewson, Roberta Lim, and Michael Novak for their efforts throughout 2020 to complete field monitoring of the 1038(c) Exemptions.

Will Olsen devised the monitoring protocol, with revisions provided by Drew Coe, Stacy Stanish, and Pete Cafferata of CAL FIRE. Will Olsen undertook the primary data analysis and report writing, with revisions and assistance from Drew Coe. We'd also like to thank the numerous CAL FIRE Forest Practice Inspectors, and Review Team Agency staff, for their input on the monitoring, the 1038(c) Exemption, and this report. Additionally, we'd like to thank the timberland owners who took the time to provide information about individual Exemptions, meet field staff on site, and allow us access to their property, in addition to the Licensed Timber Operators and Registered Professional Foresters who were willing to share their information and time.

# Monitoring Report on 1038(c) 0-150 Foot Fire Hazard Reduction Exemptions

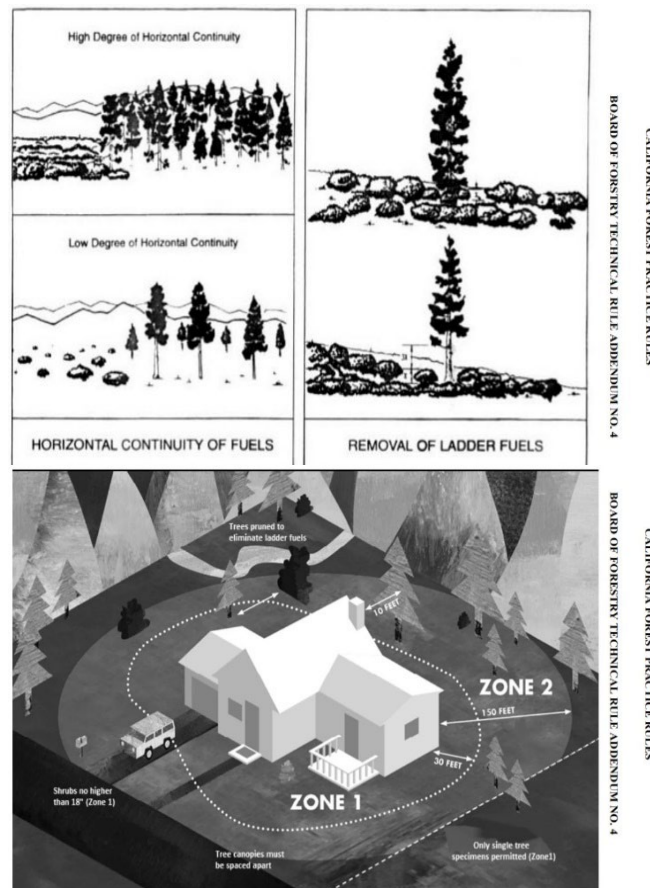
## Introduction

### Background

- **Monitoring of 14 CCR § 1038(c) 0-150 Foot Fire Hazard Exemptions is part of ongoing monitoring of THP-exempt timber harvesting on non-federal land in California, focusing on whether the outcomes achieve the intent of the statute.**
- **The 1038(c) Exemption Notices allow timberland owners to remove commercial tree species within 150 feet of permitted structures as per PRC §§ 4290 and 4291, and are one of many tools intended to increase structure resiliency to wildfires.**
- **The core intent of 1038(c) Notices is to eliminate vertical and horizontal fuel continuity and create defensible space around permitted structures.**

Previous monitoring of timber harvesting on non-federal land in the state of California focused heavily on traditional Timber Harvesting Plans (THP), but with the expansion and increased use of Exemption and Emergency Notice documents (“EX-EM Notices”), a new focus on these THP-exempt, non-discretionary timber harvesting tools was initiated in 2018. The 2018 Senate Bill 901 mandated annual assessments of the use, compliance, and effectiveness of Exemption and Emergency Notice provisions. The first formal report to the Board of Forestry and Fire Protection (Board), the “Report on Emergency Notice of Timber Operations Monitoring Results and Exemption Notice Usage” [1], was submitted to and approved by the Board in December 2019, and includes more background on monitoring of EX-EM Notices.

For 2020, the core monitoring focus was on 14 CCR § 1038(c) Structure Protection 0-150 Foot Fire Safe Exemptions, hereafter “1038(c)” or “150 Foot Exemption”, where the intent is to allow timber operations to occur for the removal of commercial tree species



**Figure 1:** Visual guidance from TRA #4 in the California Forest Practice Rules.



within 150 feet of an approved and legally permitted structure to reduce the fire hazard to the structure. The Forest Practice Rule language, and Technical Rule Addendum No. 4 (TRA #4, **Figure 1**), for this [Exemption](#) states:

***“The cutting or removal of trees in compliance with PRC §§ 4290 and 4291, which eliminates the vertical continuity of vegetative fuels and the horizontal continuity of tree crowns for the purpose of reducing flammable materials and maintaining a fuelbreak to reduce fire spread, duration and intensity. The requirements of this subsection shall not supersede the requirements of PRC § 4291.”***

Subsequent Forest Practice Rules also outline additional regulatory expectations for 150 Foot Exemptions, including slash treatment and prohibitions of certain silvicultural methods.

The monitoring of the 1038(c) Exemption comes following several destructive recent wildfires in California within forested regions, including:

- 2018 Camp Fire with over 18,000 structures destroyed
- 2020 North Complex Fire with over 2,300 structures destroyed
- 2020 CZU Lightning Complex with nearly 1,500 structures destroyed

As such, the assessment of the use of the 150 Foot Exemption is timely, as it is one tool within a range of options for protecting personal property and communities, increasing the safety of fire crews during active structure protection, and allowing timberland owners and licensed timber operators (LTOs) to commercialize timber products in the process.

#### Monitoring Overview

- **Monitoring was based on a stratified random sample across the state, sampling 75 1038(c) Notices from different Fire Hazard Severity Zones.**
- **Monitoring was rapid, and focused on residual conifers, cut/removed trees, and factors affecting potential fire behavior, guided in part by current defensible space recommendations and Exemption-specific regulations. It was outcome-oriented and not focused on Rule enforcement.**

For monitoring, a random sample was selected from all accepted 150 Foot Exemptions found in the California Timber Regulation and Environmental Evaluation System (CalTREES<sup>1</sup>) from March 1 to December 31 2019, that had also been mapped within the Forest Practice GIS database by January 2020. A total of 338 1038(c)s were eligible to be sampled, all of which were assigned a Fire Hazard Severity Zone (“FHSZ”) based on the most recent FHSZ mapping by CAL FIRE. We randomly selected seventy-five (75) 1038(c) Exemptions, stratified by the proportion of 1038(c) Exemptions in each FHSZ in order to capture statewide variability in fuel conditions, to achieve results with a 10% margin of error and 95% confidence level. As such, the final random sample consisted of 6 “Moderate”, 16 “High”, and 53 “Very High” FHSZ 1038(c)s. **Table 1** indicates the final sample distribution, and **Figure 2** shows sample locations and the population distribution.

<sup>1</sup> CalTREES is an on-line system for submission and review of timber harvesting documents on non-federal lands in California. [<https://caltreesplans.resources.ca.gov/caltrees/Default.aspx>]

**Table 1:** 1038(c) sample distribution by Forest Practice Area and Fire Hazard Severity Zone.

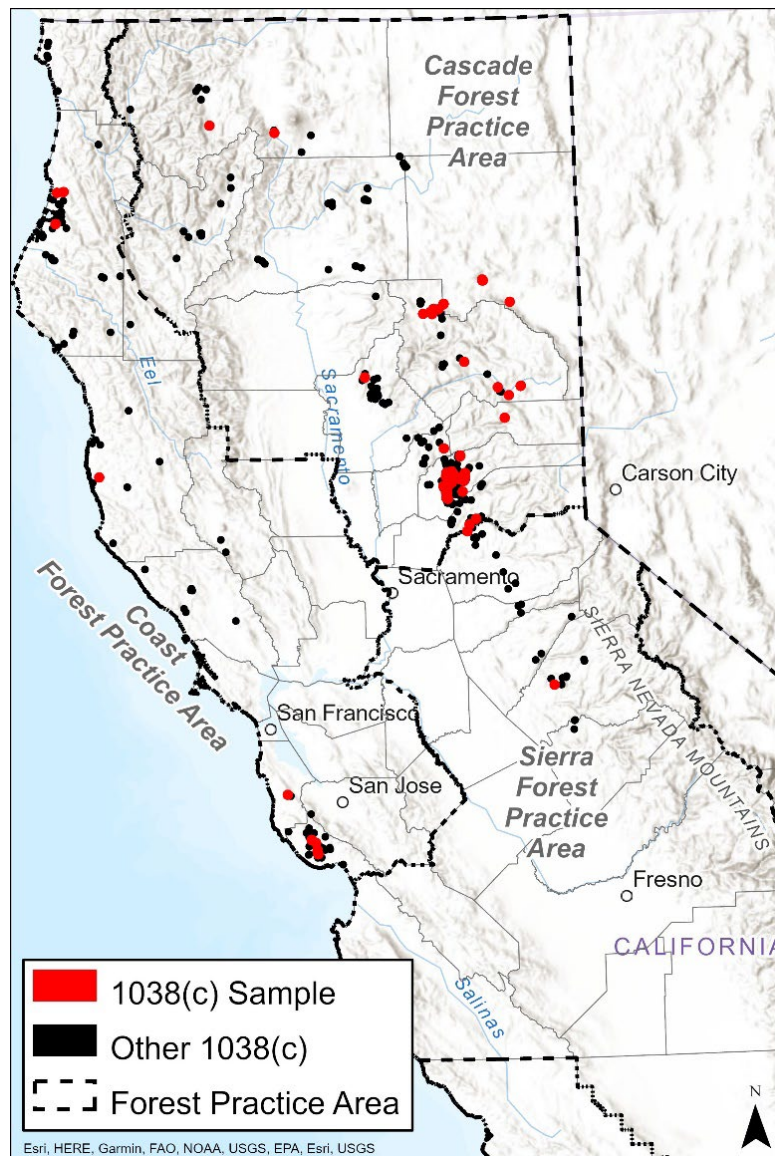
Forest Practice Area	Fire Hazard Severity Zone			Total
	Moderate	High	Very High	
1 (Coast)	6	3	0	9
2 (Cascade)	0	12	52	64
4 (Sierra)	0	1	1	2
<b>Total</b>	<b>6</b>	<b>16</b>	<b>53</b>	<b>75</b>

Protocol and field data sheets are included in Appendix 1, and were developed with the goal of all sampling being rapid and repeatable. The monitoring protocol focused on the 12 closest residual conifer trees, and 12 closest stumps, from the treated structure, with this protocol applied to no more than three permitted structures per 1038(c) Exemption Notice, in order to rapidly establish minimum post-harvest treatment outcomes.

Measurements focused on tree and stump distances to structures and each other, crown base and ladder fuel heights, and tree crown contact. Additionally, rapid assessments were made for general 1038(c) requirements and certain Public Resource Code (PRC) requirements (e.g., watercourse protection).

*Assumptions Included in Monitoring and Analysis*

Field crews based all monitoring on publicly available harvest documents, and timberland owner information. We assumed all structures were legally permitted, as activities associated with the 150 Foot Exemption are required to be linked to a permitted structure, and determining compliance with county building requirements was outside the scope of this monitoring. Monitoring also included cases where timberland owners treated their own property within 150 feet of permitted structures on adjacent ownerships, as



**Figure 2:** 1038(c) population (black) and sample (red) location, with Forest Practice Areas shown.

allowed under the Forest Practice Rules. Residual tree measurements (**Table 2**) were restricted to conifer species, in line with the intent of the Exemption for commercialization of timber, with qualitative data gathered on non-commercial species. A plain language interpretation of the requirements set forth in 1038(c), TRA #4, and the [Ready For Wildfire Defensible Space Guidelines](#) were used as the basis for addressing defensible space, tree spacing, and ladder fuel treatment. We measured tree spacing based on distance between tree boles, as a non-subjective measurement, as opposed to the more subjective distance between crown drip line. Binned groups, e.g. “Under 2 feet”, “2 to 5 feet”, were used for maximum ladder fuel heights within the immediate proximity of each tree or stump.

**Table 2:** Measurements made on residual conifers and harvested stumps for each 1038(c).

Variable	Measurement
<u>Residual Conifers</u>	Distance to structure; Distance to nearest tree; DBH; Species; Crown base height; Tree height; Crown-to-crown contact; Ladder fuel height category
<u>Residual Stumps</u>	Distance to structure; Ladder fuel height category; Stump diameter category
Basal Area	- Summed and averaged for all sampled structures
QMD	- Found Notice-wide for all sampled structures
Single Tree Specimens	- Summed trees within 30 or 10 feet, divided by number of sampled structures
Defensible Space	- Geometric mean of up to 12 trees nearest to treated structures, for up to three structures
Defensible Space (Residences)	- Geometric mean of up to 12 trees nearest residences, for up to three residential homes

Consistent with the assumption of the CAL FIRE “Ready for Wildfire” guidelines, surface to crown vertical fuel continuity was evaluated. Basal area was summed for all treated structures, and divided by the number of structures to give a Notice-wide average; it should be considered the *minimum* basal area present on each 1038(c). Basal area was also calculated within 10 and 30 feet of each of the treated structures. Quadratic mean diameter (QMD) was calculated for the entire Notice based on all measured trees. We determined if the TRA #4 guideline for only single tree conifer specimens had been achieved by summing the number of trees within 30 feet or 10 feet of treated structures, and dividing by the number of treated and measured structures. If the average number of trees per structure within 30 or 10 feet was not a whole number (e.g., 1.5) we based a final outcome on if at least one structure had one tree or less within the 30 or 10-foot zone.

We also used the *geometric mean* of post-harvest tree-to-structure distances as it provides a better estimate of central tendency and reduces the influence of outliers. For example:

- For a home with four trees, 5, 10, 10, and 100 feet away, the arithmetic mean would be ~31 feet, calculated as:  $5+10+10+100 \div 4 = 125 \div 4 = 31$  feet
- The geometric mean would be 15 feet, capturing the greater influence of the more prevalent conifers in close proximity to a structure. It is calculated as the product of all distances to the *n*th root:
  - $(5*10*10*100)^{(1/n)} = 50,000^{(1/4)} = 15$  feet

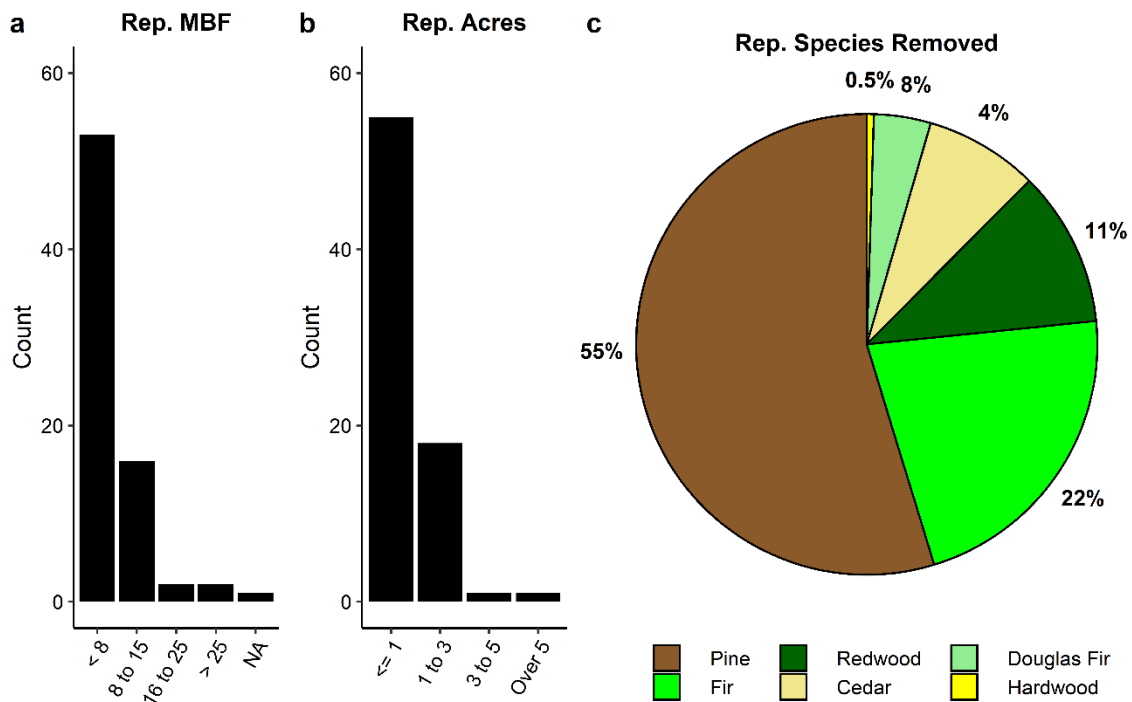
## Results

### Reported Exemption Information

- **Overwhelmingly, 1038(c)s reported low intensity timber harvesting and small acreage, per the design of the Exemption.**
- **75% of the timberland owners who reported profit or cost estimates reported a financial loss from operations, with an average estimated cost of \$11,500 for timber removal.**
- **19% of timberland owners who reported costs from timber operations indicated they broke even, and 6% reported a net profit.**

Expectedly and by design, the 1038(c) Exemptions were limited in reported scale and harvest intensity. The Notices were generally small in reported acreage and timber volume removed (Figure 3).

Most 150 Foot Exemptions reported estimated volumes to be removed of less than 8 thousand board feet (MBF) ( $n = 53$ ), and only two reported >25 MBF (Figure 3a). Most 1038(c)s were one acre or less in reported harvest area size ( $n = 55$ ), while 18 were one to three acres reported harvested (Figure 3b). The two 1038(c)s with >25 MBF were reported as 0.5 and 5 acres in harvest area size, respectively. Two Notices did not have a volume removal estimate indicated on the document form. Sample-wide, the majority of reported species removed were ponderosa or sugar pine (55%), followed by fir (22%) and coast redwood (11%) (Figure 3c), partially reflecting the different districts or ecoregions where the 1038(c)s were filed.



**Figure 3:** Reported volume removed (a), reported acreage harvested (b), and the distribution of reported species removed, sample wide (c).



**While not all timberland owners reported their financial profit or loss from 1038(c) Exemptions, 36 landowners, or 49% of the sample, were willing to share estimates. Of the 36 landowners, 27, or 75%, indicated that the 150 Foot Exemption resulted in a financial loss.**

The reported cost estimates ranged from \$1,000 for a single structure, to over \$50,000 where multiple structures and surface fuels were treated. The average estimated cost based on landowner estimates was \$11,500. Seven of the timberland owners reported breaking even; anecdotally, some of these owners indicated the LTOs took the harvested trees in exchange for equipment and labor time. Two owners reported profit estimates of \$100 and \$2,000, respectively.

A total of 20 of the 150 Foot Exemptions were paid for with grant funding, at no cost to the timberland owners. These were Fire Prevention grants awarded to local entities.

#### General Field Observations

- **Operations on many 1038(c)s appeared to be done to increase defensible space and reduce fuel continuity, while others were done only for non-fire reasons, such as increasing sunlight or the removal of a tree with potential windthrow hazard.**
- **1038(c) Exemptions typically treated 1-2 legally permitted structures, and 95% of the Notices treated at least one residential home.**
- **20% of the 150 Foot Exemptions had an overlapping or additional Exemption on the monitored ownership, either concurrently active with the 1038(c) or from a previous year.**
- **17% of the 1038(c)s had a classified watercourse, a majority which were Class III or Class IVs; watercourses were overwhelmingly adequately protected on these Notices.**
- **Slash and fuels from timber harvest operations were treated correctly, or prepared for treatment, on nearly all Notices.**
- **Flammable non-irrigated vegetation, grass, and litter/duff were generally not found in abundance on 1038(c)s near treated structures, but were present to some degree on many Exemptions.**
- **Hardwood and ornamental trees were found within 30 feet of treated structures on over 50% of the Notices.**
- **Well over half of the 1038(c)s sampled were adjacent to another parcel in which a structure was located within 100 feet of the structure that was the subject of the 1038(c) treatment. This circumstance was generally observed on parcels less than one acre in size. Regardless, the structure on the untreated parcel represents a potential radiant heat or ember source (i.e., exposure) to which the 1038(c) Exemption treatments may not be responsive. This observation underscores the need for coordinated, community-wide fuels treatments (i.e., fuel breaks around communities**

where housing density is relatively high) in addition to individual parcel treatments.



**Figure 4:** Examples of 1038(c) harvesting, with more intensive tree removal and surface fuel treatment (a), and less intensive, single tree removal (b and c).

**Anecdotally, monitoring found many 1038(c) Exemptions had spatially limited harvesting operations. It was not uncommon to encounter 1038(c)s where only one to two commercial trees were removed in harvest operations, sometimes in efforts to remove a hazard tree, increase sunlight, or otherwise achieve a non-fire hazard reduction related goal (Figure 4b, c). Generally, 1038(c)s involved treating a residence, while very few Notices involved timber removal to protect non-residential infrastructure facilities (e.g., communications infrastructure), and a minority had additional permitted treatments present, such as 150 to 300 Foot 1038(c)(6) Exemptions.**

Fifteen (15) of the 150 Foot Exemptions, or 20%, had past or present overlapping or additional Exemptions on the parcel associated with the timber operations. Additional Exemptions were comprised of 150-300 Foot Structure Protection, <10% Dead, Dying, or Diseased, Utility Right-of-Way Conversion, and Less Than 3 Acre Conversion Exemptions. Anecdotally, <10% Dead, Dying, or Diseased Exemptions are sometimes also submitted on parcel areas beyond 150 feet of structures in order to enable equipment activity and log landing areas. One (1) parcel also had an active Timber Harvesting Plan (THP). Most 150 Foot Exemptions involved treating one or two permitted structures; 95% of the Notices treated at least one residential home. Four (4) Notices did *not* have a habitable residence associated with them, but instead infrastructure such as a communications tower or water treatment and storage facilities, or a home under active construction (**Table 3**).

**Table 3:** Distribution across the sample of total treated structures per Notice, and the number of residential homes treated per Notice.

<b>Treated Permitted Structures Per Exemption (#)</b>				
<u>1 Structure</u>	<u>2 Structures</u>	<u>3 Structures</u>	<u>4 Structures</u>	<u>5 Structures</u>
34	28	10	2	1
<b>Treated Residential Homes Per Exemption (#)</b>				
<u>0 Homes</u>	<u>1 Home</u>	<u>2 Homes</u>	<u>3 Homes</u>	<u>4 Homes</u>
4	65	4	-	2

**Classified watercourses were typically not associated with 1038(c) Exemptions, and when found, were mainly ephemeral Class IIIs or man-made Class IVs. Regardless of classification, watercourses were overwhelmingly adequately protected during operations.**

Classified watercourses were found on 17% (n = 13) of the 1038(c)s, either within a harvest area, near a road used for removing timber, or associated with the potentially treatable 150-foot area. Watercourses were mainly Class IIIs or Class IV constructed ditches; three (3) parcels had associated Class I watercourses, and one (1) had a Class II pond. Three (3) watercourses had tree removal within an ELZ (equipment limitation zone). Two 150 Foot Exemptions had *minor* (“Trace” or < 1 yard<sup>3</sup>) discharges, or 3% of the entire sample. Overall, when and where present, watercourses were adequately protected.

**Slash treatment was completed and potential fuels created by harvest activity were treated on the overwhelming majority of 1038(c)s, keeping with the intent of the Exemption (Table 4). Over half the 1038(c) Exemptions had mastication or chipping of surface fuels completed as well within the 150-foot zone (Table 4).**

**Table 4:** Percent of 1038(c) Exemption Notices with fuel-related variables or treatments present or absent.

	<b>Present</b>	<b>Absent</b>
Slash >1” Diameter	37%	63%
Slash >1” Diameter, >25% of harvest area	1%	99%
Piled fuel/slash to be burned or chipped	11%	89%
Chipping or Mastication of fuels within treatment area?	51%	49%
Chipping or Mastication of fuels outside treatment area?	15%	85%
Dead Standing Conifers in treated area?	13%	87%
Dead Standing non-commercial trees in treated area?	3%	97%

**Overall, 1038(c)s did not have excessive flammable fuels and vegetation near treated structures; however, individual potentially flammable sources of radiant heat were found on over 50% of the Exemptions. Non-commercial hardwood or ornamental trees were found within 30 feet of structures on over half of the Notices.**

Monitoring also found that while most 150 Foot Exemptions had non-irrigated, flammable vegetation (i.e., shrubs or brush) present within 30 feet of a structure, 99% of the 1038(c)s did not have flammable vegetation within 30 feet of structures in excess of 25% of the area around a permitted building. Due to the rapid nature of our monitoring, we do not have further details on the flammable vegetation found near structures (i.e., type, density, or distance from a building). Similarly, within 100 feet of treated structures, grass over 4 inches in height and duff or litter over 3 inches in depth were present to some degree on most 1038(c)s. However, flammable grass or duff/litter was not present on over 25% of the 100-foot area near structures for 92% and 99% of the monitored Notices, respectively, indicating that finer surface fuels were generally not continuous proximal to the structures. Non-commercial trees over 6 inches DBH (diameter at breast height), such as hardwoods or ornamentals, were found within 30 feet of treated structures on 51% of the 1038(c)s. Likewise, 56% of the 1038(c)s had non-commercial trees in crown contact with commercial conifer trees within the 150-foot treatment zone.

**Fifty-seven (57) percent of the monitored 1038(c) Exemptions had residences on adjacent parcels within 100 feet of the treated residences on the monitored property, a potential source of radiant heat and/or embers if ignited, largely as a product of parcel size and building location. These Exemptions were mostly associated with parcels 1 acre or less in size.**



**Figure 5:** An example of a sampled 1038(c) where an adjacent parcel (left) had a structure and fuel in close proximity to the structure (right) that was the object of treatment under the submitted 150 Foot Exemption.

We found that 43 homes, or 57% of the 150 Foot Exemptions, also had another residence within 100 feet of the treated primary residence(s) on a separate parcel (**Figure 5**). That is, due to parcel sizes, structure location, or other factors; 57% of the 1038(c)s had a potential ember or radiant heat source (i.e., exposure), depending on separation distance, that could not be treated through forest management alone by the timberland owner of the sampled Exemption. For 1038(c) Exemptions where adjacent homes within 100 feet on other parcels were present, 74% were on parcels 1 acre or less in size.

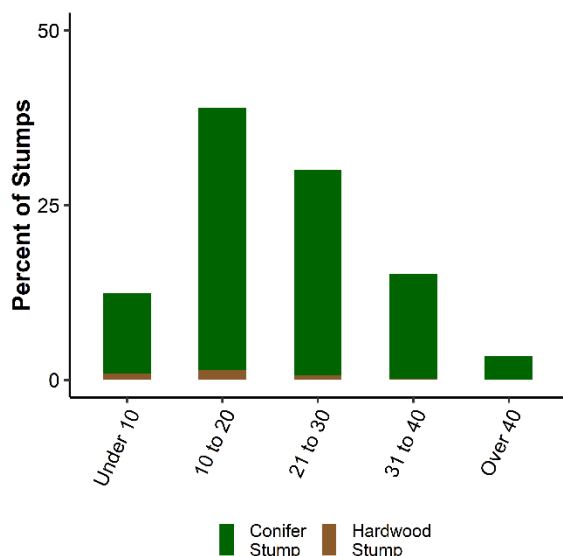
#### Tree Removal Observations

- **84% of the 150 Foot Exemptions had some degree of residual stumps left after harvesting.**
- **A majority of residual stumps were 10-20” or 20-30” in diameter, and only 3% of the stumps were 40” or larger.**
- **38% of all residual stumps were within 30 feet of a permitted structure, and 59% were within 50 feet of a permitted structure.**
- **A stump related to the 1038(c) was found beyond 150 feet of a permitted structure in absence of any other permit on only two (2) Exemptions, and the distances beyond 150 feet were within the bounds of professional error in distance measurement.**

While not all 1038(c)s had stumps remaining within the treated area following logging, due to some landowners opting to grind or otherwise remove stumps, 84% of the sample had residual tree stumps from the treatment present to some degree. Overall, the monitoring crew measured 1,001 stumps, with an average of 9 cut trees per structure, per 1038(c) Exemption.



Generally, removed trees had a stump diameter between 10 and 30 inches, with the smallest and largest diameters in the minority of residual stumps.



**Figure 6:** Residual stump diameter class in inches, related to harvesting, on the sampled 1038(c)s, colored as a conifer or hardwood, left. Right, a monitored 1038(c) with stumps within 30 feet of a home in the foreground. The owner also stated they installed ember-resistant vents on their home in addition to increasing defensible space.

Of the residual stumps present across all 1038(c)s, 13% were under 10 inches in diameter, 39% 10 to 20 inches, 30% 21 to 30 inches, and 15% and 3% were 31 to 40 inches and over 40 inches in diameter, respectively (**Figure 6**). The most frequent stump sizes found on nearly 70% of the 150 Foot Exemptions were 10 to 20 inches or 20 to 30 inches in diameter, while stumps less than 10 inches were found on only 8% of Exemptions, and stumps more than 40 inches were found on 3% of Exemptions.

**Almost two-thirds of the stumps were within at least 50 feet of structures, while only 10% of stumps were found over 100 feet from sampled structures.**

Sample-wide, stumps averaged 50 feet from structures (standard deviation (sd) = 35 feet), where present. Thirty-eight (38) percent of stumps were within 30 feet of treated structures, 59% within 50 feet, and only 10% were found beyond 100 feet of treated structures. On only two (2) 150 Foot Exemptions was a stump related to harvesting found beyond 150 feet of a permitted structure, in absence of any other permit for harvesting. However, the distances beyond 150 feet were not excessive and within a reasonable margin of error in measurement. Lastly, 60% of the ladder fuels in the vicinity of residual stumps had a maximum ladder fuel height of two feet or less, indicating concurrent treatment of ladder fuels with tree removal, or absence of ladder fuels regardless of tree removal.

#### Residual Trees and Defensible Space Observations

- **Residual conifers were found to some degree on all but one 1038(c); only one Notice had complete commercial tree removal observed, and it was a parcel less than one acre in size.**

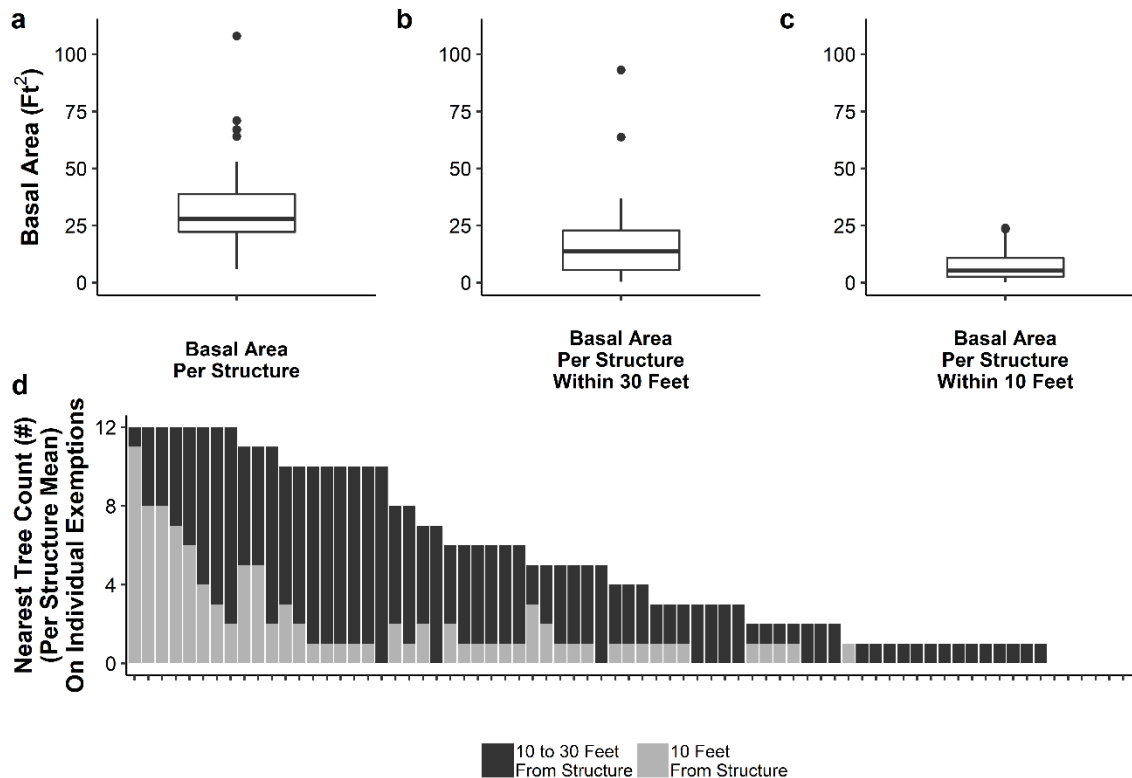
- Basal area decreased as distance to structure decreased, but was often still substantially present. Most residual trees were 20 inches or less in diameter near structures.
- Just under half of 1038(c)s had 5 or more conifers within 30 feet of a residential home, and 27% had 10 or more conifers within 30 feet of a residential home, counter to the plain language interpretation of the Exemption.
- Only 31% of Notices met the interpreted intent of Technical Rule Addendum No. 4, for only single tree specimens within 30 feet of homes, and most residual conifers displayed continuous crown connectivity; average tree spacing where crown contact was absent was 24 feet.
- On average, 84% of the 1038(c)s had eliminated surface to crown vertical fuel continuity, although 41% of 1038(c)s had individual conifers that likely should have been removed, or had ladder fuels treated, per the 1038(c) intent.
- Just over 50% of the 1038(c)s had 30 feet or more of mean geometric defensible space after operations, and small parcel size seemed to be an influence on those 1038(c)s that did not meet the 30-foot criteria.
- A very small minority of Exemptions seemed to focus harvest intent on non-residential structures only, without commensurate treatment of areas directly proximate to habitable structures.

#### *Residual Stand Structure*

Based on the nearest conifers to structures, minimum average residual basal area per structure on the 1038(c) Exemptions ranged from 6 to 108 feet<sup>2</sup> (mean = 32 feet<sup>2</sup>, sd = 16 feet<sup>2</sup>), while within 30 and 10 feet of structures the Notice-wide per-structure mean was 15 feet<sup>2</sup> and 4 feet<sup>2</sup>, respectively (**Figure 7a, b, c**). The quadratic mean diameter of conifers nearest structures ranged from 13 to 49 inches on the 1038(c)s, with a median Notice-wide QMD of 23 inches. Sample-wide, 53% of residual conifers were < 20 inches in diameter, 43% were 21 to 40 inches in diameter, and 4% exceeded 40 inches. On only one Exemption did monitoring crews discover that all trees within 150 feet of a permitted structure had been removed, or clearcut, which is prohibited in the Exemption requirements; this Notice had not received an inspection or subsequent violation. On one other 1038(c), the timberland owner admitted to converting a small part of the treated area to a non-timber use after operations were completed and inspections had occurred.

#### *Conifer Counts Near Structures*

Less than 10% of the 150 Foot Exemptions had a post-harvest outcome where there were no commercial conifer trees within either 30 feet or 10 feet of permitted structures (**Table 5**), reflecting the basal area results above. Following the guidelines in TRA #4 for only single tree specimens within 30 feet of residences, 31% of the 1038(c)s with homes met this guideline (**Table 5**). Within the 10 foot zone, 72% had one conifer or less in the 10-foot zone (**Table 5**). These results, it should be noted, exclude any non-commercial (e.g., hardwood or ornamental) trees within the 30 and 10-foot zones of homes.



**Figure 7:** Basal area averaged by number of treated structures, for all conifers nearest treated structures (a), within 30 feet of treated structures (b), and within 10 feet of treated structures (c). In each panel, the black middle line represents the median value, the box represents the 25<sup>th</sup> and 75<sup>th</sup> percentile of all measurements, and the “whiskers” or lines extending out are values 1.5 times the value range within the box, while black points beyond the whiskers are considered to be significant outliers. Bottom, d, is the per structure mean of nearest number of conifers, within 30 feet or less and up to 12, colored by their location. Bars that do not add up to 12 indicate either the other residual trees were beyond 30 feet from a structure, or there were fewer than 12 residual conifers, on average, per structure on a parcel.

**Table 5:** Percent of 1038(c)s with no conifer trees in excess of 6” DBH within 30 feet or 10 feet of treated structures on a parcel, and percent of 1038(c)s with one conifer, on average, per residential home within the 30 and 10-foot zones of a home. Bold text added to percentages to emphasize outcomes.

	<b>Yes</b>	<b>No</b>
<u>No Conifers Within 30 Feet of Treated Structures</u>	<b>9%</b>	<b>91%</b>
<u>No Conifers Within 10 Feet of Treated Structures</u>	<b>9%</b>	<b>91%</b>
<u>Only 1 Conifer Per Residence Within 30 Feet</u>	<b>31%</b>	<b>69%</b>
<u>Only 1 Conifer Per Residence Within 10 Feet</u>	<b>72%</b>	<b>28%</b>

It also should be noted that where conifers were found within 30 feet of residential homes, 45% of these 150 Foot Exemptions had 5 or more conifers within the 30-foot zone, and 27% had 10 or more conifers within that 30-foot zone, in direct contrast to the intent of the 1038(c) Exemption language.

### *Tree Crown Continuity, Spacing, and Potential Surface-Crown Vertical Fuel Continuity*

**Most residual conifers on 150 Foot Exemptions were in contact with each other via their crowns, regardless of whether they were within 30 feet of treated structures or further away from the structure. Crown contact decreased significantly as tree spacing increased. Most of the Notices had eliminated potential surface to crown vertical fuel continuity, with either intentional or unintentional removal of the lowest limbs (Figure 8), decreasing the live crown ratio of trees and increasing crown base height, along with an absence of substantial surface fuels. Forty-one percent (41%) of the 1038(c)s still had one or more trees with potential vertical fuel continuity within 30 feet of treated structures present (i.e., targeted trees as per the 1038(c) intent) after operations.**

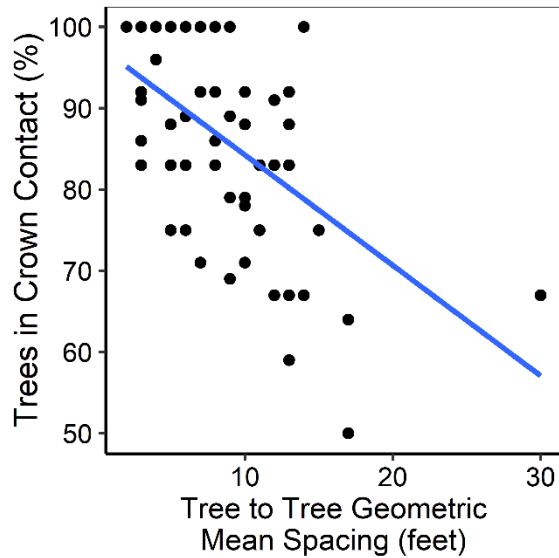


**Figure 8:** Two examples of residual conifers after operations were complete. The left shows reduction of surface fuels, creation of defensible space, and a single tree within 30 feet of a residence. On the right, a 1038(c) with over 50 feet of defensible space, and denser residual conifers and hardwoods outside of that area, but within the 150-foot treatment zone of a communications tower, and no surface fuels to allow surface to crown fuel connectivity.

Individual 1038(c)s with more than one residual tree left had 50 to 100% of the measured residual trees in crown contact, and 83% of the 1038(c)s had 75% or more of the nearest conifers in crown contact. Within 30 feet of residences, 69% of the 1038(c)s had at least 75% of conifers in the 30-foot zone in crown contact. Trees in crown contact averaged 9 feet apart, based on the next nearest stem, while those with crown separation averaged 24 feet between stems. Across over 1,400 trees measured, the average tree spacing was 11 feet (sd = 9.6 feet). On individual 1038(c)s, the tree-to-tree geometric mean ranged from 2 feet to 30 feet. As tree-to-tree geometric mean distance increased on 1038(c)s, crown contact decreased ( $r^2 = 0.28$ ,  $p < 0.001$ ) (**Figure 9**).

Average crown base height on 1038(c)s ranged from 2 to 48 feet, with a median of 20 feet (sd = 10 feet). Individual 1038(c)s had 6% to 100% of residual conifers with





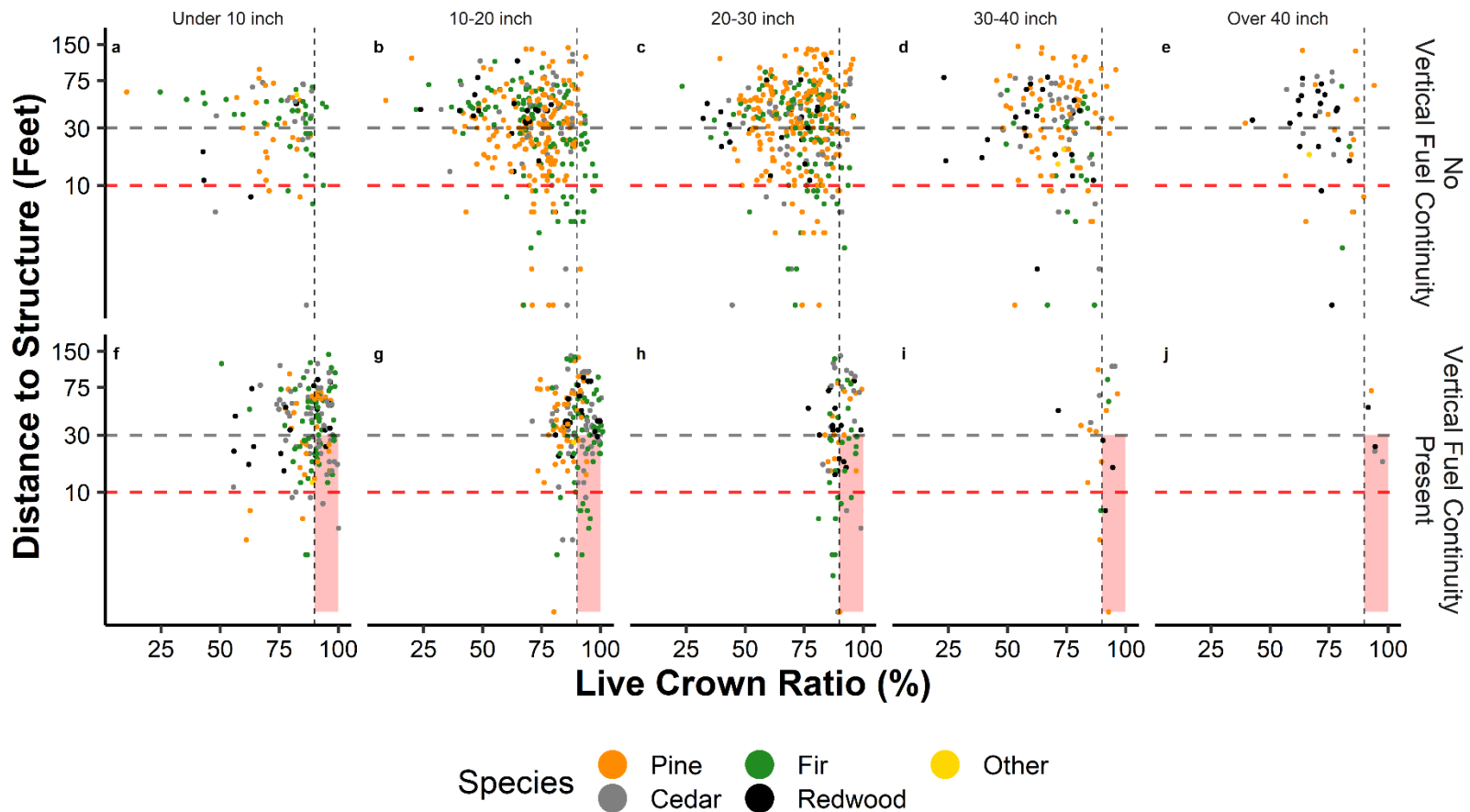
**Figure 9:** Linear regression between the percent trees in crown contact for 1038(c) Notices and the geometric mean spacing of residual conifers.

had a live crown ratio of approximately 90%, as opposed to a live crown ratio of 70% for conifers with vertical continuity absent. The conifers with potential vertical fuel continuity, especially as diameter and height increases, with 90% live crown or more, represent a potential flame, radiant heat, and ember source if ignition occurred. **Figure 10** highlights, within the light red boxes in panels **f** through **j**, those residual conifers on 1038(c)s that likely should have been treated, either through removal or treatment of ladder fuels. These trees fall within 30 feet of structures, have potential vertical fuel continuity, and a high live crown ratio. These conifers represented 7% of all measured trees on the 150 Foot Exemption sample, spread across 31 separate 1038(c)s, the majority of which did not meet the single tree specimen guidelines of PRC § 4291 in the 30-foot zone of permitted structures.

potential surface to crown vertical fuel continuity, based on potential maximum flame length from ladder fuels and the crown base height. Twenty percent of the monitored 1038(c)s had potential vertical fuel continuity on at least 50% of their residual conifers, and just under half had 75% or more of their residual conifers with vertical continuity.

**When considering the most common ladder fuel class found on a 1038(c), and the average crown base height on the Notice, 16% of the sampled Notices had, on average, potential vertical fuel continuity; however, many of these Notices did have single trees with potential vertical fuel continuity absent.**

Trees with potential vertical fuel continuity, regardless of diameter, generally



**Figure 10:** Measured residual conifers on 1038(c)s, with either potential vertical fuel continuity absent (top) or present (bottom), by diameter class, and colored by species type. The vertical black dashed lines indicate the 90% live crown ratio. Horizontal dashed black and red lines show the 30-foot and 10-foot distance from a structure, respectively. The light red panels on the bottom, in columns f through j, indicate those trees with potential surface to crown fuel continuity, that are within 30 feet of treated structures, and have 90% of their total height as live crown; they are potentially substantial ember and/or radiant heat sources. Note: the y-axis is shown on a log<sub>10</sub> scale.

*Defensible Space Following Timber Operations*

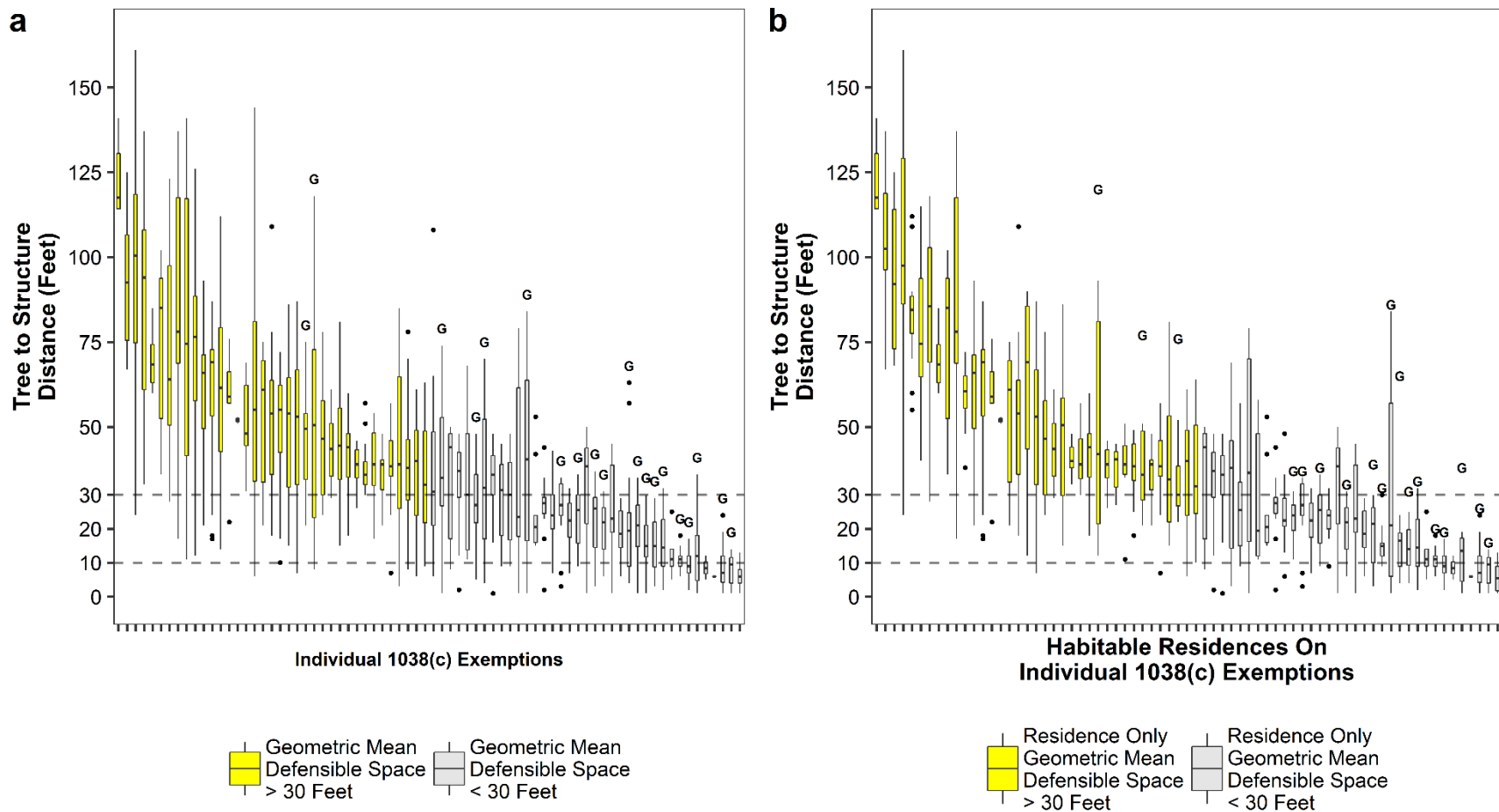
**In general, just over half of the 1038(c) Exemptions met the primary intent of the Exemption for creation of defensible space and eliminating fire hazard near residences and permitted structures. However, there is nuance to this finding, as ownership size and considerations of vertical fuel continuity are important.**

Just over 50%, or 38 of the 75 sampled 150 Foot Exemptions, had a geometric mean of 30 feet or more space created around structures following timber operations (**Figure 11a, Figure 12**). Of those with 30 feet or more of mean defensible space, 58% also had single tree specimens in the 30-foot zone around treated structures (**Figure 12, Figure 13**). Geometric mean defensible space averaged 53 feet (sd = 19 feet) for those 1038(c)s with 30 feet or more of defensible space, while those with less than 30 feet averaged 19 feet of defensible space (sd = 8 feet) (**Figure 11a**). Excluding other permitted structures and considering residential homes only, 52% of the 1038(c)s had a mean defensible space of 30 feet or more around residences, with an average of 54 feet (sd = 22 feet) (**Figure 11b**). Those Exemptions with less than 30 feet of mean defensible space around residences averaged tree-to-home geometric mean distances of 17 feet (sd = 7 feet) (**Figure 11b**). **Table 6** shows the additional breakdown of defensible space outcomes and other variables by Fire Hazard Severity Zone.

**Table 6:** Percent of 1038(c)s that achieved 30 feet of mean defensible space on all treated structures, that achieved 30 feet of mean defensible space on residential structures only, that eliminated potential vertical fuel continuity, and that met guidance for single tree specimens within 30 feet of residential homes, by Fire Hazard Severity Zone. Percentages have been rounded.

Fire Hazard Severity Zone	30 Feet of Geometric Mean Defensible Space?		Residential 30 Feet of Geometric Mean Defensible Space?		Potential Ladder Fuel Vertical Connectivity?		Residential Single Tree Specimens Within 30 Feet?	
	Yes	No	Yes	No	Absent	Present	Yes	No
Moderate	17%	83%	17%	83%	83%	17%	17%	83%
High	87%	13%	79%	21%	80%	20%	50%	50%
Very High	46%	54%	51%	49%	85%	15%	27%	73%

For the 1038(c) Exemptions funded by grants, a mean distance of 30 feet of defensible space was achieved on 10% of the Notices; the remaining 90% of grant funded 1038(c)s where this level of mean defensible space was not achieved averaged 17 feet of space (sd = 7 feet) (**Figure 11a**). When considering residential homes only, which were found on 18 of the 20 grant funded 1038(c)s, 15 of the Notices also did not result in 30 feet or more of mean defensible space around residences. Lastly, all of the grant funded 1038(c)s had more than one conifer specimen present within 30 feet of treated residences, but surface to crown fuel connectivity was absent in 16 of the 18 Notices with residences

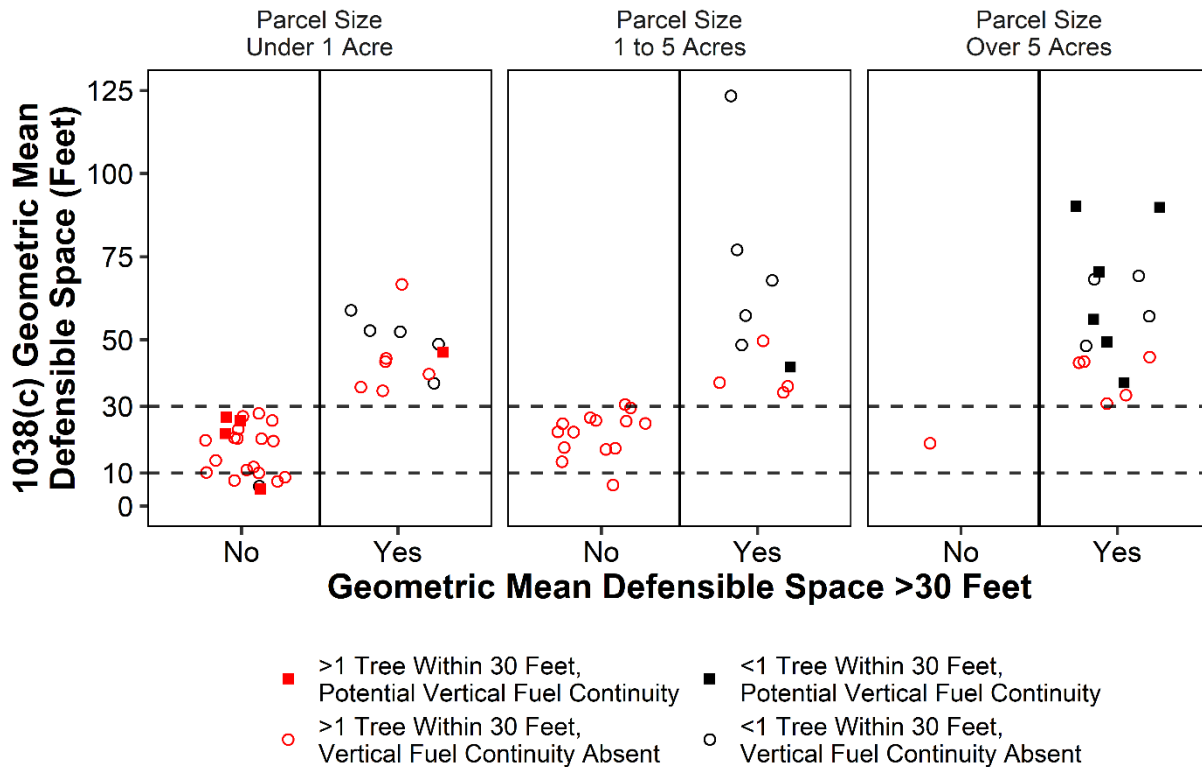


**Figure 11:** Geometric mean defensible space based on residual conifers on each 1038(c). Boxes, whiskers, and points have the same characteristics described for **Figure 7**. Left, a, shows all the Exemptions, with the exception of one with no residual trees (n=74), by decreasing mean defensible space from left to right, with the boxplot color indicating if 30 feet of mean defensible space was achieved or not. A “G” above a box indicates the Notice was funded by a grant. Right, b, is the same but for *only* 1038(c)s with habitable residences (n=71) present. A “G” above a box indicates grant funding; individual Notices in a and b do not align, due to different sample sizes.





**Figure 12:** Top, an example of a 1038(c) that met all aspects of the intent of the 1038(c) Exemption, with the creation of over 30 feet of defensible space, single tree specimens within 30 feet of the residence, with pre- and post-harvest NAIP imagery, and a post-harvest image to the right shown. Bottom, a 1038(c) on a parcel less than one acre in size, that removed conifers from within 10 feet of a residence, however retained multiple trees within 30 feet, and had less than 30 feet of defensible space following operations, with pre- and post-harvest NAIP imagery and a post-harvest image to the right.



**Figure 13:** Monitored 1038(c)s, grouped by parcel size, with each panel split by those Notices with 30 feet of geometric mean space and those without. Squares indicate that potential vertical fuel continuity was present on an Exemption, while circles indicate it was absent; red color indicates there was more than one tree within 30 feet of structures, while black indicates there was one tree or less within 30 feet of structures. The two dashed lines indicate the 30-foot and 10-foot thresholds for geometric mean defensible space on the y-axis.

Interestingly, the median Notice-average crown base height on 1038(c)s with 30 feet of mean defensible space was 19 feet, while on the Notices without 30 feet of average defensible space, that value was 21 feet. As such, despite the observation that almost 50% of 1038(c)s did not have 30 feet or more defensible space following operations, 89% of these Notices did have, on average, conifer crown bases above potential ladder fuel flame lengths (**Figure 13**). Once within the 30-foot zone surrounding habitable residences, over three-quarters of residual conifers, sample-wide, did not exhibit vertical fuel continuity from the surface into the tree crown.

**Parcel size influenced harvest outcomes. Small parcels in residential settings may inherently limit operations, and Exemption intent may conflict with landowner preferences for shade and privacy aesthetics. Only 5% of operations under 1038(c)s failed to achieve any basic fire hazard reduction metrics (30 feet space, single tree specimens, absence of vertical fuel continuity).**

Parcel size where treatments occurred seemed to affect, at least in part, harvest outcomes. On parcels one acre or less in size, only 37% of the 1038(c)s had 30 feet of average defensible space; on parcels over one acre and less than five, 42% of Exemptions had 30 feet or more of mean defensible space (**Figure 13**). For those parcels

over five acres in size where 150 Foot Exemptions occurred, 94% of the harvest outcomes resulted in 30 feet or more of mean defensible space around permitted structures (**Figure 13**). Twelve of the Notices funded by grants that did not result in 30 feet or more average defensible space were found on parcels less than one acre in size.

Only four (i.e., 5%) of 1038(c) Exemptions had less than 30 feet of mean defensible space, more than one tree per structure within the 30-foot zone of residences, and potential vertical fuel continuity present. All four Notices were on parcels less than one acre in size (**Figure 13**). These Exemptions also had other residences on adjacent parcels within 100 feet of the treated structures. Conversely, seven of the 1038(c)s resulted in 30 feet or more of mean defensible space and only single tree specimens within 30 feet of treated structures, but had potential vertical fuel continuity present (**Figure 13**). These Notices averaged 11 acres in parcel size. The larger ownerships had 27 feet<sup>2</sup> per structure on average and a mean QMD of 20 inches following harvest. They also showed fewer constraints for treatment with an average geometric mean defensible space of 62 feet (sd = 21 feet). Whereas the 4 one acre or less parcels identified above had 22 feet<sup>2</sup> acre<sup>-1</sup>, a mean QMD of 23 inches post-harvest, and an average geometric mean defensible space of 20 feet (sd = 9 feet).

In the case of the 1038(c)s where harvest operations occurred around both residential homes and additional permitted structures, 58% had 30 feet or more of mean defensible space around the residences, regardless of space around other structures. Of the remaining 42% of 1038(c)s where less than 30 feet of mean defensible space existed around residences, nine notices also did not achieve 30 feet or more defensible space around the other treated structures, while five did achieve this standard. Therefore, of the entire sample of 1038(c) Exemptions, 7% had what was likely a greater focus on non-residential structures, failing to use the Exemption to increase defensible space around residences. The average geometric mean space around these residences was 22 feet, while for the non-residential structures it was 42 feet. This subset also failed to meet the single-tree specimen threshold within 30 feet of the residences. However, four of these five Exemptions had an absence of potential surface to crown vertical fuel continuity, illustrating the multiple metrics to be considered in assessing the outcome of treatments completed under 1038(c) Exemptions.

## Case Study – 2020 North Complex Fire, Butte County, CA

The North Complex Fire began as a series of lightning caused fires that started in August 2020 in Plumas and Butte counties, including the Bear and Claremont fires. Exceptionally high temperatures and low humidity were present moving into September 2020 and the Labor Day weekend, when a substantial wind event occurred on September 8, 2020, with wind gusts in the early morning exceeding 60 mph at the Jarbo Gap weather station in Butte County. Throughout the day and evening, extreme fire behavior was observed, with a rapid wind driven rate of spread to the southwest down the Middle Fork of the Feather River Canyon, eventually reaching populated areas in Butte County near Lake Oroville and burning 318,935 acres before containment.

A total of seven mapped 1038(c)s were identified within the final footprint of the North Complex Fire within Butte County, having been accepted by CAL FIRE between 2015 and 2018. While it is possible there are more unmapped legacy 150 Foot Exemptions within this area, these seven mapped Exemptions are the extent of data available to assess the efficacy of these Notices during a worst case scenario fire event. This case study should be viewed as a limited and simple after action look at outcomes, and more qualitative than quantitative.

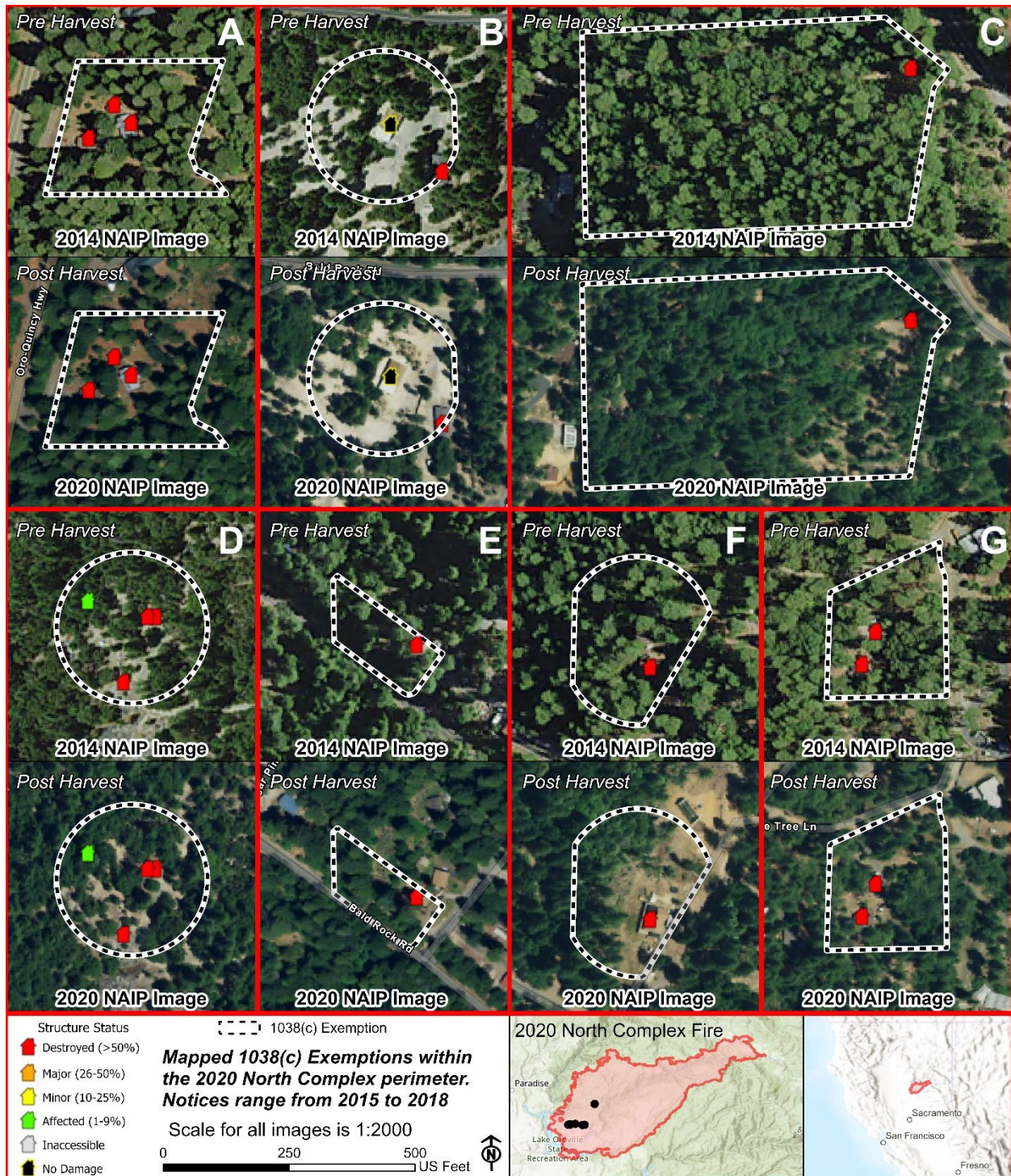
**Figure 14** displays the outcomes of the seven 1038(c)s. Panel A through G show the Forest Practice GIS approximated harvest areas, or parcel boundaries when actual harvest areas were unknown, with high resolution pre-harvest 2014 USDA NAIP imagery on top, and post-harvest, pre-fire 2020 USDA NAIP imagery on bottom. The color-coded buildings indicate damage inspection assessments performed immediately after the fire by CAL FIRE Damage Inspection Specialists (DINS).

In all seven examples, residential structures were deemed “destroyed” or over 50% damaged, while assorted outbuildings were either destroyed or sustained limited damage. On only one Exemption was a structure deemed unaffected with no damage, described as an unenclosed utility structure (Panel B). Visually, based on the before and after imagery, all seven Exemptions appear to have had some level of harvesting, ranging from potentially single tree removal (Panel E), to more substantial tree removal (Panel F). Of the seven Exemptions in this simple case study, Panel F displays what was the greatest level of defensible space, likely well in excess of 30 feet on average.

Regardless of the level of intensity of treatment, post-fire outcomes were not favorable for residential homes, indicative of the difficulty of managing forest fuels for specific outcomes in a worst-case wind driven fire event under extreme burning conditions within the wildland urban interface [2]. Likewise, it underscores that the use of 1038(c) Fire Hazard Reduction Exemptions to increase defensible space, and to reduce vertical and horizontal connectivity of fuels, is simply one tool and factor amongst other considerations. These other considerations include home maintenance and hardening, non-timber related fuel management, presence of active fire suppression or structure defense actions, and considerations for entire communities during extreme fire events. The limited findings from this case study of the North Complex Fire does not conclude that 1038(c)s are ineffective. Rather, it indicates that more rigorous and thorough post-



fire evaluations are needed to truly determine the effectiveness of 1038(c) under a range of fire conditions.



**Figure 14:** Seven mapped 1038(c)s within the 2020 North Complex Fire in Butte County, CA. In panel A through G, the top image shows pre-harvest 2014 NAIP imagery, and the bottom image shows post-harvest 2020 NAIP imagery, with mapped harvest areas or parcels, dependent on the document information provided shown as dashed black lines with white backgrounds. The colored house symbols indicate

structures found on each parcel, and indicate the level of damage observed by CAL FIRE Damage Inspection Specialists (DINS).



## Discussion

- **1038(c)s were relatively small in spatial scale, had lower harvest intensity, and were sometimes used for non-fire hazard related tree management goals. Costs associated with many 1038(c)s were substantial.**
- **If the goal of the 1038(c) is to create 30 feet of defensible space and reduce fuel loads near structures, many 1038(c)s do not achieve this goal; however, methods to reduce fire hazard in other ways should be taken into account, such as elimination of surface fuels, and home hardening.**
- **Fuel treatment and home hardening and retrofitting are not mutually exclusive, and should be viewed as complimentary actions for reducing fire hazard at the individual property and community scales.**
- **Wildfires will continue to occur and likely increase in extent, intensity, and severity; this underscores the need for multiple approaches at multiple scales to address wildfire threat to life and property in the wildland urban interface (WUI).**

Generally, 1038(c)s were found to have small spatial footprints, and frequently substantially lower timber harvest intensity in terms of board foot volume removal. While there were some sampled 1038(c)s with multiple structures present and more substantial pre-existing conifer stands where the harvesting footprint and intensity was greater, they were frequently the exception and not the norm. This finding is consistent with the findings in the CAL FIRE Pilot EX-EM Notice Monitoring report [3], where Drought Mortality Exemption Notices were frequently used to remove one or two dead or dying trees from small residential parcels. Effectively, within the confines of the California Forest Practice Rules, the 1038(c) exists as a tool for landowners and LTOs to legally remove timber, and commercialize it if possible, for fire hazard reduction. However, the 150 Foot Exemption appears to frequently be used as a “catch-all” for any type of commercial tree removal proximal to structures.

Removal of conifers in close proximity to residences may cost more than the value of the conifers removed. This was revealed during conversations with timberland owners in the course of sampling who indicated the 1038(c) on their property resulted in a financial loss (**Figure 15**). This indicates that for some landowners, timber removal near homes and structures may be financially infeasible. It also suggests the cost of timber removal alone may preclude retrofitting of structures to harden them against ember intrusion and flame impingement.

Additionally, the presence of hardwoods and ornamental trees within 30 feet of structures on over 50% of the sample, and hardwoods in crown contact with conifer species, suggests a need for guidance to landowners and licensed professionals in how to treat, or not treat, these tree species. Further research and



**Figure 15:** Sawlogs that were not commercialized on a 1038(c) that resulted in a financial loss to the landowner, as the LTO was going to require payment to remove them.

guidance on the role these non-conifer tree species may play in influencing fire hazard risk to structures and residual conifers may also benefit landowners and licensed professionals.

**In terms of creating defensible space and reducing potential fire behavior, as per the concepts illustrated in [Ready For Wildfire](#) and recent research [4][5], the sampled 1038(c)s had variable outcomes. Just over half of the 1038(c)s established 30 feet or more of mean defensible space, and a minority had only single tree specimens within 30 feet of residences. This might indicate that ambiguity in the regulation is affecting implementation of the Exemption requirements. For instance, the TRA #4 requirement to leave single tree specimens in Zone 1 is unclear whether single trees of differing species are allowable, or whether it is referring to a single tree regardless of species. The variable outcomes all suggest that not all who undertake 1038(c)s on their property have wildfire hazard reduction as a goal. Alternatively, it may also indicate the costs associated with fully implementing the 1038(c) Exemption are too high for a large proportion of landowners.**

Anecdotally, there were also some 150 Foot Exemptions in which the properties were in a condition that met wildfire resiliency guidelines prior to operations under the Exemption. Further, some 1038(c)s that had substantial residual conifers within 30 feet, and even 10 feet, of structures also had essentially no vertical fuel connectivity. In these instances, the threat to homes posed by the residual conifers would likely only be in the form of an active crown fire. Of course, some Notices also had residences that were observed with firewood piles, wooden decks, and other factors that have been shown to cause home ignition. Likewise, the lack of defensible space and open area around structures may prohibit first responders from undertaking active structure defense, which can also be a critical factor to structure survival [4].

Slash treatment, regardless of harvest intensity and footprint, was found to be consistently completed by LTOs and enforced by CAL FIRE Forest Practice Inspectors. These observations appear to indicate generally successful implementation of slash treatment and Forest Practice Rule compliance.

Multiple studies and reports have shown the importance of defensible space and additional home maintenance, hardening, and fire-safe construction [4][6][7], in addition to wind direction and the arrangement and health of surrounding vegetation [8]. Research has also shown that older homes, manufactured homes, and homes not adequately maintained (e.g., cleaning out gutters, removal of leaves and needles from roofing) are susceptible to embers ahead of a fire front, rather than direct flames, which can result in home ignition [4][9]. As of the writing of this report, the state is poised to develop new structure and community hardening standards; and continues to explore homeowner funding assistance opportunities to support structure retrofitting. It is worth emphasizing that landscape treatments and structure hardening are complimentary actions. As was apparent during sampling, parcel size alone can limit defensible space creation unless adjoining parcel owners cooperate. In cases where house-to-house exposure is likely, greater hazard reduction may be derived from home hardening and fuel treatments directly focused on the entire community (i.e., community fuel breaks around denser

portions of intermix WUI<sup>2</sup>), rather than individual parcels, especially at the interface with wildlands [10][11][12].

The case study looking at the effectiveness of 1038(c) Exemptions in the North Complex Fire shows limited effectiveness of these activities in reducing structure loss. However, inferences from this case study are limited without better data detailing how fuels were treated around the structure, and how fire behavior and other factors influenced the outcome. As such, integrating the implementation of 1038(c) requirements, when applicable, into Defensible Space inspections and the effectiveness of the Exemption activities into the incident Damage Inspections process might provide a more rigorous evaluation of Exemption efficacy following wildfire.

Overall, the 1038(c) Exemption is an important regulatory vehicle for increasing a structure's resiliency to wildfire. Efforts should be made to increase the landowner and LTOs understanding of what's necessary to implement an effective fire hazard reduction treatment proximal to structures. It may also be necessary to provide mechanisms and incentives to offset the high costs of performing tree removal work close to structures.

## Recommendations

Based upon the results of the monitoring, the following recommendations are offered for consideration:

- 1. CAL FIRE should develop additional guidance for landowners and Licensed Timber Operators on the requirements of the 1038(c) to ensure that the intent of the Exemption is met. Focus should be placed on the need to adequately treat the area within 30 feet of the structure.**
  - CAL FIRE could consider integration of guidance with broader landowner and LTO education on fuels and home hardening treatments, as well as guidance for implementing these treatments based upon the best available science.
  - Consider revising the FPRs to provide clearer direction to landowners and LTOs on the required elements of 1038(c). This might include better integration of FPR 1038 language and Technical Rule Addendum No. 4 with the requirements of PRC §§ 4290 and 4291.
    - i. Revisions might include better clarification on the requirements within Zone 1 of TRA #4.
  - Guidance is needed on how to treat hardwoods and/or ornamentals within 30 feet of the structure.
- 2. Broader guidance should be given on Exemptions so that landowner objectives can be coupled with the appropriate Exemption type.**
- 3. CAL FIRE could consider integration of Forest Practice and Defensible Space inspections where 1038(c) Exemptions are utilized. The 1038(c) Exemption presents an opportunity for achievement of both Forest Practice**

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<sup>2</sup> The area where houses and wildland vegetation directly intermingle.



**and Fire Prevention objectives toward structure resilience to wildfire and should be noted in Defensible Space reporting in the future.**

- If activities are explicitly identified and mapped, post-fire effectiveness of 1038(c) treatments could potentially be integrated into the incident Damage Inspection process.

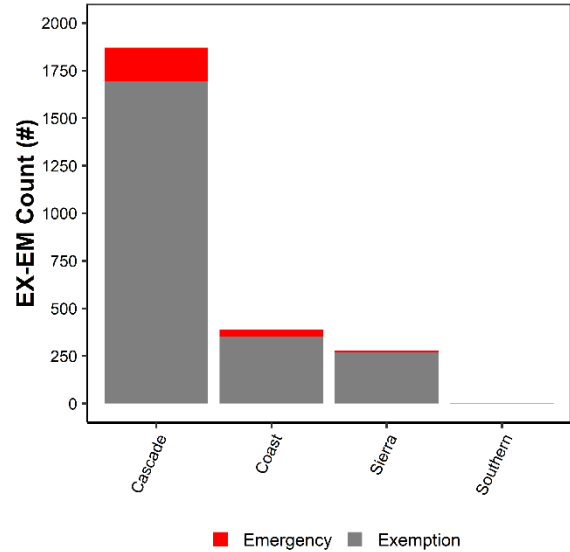
# Exemption and Emergency Notice Submittals, Inspections, and Violations

## Exemption and Emergency Notice Submissions

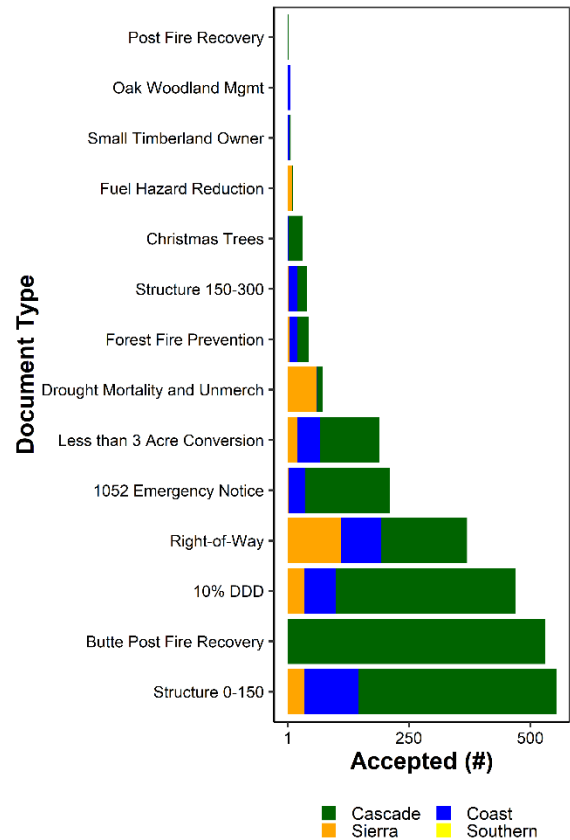
### 2019 Non-discretionary documents

In 2019, approximately 91% of accepted non-discretionary documents were Exemptions, while the remaining 9% were Emergency Notices (**Figure 16**). Over two-thirds of the accepted Exemptions were for 0-150 Foot Fire Hazard Reduction, Butte Post Fire Recovery, and <10% Dead, Dying, or Diseased Exemptions (**Figure 17**). Right-of-Way Conversion Exemptions accounted for 16% of accepted Exemptions, Drought Mortality and Unmerchantable Sawlog documents made up about 3% of accepted Notices, and 150-300 Foot Fire Hazard Reduction and Forest Fire Prevention Exemptions each were less than 2% of total accepted Notices (**Figure 17**). Less Than 3 Acre Conversions comprised 8% of Exemptions in 2019, while only seven Small Timberland Exemptions were submitted and accepted.

In terms of reported acreage on Exemptions, when the <10% Dead, Dying, or Diseased, Christmas Tree, and Right-of-Way Conversion Exemptions are removed, as they often do not reflect actual harvested area, 39% and 34% of the reported acreage was attributed to Drought Mortality and Forest Fire Prevention Exemptions, respectively (**Table 7**). Twelve percent of the reported acres were for 0-150 Foot Fire Hazard Reductions, and 8% of the reported acreage was under Butte Post Fire Recovery Exemptions. Despite Less Than 3 Acre Conversions accounting for 8% of accepted Notices, they accounted for only for 2% of reported acreage. The six Oak



**Figure 16:** Accepted non-discretionary documents in 2019 by Forest Practice Area, with colors indicating either Exemptions (gray) or Emergency Notices (red).

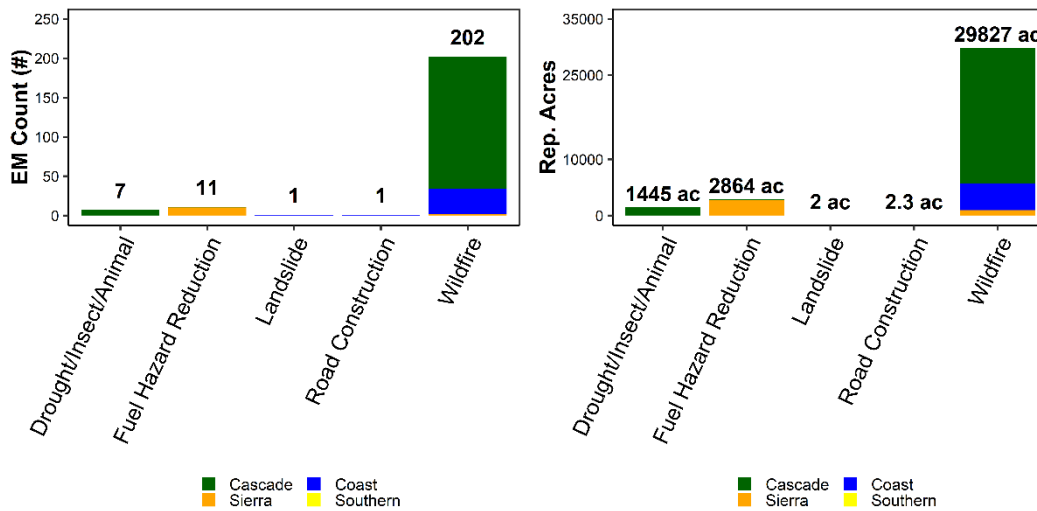


**Figure 17:** 2019 accepted non-discretionary documents by type, with colors corresponding to the Forest Practice Area where the document was submitted and accepted.

Woodland Management Exemptions accepted accounted for approximately 2% of reported Exemption acreage as well.

**Table 7:** Accepted Emergency and Exemption Notices by type for 2019, with reported acreage and percent of acreage by Emergency or Exemption type. The far right column shows percent reported acreage by Exemption type, with <10% Dead, Dying, or Diseased, Christmas Tree, and Right-of-Way Conversion Exemptions excluded. Numbers are rounded, and percentages may not add up to exactly 100% due to rounding.

2019 EMERGENCY NOTICES	% Total Notices	Rep. Acres	% of Acres	% Acres (Excluding 10% DDD, Christmas Tree, and ROW)
Emergency Notice of Timber Operations	95%	31,276	92%	
Fuel Hazard Reduction	5%	2864	8%	
2019 EXEMPT TIMBER HARVESTING	% Total Notices	Rep. Acres	% of Acres	
0-150 Foot Fire Hazard Reduction	24%	1871	<1%	12%
Butte Post Fire Recovery	23%	1232	<1%	8%
<10% Dead, Dying, or Diseased (10% DDD)	20%	2,151,843	78%	-
Right-of-Way Conversion (ROW)	16%	329,609	12%	-
Less Than 3 Acre Conversion	8%	294	<1%	2%
Drought Mortality and Unmerchantable Sawlog	3%	6049	<1%	39%
Forest Fire Prevention	2%	5177	<1%	34%
150-300 Foot Fire Hazard Reduction	2%	206	<1%	1%
Christmas Trees	1%	253,902	9%	-
Small Timberland Notice	<1%	179	<1%	1%
Oak Woodland Management	<1%	351	<1%	2%
Post Fire Recovery	<1%	3	<1%	<1%



**Figure 18:** The number of accepted Emergency Notices by type (left), and the reported acreage on Emergency Notices by type (right), with colors indicating the Forest Practice Area where they were submitted and accepted in 2019.

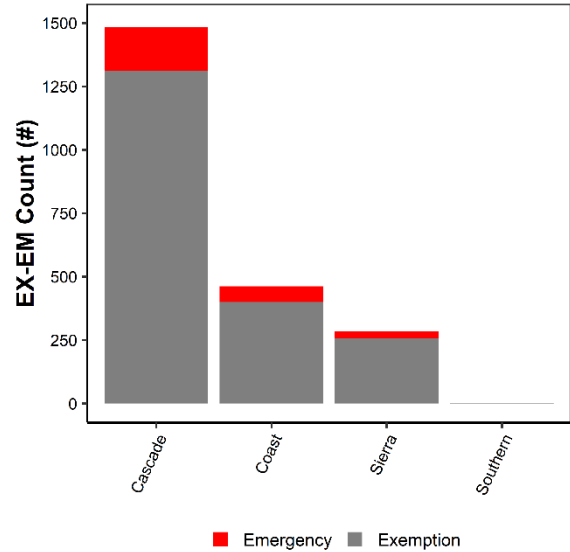
Accepted Emergency Notices were overwhelmingly for wildfire-related emergencies (91%), while 5% of accepted Emergency Notices were for Fuel Hazard Reduction, with the remaining percentage of accepted Emergency Notices for drought, insect, animal, or pathogen damage, landslide mortality, and emergency road

construction (**Figure 18**). Nearly 30,000 acres or 87% of the reported acreage under Emergency Notices was for wildfire related tree mortality, most of which was in the Cascade Forest Practice Area (**Figure 18**), including continued salvage within the 2018 Carr, Delta, and Hirz fire perimeters. Eight percent of the reported acreage was under Fuel Hazard Reduction Emergencies, and 4% for drought, insect, animal or pathogen damage (**Figure 18**).

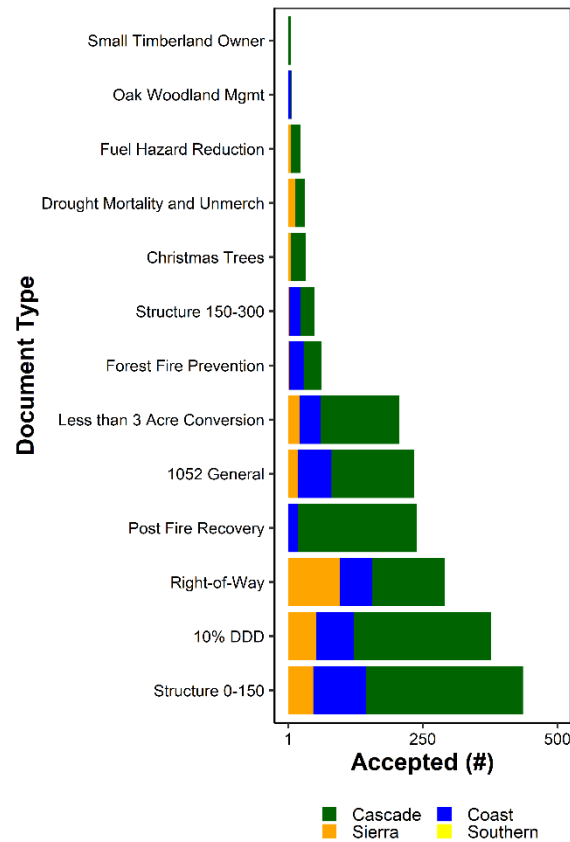
### 2020 Non-discretionary documents

In 2020, approximately 88% of accepted non-discretionary documents were Exemptions, while the remaining 12% were Emergency Notices (**Figure 19**). The 0-150 Foot Fire Hazard Reduction Notices accounted for 22% of accepted Exemptions, followed by 19% of the Exemptions for <10% Dead, Dying, or Diseased harvesting (**Figure 20**). Right-of-Way Conversions accounted for 15% of the 2020 Exemptions, while 12% of Exemptions were for Post Fire Recovery, and 10% of accepted Exemptions were for Less Than 3 Acre Conversions, a substantial majority of which were within the Cascade Forest Practice Area (**Figure 20**). Three percent of accepted Exemptions were for the Forest Fire Prevention Exemption, and ~3% were for the 150-300 Foot Fire Hazard Reduction Exemption. The remaining Notice types were less than 2% of all accepted Exemptions. A total of six Small Timberland Owner Exemptions were accepted, five of which were in the Cascade Forest Practice Area.

In terms of reported Exemption acreage, once the <10% Dead, Dying, or Diseased, Christmas Tree, and Right-of-Way Conversion Exemptions were excluded, 45% of the reported acreage was for Drought Mortality and Unmerchantable Sawlog Exemptions, while 33% was for the Forest Fire Prevention Exemptions, the majority of which were within the Cascade Forest Practice Area



**Figure 19:** Accepted non-discretionary documents in 2020 by Forest Practice Area, with colors indicating either Exemptions (gray) or Emergency Notices (red)

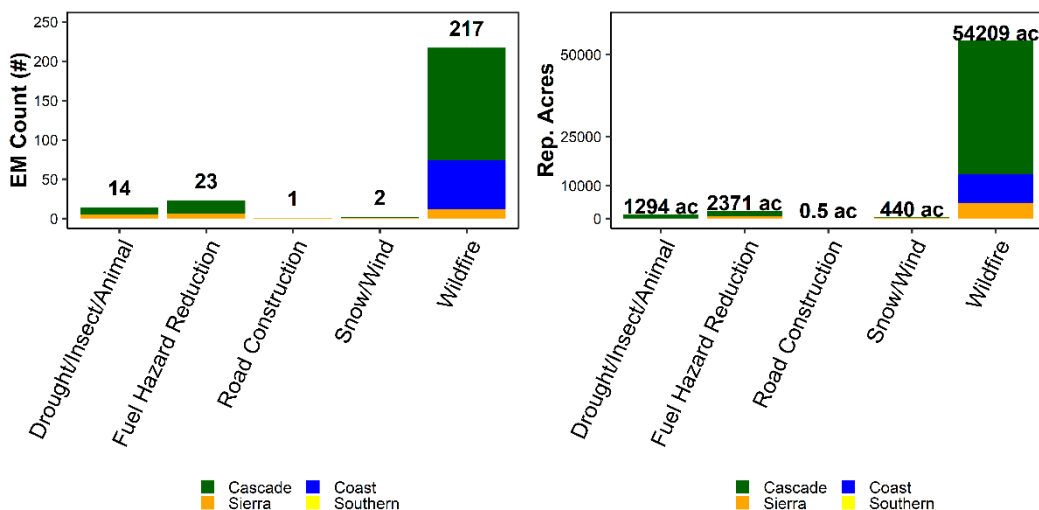


**Figure 20:** 2020 accepted non-discretionary documents by type, with colors corresponding to the Forest Practice Area where the document was submitted and accepted.

(Table 8). The 0-150 Foot Fire Hazard Reduction Notices made up 15% of reported acreage, while the Post Fire Recovery Exemption accounted for 3% of all reported acres. The Less Than 3 Acre Conversion Exemption made up 10% of accepted Notices in 2020, but only accounted for 2% of the reported acreage. The Small Timberland Owner Exemptions accounted for approximately 114 reported acres or <1% of all reported acreage.

**Table 8:** Accepted Emergency and Exemption documents by type for 2020, with reported acreage and percent of acreage by Emergency or Exemption type. The far right column shows percent of reported acreage by Exemption type, with <10% Dead, Dying, or Diseased, Christmas Tree, and Right-of-Way Conversion Exemptions excluded. Numbers are rounded, and percentages may not add up to exactly 100% due to rounding

2020 EMERGENCY NOTICES	% Total Notices	Rep. Acres	% of Acres	% Acres (Excluding 10% DDD, Christmas Tree, and ROW)
Emergency Notice of Timber Operations	91%	55,943	96%	
Fuel Hazard Reduction	9%	2371	4%	
2020 EXEMPT TIMBER HARVESTING	% Total Notices	Rep. Acres	% of Acres	
0-150 Foot Fire Hazard Reduction	22%	2542	<1%	15%
<10% Dead, Dying, or Diseased (10% DDD)	19%	1,852,393	74%	-
Right-of-Way Conversion (ROW)	15%	475,627	19%	-
Post Fire Recovery	12%	428	<1%	3%
Less Than 3 Acre Conversion	10%	339	<1%	2%
Forest Fire Prevention	3%	5684	<1%	33%
150-300 Foot Fire Hazard Reduction	3%	213	<1%	1%
Christmas Trees	2%	153,156	6%	-
Drought Mortality and Unmerchantable Sawlog	2%	7788	<1%	45%
Oak Woodland Management	<1%	238	<1%	1%
Small Timberland Notice	<1%	114	<1%	<1%



**Figure 21:** The number of accepted Emergency Notices by type (left), and the reported acreage on Emergency Notices by type (right), with colors indicating the Forest Practice Area where they were reviewed and accepted in 2020



Accepted Emergency Notices in 2020 were overwhelmingly for wildfire-related emergencies (84%), while 9% were for Fuel Hazard Reduction. The remaining percentage of accepted Emergency Notices were for drought, insect, animal, or pathogen damage, snow and wind damage, and emergency road construction (**Figure 21**). Over 54,000 acres or 93% of the reported acreage under Emergency Notices were for wildfire-related tree mortality, some of which was for wildfire-related tree mortality in previous years, but much of which was due to the historic 2020 wildfire season (**Figure 21**). Similar to 2019, the majority of reported Emergency Notice acreage from wildfires was in the Cascade Forest Practice Area, followed by a large portion within the Coast Forest Practice Area. The Sierra Forest Practice Area saw an increase in Emergency Notice numbers and reported acreage relative to 2019, also in response to the historic 2020 fire season (**Figure 21**). Four percent of the reported acreage was under Fuel Hazard Reduction Emergencies, with 2% for drought, insect, animal, or pathogen damage (**Figure 21**).

## Exemption and Emergency Notice Inspections and Violations

### Inspections

CAL FIRE Forest Practice Inspectors conducted over 1,400 inspections on Emergencies and Exemptions in 2019, for over 1,100 individual non-discretionary documents, totaling 3,179 reported field hours, or collectively 132 days of field inspections<sup>3</sup>. Exemptions accounted for 74% of inspections, the most prevalent being for Less Than Three Acre Conversion, 0-150 Foot Fire Hazard Reduction, and Right-of-Way Conversion Exemptions. Emergencies accounted for 26% of the inspections, and involved a total of 863 hours of field inspection time on 300 individual Emergency Notices.

In 2020, Forest Practice Inspectors conducted 1,300 inspections on 936 individual non-discretionary Emergency and Exemption Notices, for a total of 2,750 hours of field hours<sup>4</sup> (or approximately 115 days, collectively). Exemptions accounted for 71% of the inspections, with the majority being for Less Than Three Acre Conversions; <10% Dead, Dying, or Diseased; and 0-150 Foot Fire Hazard Reduction Exemptions. Approximately 8% of the field time was dedicated to Right-of-Way Conversion Exemptions only, while Forest Fire Prevention Exemptions received 50 inspections. Emergency Notices accounted for 29% of inspections, with 920 hours of field time during 381 separate inspections on 267 individual Emergency Notices.

When considering only the non-discretionary Notices submitted and accepted in 2019, almost 1,150 inspections were done, covering almost 2,500 hours of field inspection, inclusive of inspections in both 2019 and 2020. For those non-discretionary Notices submitted and accepted in 2020 only, 418 inspections occurred with nearly 1,000 hours of field inspection time during 2020.

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<sup>3</sup> This number includes not just EX-EM Notices from 2019, but also active Notices from 2018 and those Notices still under Maintenance Periods.

<sup>4</sup> This number includes not just EX-EM Notices from 2020, but also active Notices from 2019 and those Notices still under Maintenance Periods.

## Violations

A total of 111 violations were issued on Emergency and Exemption Notices in 2019, 91% to Exemptions and 9% to Emergency Notices. Less Than Three Acre Conversions accounted for 60% of the Exemption violations, while 7% were for Right-of-Way Conversion Exemptions. Of note is that six 0-150 Foot Fire Hazard Reduction Exemptions received violations for failure to treat surface fuels created by timber harvesting, or 2.5% of all inspected 0-150 Foot Exemptions that had been accepted in 2018 and 2019.

In 2020, 76 violations were issued to Emergency and Exemption Notices, with 71% given to Exemptions and 29% to Emergency Notices. Less Than Three Acre Conversions were again the most prominent Exemption type with Forest Practice Rule violations, accounting for 39% of the Exemptions with violations, followed by the 0-150 Foot Fire Hazard Reduction (19%) and Forest Fire Prevention Exemptions (17%). Nine percent (9%) of violations were issued to Right-of-Way Conversion Exemptions. For Emergencies, 86% went to post-fire Emergency Notice projects, while the remaining 14% were issued to Fuel Hazard Reduction Emergencies.

For documents submitted and accepted in *only* 2019, 48 violations were given on 31 individual Exemption Notices; 23% of which were to Emergency Notices, and the remaining violations related to Exemptions. Similar to inspections, this is inclusive of both 2019 and 2020 years. For those Emergency and Exemption Notices submitted in 2020 *only*, 30 violations were given on 16 separate Notices. Only one was to an Emergency, a Fuel Hazard Reduction Notice, while the rest were to Less Than Three Acre Conversion; Forest Fire Prevention; Drought Mortality; 0-150 Foot Fire Hazard Reduction; 150-300 Foot Fire Hazard Reduction; and <10% Dead, Dying, or Diseased Exemptions.

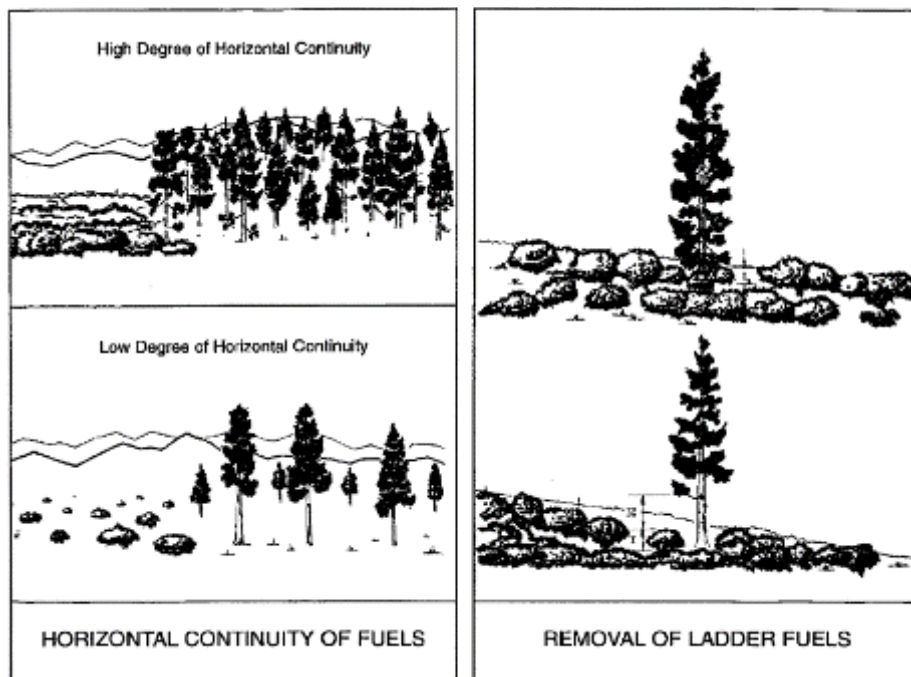
## References

1. Olsen, Will, Coe, Drew, Stanish, Stacy., Cafferata, Pete. 2019. "Report on Emergency Notice of Timber Operations Monitoring Results and Exemption Notice Usage". California Department of Forestry and Fire Protection and State Board of Forestry and Fire Protection. Sacramento, CA. 35 p. plus Appendices.  
[https://www.researchgate.net/publication/345036759\\_REPORT\\_ON\\_EMERGENCY\\_NOTICE\\_OF\\_TIMBER\\_OPERATIONS\\_MONITORING\\_RESULTS\\_AND\\_EXEMPTION\\_NOTICE\\_USAGE](https://www.researchgate.net/publication/345036759_REPORT_ON_EMERGENCY_NOTICE_OF_TIMBER_OPERATIONS_MONITORING_RESULTS_AND_EXEMPTION_NOTICE_USAGE)
2. Keeley, Jon E, and Alexandra D Syphard. 2019. "Twenty-First Century California, USA, Wildfires: Fuel-Dominated vs. Wind-Dominated Fires." *Fire Ecology* 15 (1): 24.  
<https://doi.org/10.1186/s42408-019-0041-0>
3. Olsen, Will, Coe, Drew, Stanish, Stacy, Cafferata, Pete, Huff, Eric, Lang, Suzanne, Rohr, Francesca. 2019. "Exemption and Emergency Notice monitoring pilot project report". California Department of Forestry and Fire Protection and State Board of Forestry and Fire Protection. Sacramento, CA. 110 p. plus Appendices.  
[https://www.researchgate.net/publication/335149799\\_Exemption\\_and\\_Emergency\\_Notice\\_Monitoring\\_Pilot\\_Project\\_Report](https://www.researchgate.net/publication/335149799_Exemption_and_Emergency_Notice_Monitoring_Pilot_Project_Report)
4. Syphard, Alexandra D., and Jon E. Keeley. 2019. "Factors Associated with Structure Loss in the 2013–2018 California Wildfires." *Fire* 2 (3): 49. <https://doi.org/10.3390/fire2030049>
5. Syphard, Alexandra D., Teresa J. Brennan, and Jon E. Keeley. 2014. "The Role of Defensible Space for Residential Structure Protection during Wildfires." *International Journal of Wildland Fire* 23 (8): 1165. <https://doi.org/10.1071/WF13158>
6. Cohen, Jack D. 2004. "Relating Flame Radiation to Home Ignition Using Modeling and Experimental Crown Fires." *Canadian Journal of Forest Research* 34 (8): 1616–26.  
<https://doi.org/10.1139/x04-049>
7. Cohen, Jack D. 2000. "Preventing Disaster: Home Ignitability in the Wildland-Urban Interface." *Journal of Forestry* 98 (3): 15–21. <https://doi.org/10.1093/jof/98.3.15>
8. Gibbons, Philip, A. Malcolm Gill, Nicholas Shore, Max A. Moritz, Stephen Dovers, and Geoffrey J. Cary. 2018. "Options for Reducing House-Losses during Wildfires without Clearing Trees and Shrubs." *Landscape and Urban Planning* 174 (March): 10–17.  
<https://doi.org/10.1016/j.landurbplan.2018.02.010>
9. Cohen, Jack D., and Richard D. Stratton. 2008. "Home destruction examination: Grass Valley Fire, Lake Arrowhead, California." Tech. Paper R5-TP-026b. Vallejo, CA: US Department of Agriculture, Forest Service, Pacific Southwest Region (Region 5). 26 p.  
[http://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/fsbdev3\\_046340.pdf](http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_046340.pdf)
10. Rogers, Gene, Wendel Hann, Charley Martin, Tessa Nicolet, and Morgan Pence. 2008. "Fuel treatment effects on fire behavior, suppression effectiveness, and structure ignition, Grass Valley fire, San Bernardino National Forest." US Department of Agriculture, Forest Service. R5-TP-026a. [https://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/fsbdev3\\_045471.pdf](https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_045471.pdf)
11. Aronson, Glen, and Dominik Kulakowski. 2013. "Bark Beetle Outbreaks, Wildfires and Defensible Space: How Much Area Do We Need to Treat to Protect Homes and Communities?" *International Journal of Wildland Fire* 22 (2): 256. <https://doi.org/10.1071/WF11070>
12. Gibbons, Philip, Linda van Bommel, A. Malcolm Gill, Geoffrey J. Cary, Don A. Driscoll, Ross A. Bradstock, Emma Knight, Max A. Moritz, Scott L. Stephens, and David B. Lindenmayer. 2012. "Land Management Practices Associated with House Loss in Wildfires." Edited by Rohan H. Clarke. *PLoS ONE* 7 (1): e29212. <https://doi.org/10.1371/journal.pone.0029212>

# Appendix 1: 1038(c) 0-150 Foot Structure Protection Exemption Monitoring Protocol

## 1038(c) 0-150 Foot Structure Protection Exemption Monitoring

For CAL FIRE's monitoring of exempt timber harvesting for structure protection, the monitoring will focus on post-treatment outcomes and forest structure, relative to protected structures, for 0-150 foot treatment area<sup>5</sup>. The monitoring will involve compliance metrics, implementation metrics, and a rapid assessment piece focused on effectiveness for fuel reduction.



The questions this monitoring will strive to assess will include:

- 1) Are the 1308(c) Structure Protection Exemptions following critical compliance requirements?

<sup>5</sup> In the case where the document is a 0-150 foot, but there was another document for a 150-300 foot treatment also utilized, this will be recorded. Field work will then quantify treatments only for the 0-150 foot treated area that the Exemption explicitly covers.

- 2) Based on the landscape, and residual forest and vegetation structure, is the treated area fire resilient based on Public Resource Code, CAL FIRE Defensible Space guidelines, and general fire behavior metrics?
- 3) Do the metrics associated with the harvested trees (determined when and where possible based on residual stumps following harvest) indicate that a significant change was introduced via harvesting?
- 4) Have LTO's and TLO's (homeowners) met additional requirements to harden the landscape to wildfire, i.e., minimized fire risk from non-timber resources?

Key aspects of monitoring:

**1) Compliance**

- a. Are Exemptions meeting requirements for removal of slash and fuel from timber operations, via mulching, chipping, or pile burning?<sup>6</sup>
- b. Is the residual stand comprised of vigorous and healthy trees, with no standing dead trees left?
- c. Are vegetation, grass, and harvest related slash and fuel requirements as outlined in 1038(c) and Technical Rule Addendum 4, and Defensible Space Guidelines, being met?<sup>7</sup>
- d. Are any trees being removed outside of the 150 foot Exemption restrictions?<sup>8</sup>

**2) Implementation**

- a. Are residual trees meeting basic requirements for elimination or reduction of horizontal and vertical fuel continuity to reduce fire rate and spread and protect permitted structures?
  - i. Part of this assessment will be based on CAL FIRE guidelines for defensible space [<https://www.readyforwildfire.org/prepare-for-wildfire/get-ready/defensible-space/>]

**3) Effectiveness**

- a. Is potential fire behavior relative to permitted structures being modified and/or minimized?
  - i. This will be quantified by measurements of residual trees relative to structures and other remaining residual trees, and the surrounding average ladder fuel height and ground slope
  - ii. This will also be quantified through assessment of tree height, crown base height, and crown-to-crown contact, in order to assess live crown ratio, crown continuity, ladder fuel-crown continuity, and residual tree structure

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<sup>6</sup> Per CCR 1038(c)(3), no harvest-related slash or fuel over 1 inch in diameter within 150 feet of a structure

<sup>7</sup> CCR 1038(c)(4) and Technical Rule Addendum 4, and PRC and CAL FIRE Defensible Space guidelines for vegetation and tree spacing and slope effects

<sup>8</sup> No trees are to be commercially removed beyond 150 feet from a legally permitted structure, unless additional Exemptions or permits are in effect



- iii. Where possible, stumps will be assessed for diameter, distance from structure(s), and distance from residual trees

The focus of field work relative to residual trees is on commercial trees in closest proximity to permitted structures and each other. Sampling is limited to up to 3 structures on an ownership or Exemption; and for each structure, up to 12 residual trees and harvested trees. We have chosen 12 trees because in the case of a single home and a perfect circle around it for 150 feet, 12 trees equates to about 7 trees per acre. Seven trees is considered the upper end of the ideal number of trees sampled in variable radius plots.

Likewise, while a treated area may have more than 12 residual trees, focusing on those that are in closest proximity to structures will give insight on effectiveness where it may matter the most, per the intent of the Exemption. In other words, even in a potential sub-sample of residual trees, if the closest trees to a structure indicates fire hazard is not being reduced, the intent of the Exemption is not being met.

Strict compliance (i.e., yes/no) questions are asked relative to slash, fuel, and grass requirements for both the Forest Practice Rules and Defensible Space Guidelines, with the addition of clarifying questions if these incidences occur on  $\frac{1}{4}$  or more of the treated area. This approach is intended to address the concept of “Is it a big problem, or small problem?”. The protocol also focuses on commercial trees for measurements, as the intent of an Exemption is to commercialize timber; however, we again use binary (i.e., yes/no) questions to assess non-commercial timber effects on fuel and crown continuity in treated area.

Binned categories are used for maximum ladder fuel height within 10 feet of a tree and slope categories in order to help ensure the field protocol is rapid and to facilitate ease of data collection. In the case of the ladder fuels, the categories used correspond to potential maximum flame lengths (see image) can easily be related to crown base height and tree distance separation.



## **1038(c) Exemption Field Sampling Protocol**

Field equipment:

Loggers tape or measuring tape

D-tape

Clinometer

Laser rangefinder

Field sheets

Camera/Phone

Exemption document

### **General Exemption Summary Questions and Checklist**

- 1) Fill in date of field visit, the document number, date accepted by CAL FIRE, reported acres, reported volume removed, reported timber type and percentages removed, the number of primary home(s) protected/treated under the Exemption, and types of Exemption, Emergency, and/or Permitted treatments on the ownership, participating staff and agency, and if LTOs, RPFs, and/or TLOs are present (names not required)
- 2) Answer the checklist questions, using the list as a chance to do a walkaround the Exemption area to help determine where trees and stumps will be measured
- 3) Determine if the harvesting of trees occurred under the Exemption. If “No”, give a narrative description of why the landowner or LTO chose not to harvest (if possible) in the notes section on page 1
- 4) Determine if slash/fuel from harvest operations has been piled up waiting to still be burned
- 5) Determine if there are standing dead commercial trees > 6” DBH<sup>9</sup> within the treated area. For this protocol, “Commercial” refers to group A species, e.g., Douglas firs, Ponderosa pines, Redwoods
- 6) Determine if there are standing dead non-commercial trees >6” DBH within the treated area. For this protocol, “Non-commercial” refers to group B species, e.g., Big Leaf Maple, Coast Live Oak, Black Oak

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<sup>9</sup> >6” DBH is used here as a general threshold; typically trees under this size may not be commercialized and instead masticated, chipped, etc., and many landowners could remove it themselves without an LTO.

- 7) Determine if mastication and/or chipping of ladder fuels and shrubs has occurred, in addition to the Exemption itself, in the treated area and/or adjacent areas on the ownership
- 8) Determine if, outside of the treated area, there are other primary homes within 100 feet of the primary home(s) that were the target of the Exemption treatment, whether on the same ownership or other ownership<sup>10</sup>
- 9) Determine if within 30 feet of the structure(s) in the treatment area if there is any non-irrigated flammable vegetation<sup>11</sup> over 18” in height [1038(c)(4)]
- 10) Determine if within 30 feet of the structure(s) in the treatment area if there is any non-irrigated flammable vegetation over 18” in height on **over 25%** of the area<sup>12</sup>
- 11) Determine if grass within 100 feet of the structure(s) in the treated area is 4” or taller
- 12) Determine if grass within 100 feet of the structure(s) in the treated area is 4” or taller for **over 25%** of that area
- 13) Determine if the non-harvest related litter/duff is over 3” in depth within 100 feet of the structure(s) in the treatment area
- 14) Determine if the non-harvest related litter/duff is over 3” in depth within 100 feet of the structure(s) in the treatment area, for **over 25%** of that area
- 15) Determine if the harvest-related slash/fuel over 1” in diameter is present within 150 feet of the structure(s) in the treated area
- 16) Determine if the harvest-related slash/fuel over 1” in diameter is present within 150 feet of the structure(s) in the treated area for **over 25%** of that area.
- 17) Determine if stumps are still present in the treated area from the Exemption. If “Yes”, the “Harvested Tree Measurements” data will also be collected
- 18) If stumps are present still, determine if there are stumps from the treatment over 150 feet away from a permitted structure, with the absence of any other Exemption, Emergency, or Permitted Process under which trees could be cut and commercialized (i.e., have they violated the provisions of the Exemption and cut trees beyond 150 feet without any other means to do so commercially)

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<sup>10</sup> Identifying potential non-treatable fuel source outside of treatment area

<sup>11</sup> Vegetation that is not irrigated to retain greenness and moisture throughout the summer, resulting in flammable fuels within 30 feet of a structure and in excess of 18” in height

<sup>12</sup> Visual estimation; use professional judgement. This helps determine that while an EX may not be 100% compliant or correctly implemented, if the issues are occurring on at least ¼ of the treated area, or a small minority of the treated area

- 19) Determine if there are any non-commercial trees over 6" DBH within 30 feet of the structure(s). Similar to #5 and #6, non-commercial refers to group A vs group B species
- 20) Determine if there is any crown-to-crown contact between non-commercial residual trees >6" DBH in the treated area
- 21) Determine if there is crown-to-crown contact between commercial and non-commercial residual trees >6" DBH in the treated area
- 22) Determine using the Exemption document and field verification if there was a classified watercourse in the treatment area, if there was any harvesting within a WLPZ or ELZ (Class I, II, and III watercourses only), and if any sediment discharges from operations occurred, and what the collective volumetric estimate is. If possible, indicate in the "Notes" are on Page 1 if there is a record with the document or in CalTREES of consultation with CDFW
- 23) Add any explanatory notes, as necessary.

### **Timber Operation Outcome Measurements – 0-150 Foot**

- 1) Tree measurements will be based around either a single primary home or permitted structure, or up to three primary homes/permitted structures in the treatment area, depending on the Exemption itself.
- 2) In the case of multiple primary homes/structures in the treatment area(s), select the first home for which trees will be measured around based on which one had the most intensive harvesting around it in the 0-150 foot area (use professional judgement)
- 1) For structure #1 residual trees, start with the commercial tree >6" DBH closest to the primary home/structure treated under the Exemption (see Figure 1, Figure 2).
  - a. Identify the generalized tree species type. This protocol has uses lumped ID's for Fir, Cedar, Pine, Redwood, or 'Other'
  - b. Measure the distance to the closest primary home, rounding to the nearest foot
  - c. Measure the diameter at breast height (DBH) to the nearest inch for the tree
  - d. Measure the distance to the closest tree (conifer or hardwood), rounding to the nearest foot
  - e. Identify the closest trees type, as either a conifer ("Con") or hardwood ("HW")

- f. Determine the crown base height, measured as the lowest reaching limb ends relative to the ground, rounding to the nearest foot
  - g. Determine the tree height in feet, rounding to the nearest foot
  - h. Determine if there is crown-to-crown contact with another tree, or direct overlap with another tree, and answer as Yes/No
  - i. Determine the *maximum* shrub/ladder fuel height class within 10 feet of the bole of the tree being measured, binned into 0 foot, < 2 feet, 2 to 5 feet, or over 5 feet tall categories
  - j. Determine the slope category, on average, within 30 feet of the tree, binned into 0-20%, 20-40%, or over 40% categories
- 2) This process will be repeated by going from the initial tree that was closest in proximity to the structure, to the next tree closest to that tree *and* the structure that is >6" DBH, continuing in a circle around the structure. ***Emphasis is to be placed on the trees closest to the structure and each other, per the intent of the Exemption in reducing fire behavior relative to a permitted structure.*** Repeat until 12<sup>13</sup> trees have been measured, or there are no trees left to measure on the parcel ***within 150 feet of a permitted structure (the treatment area)***
- a. Focusing on the nearest 12 trees to the structure and to each other, even if there are more than 12 trees within 150 feet the structure, is done to place the measurement focus on where the *intent* of the Exemption is most important
  - b. The trees to be measured should be on the same ownership of the Exemption, however, the “**Distance to closest tree**” and **maximum shrub/ladder fuel height** can include trees or fuel outside of the treated 0-150 foot area and ownership
- 3) If stumps were still present, measurements will be taken starting with the stump in closest proximity to the structure(s) in the treated area for structure #1 (see Figure 3).
- a. Determine the stump tree type as either a conifer or hardwood
  - b. Measure the distance to the structure, rounding to the nearest foot
  - c. Determine the stump diameter category using the average of 2 measurements across the stump, as either < 10”, 10 to 20”, 21-30”, 31-40”, or over 40”.

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<sup>13</sup> For a single structure, 12 trees on a perfect circle comes to be approximately 7 trees per acre, in practice the upper range of desired density when using variable radius plots in timber cruising.



- d. Measure the distance from the stump to up to the three (3) closest trees to it, in feet, and identify the tree type as conifer or hardwood (“C”, or “H”)
  - e. Determine the maximum shrub/ladder fuel height class within 10 feet of the stump, using the binned categories
  - f. Determine the slope category, on average, within 30 feet of the stump, binned into 0-20%, 20-40%, or over 40% categories
- 4) Similar to the residual trees, this process will be repeated by sampling the next closest stump from the initial stump that is also closest to the primary home/structure, until 12 stumps have been measured, or all the stumps in the treated area on the ownership have been measured
  - 5) For the structure in the 0-150 foot treatment area, take a representative photos in each cardinal direction (North, South, East, West) facing away from the home to capture the treated area, **using landscape orientation for all photos**. Try to ensure no identifying features such as addresses are visible
  - 6) Repeat the above process for up to 2 more structures in the treated area, if more than one permitted structure is present.

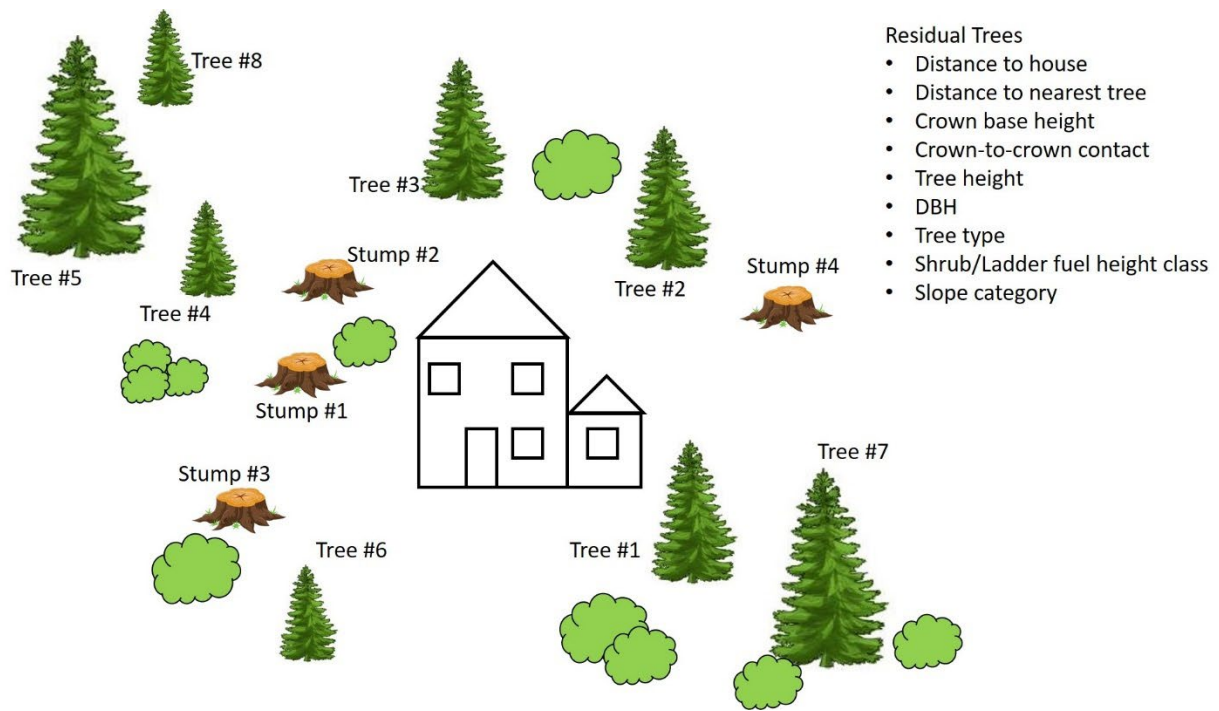
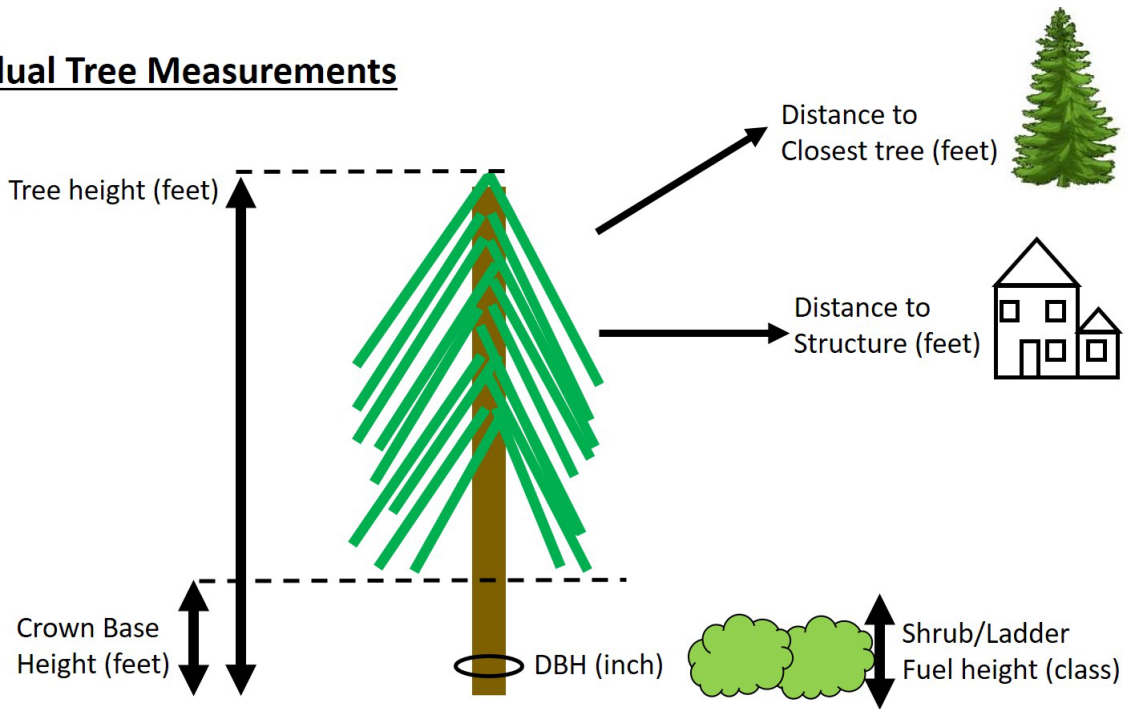


Figure 1: Metrics to be measured for residual trees and harvested trees, where remaining stumps make this possible

## Residual Tree Measurements

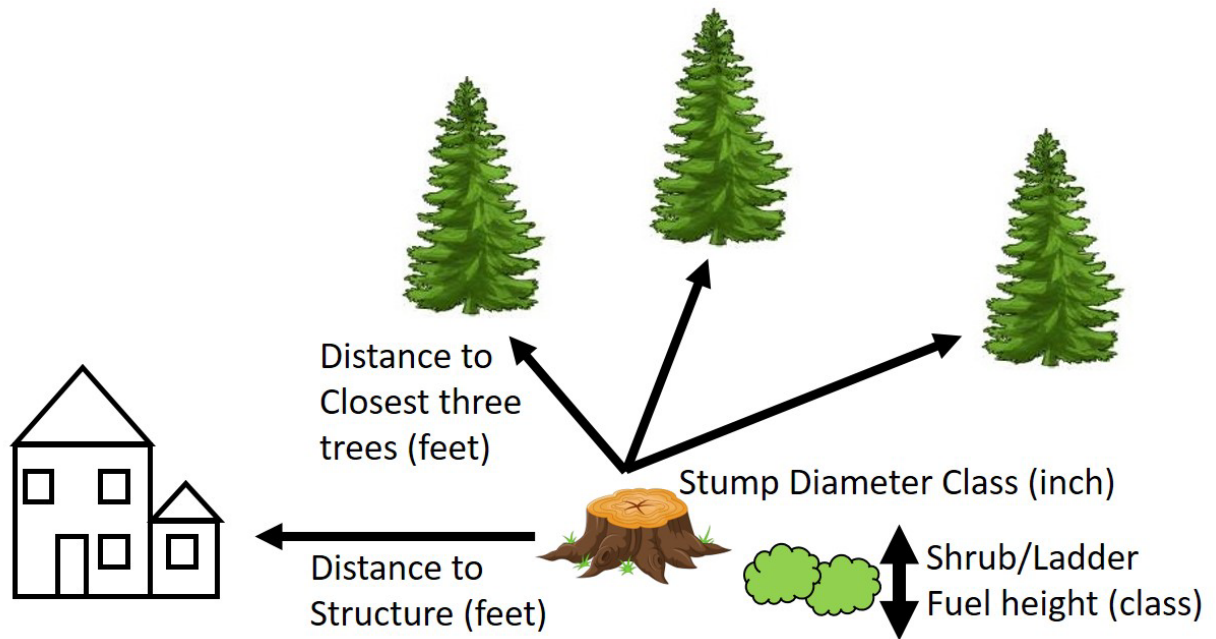


Tree type: Douglas Fir = Fir

Slope Category: 0-20%

Figure 2: All measurement metrics associated with residual trees left behind

## Harvested Tree Measurements



Slope Category: 0-20%

Figure 3: All metrics to be measured for stumps from harvested trees

**1038(c) Structure Protection Monitoring**

**Monitoring Date:**

**Document #:**

**Date Accepted:**

**Reported Acres:**

**Reported MBF:**

**Reported Timber Type/% Removed:**

**Primary Homes in treatment area (#):**

**Treatments on ownership:** 0-150 Feet: \_\_\_\_\_ 150-300 Feet: \_\_\_\_\_

**Other EX/EM/Permit Type:**

**Staff & Agency Present:**

**RPF Present (Y/N):**

**LTO Present (Y/N):**

**TLO Present (Y/N):**

**Notes on the Exemption and treated area:**



YES NO

1)			Harvesting of trees occurred under Exemption? • If NO, include narrative reason why in Notes section
2)			Piled slash/fuel from operations to be burned still?
3a)			Dead standing commercial trees >6" DBH in the treated area?
3b)			Dead standing non-commercial trees >6" DBH in the treated area?
4a)			Mastication/chipping of ladder fuels/shrubs in treated area?
4b)			Mastication/chipping of ladder fuels/shrubs outside treated area and on the ownership?
5)			Are there other <i>primary home(s)</i> outside the treated area but <i>within</i> 100 feet of the <i>primary homes(s)</i> in the treated area?
6a)			Non-irrigated (flammable) vegetation >18" tall within 30 feet of structure? [1038(c)(4)]
6b)			Non-irrigated (flammable) vegetation >18" tall within 30 feet of structure for >25% of area?
7a)			Grass >4" tall within 100 feet of structure?
7b)			Grass >4" tall within 100 feet of structure on >25% of area?
8a)			Non-harvest duff/litter >3" deep within 100 feet of structure?
8b)			Non-harvest duff/litter >3" deep within 100 feet of structure on >25% of area?
9a)			Harvest-related slash/fuel >1" diameter present within 150 feet of structure in treated area? [1038(c)(3)]
9b)			Harvest-related slash/fuel >1" diameter present within 150 feet of structure in treated area on >25% of area?
10a)			Stumps from treatment still present in treated area?
10b)			Stumps from the treatment <b>beyond 150 feet</b> of a permitted structure and no of other EX/EM/Permits?
11a)			<u>Non-commercial</u> trees >6" DBH within 30 feet of structure(s)?
11b)			Crown-to-crown contact between <u>non-commercial</u> residual trees >6" DBH in treated area?
11c)			Crown-to-crown contact between <u>commercial</u> and <u>non-commercial</u> residual trees >6" DBH in treated area?
12a)			Classified watercourse in treated area?
12b)			Harvesting in WLPZ or ELZ?
12c)	If sediment discharge from operations, collective volume of all discharges "Trace" ___ <1CY ___ 1-5CY ___ 5-10CY ___ >10CY ___		
13)	Optional: TLO Reported Est. on cost/profit: _____ \$ ___ Cost ___ Profit		

**0-150 Foot Treatment – Residual Trees – Structure # 1** (Note: All measurements rounded to nearest foot/inch)

Residual Commercial Trees >6" DBH	1	2	3	4	5	6	7	8	9	10	11	12	
<b>Species</b> [F=Fir; C=Cedar; R=Redwood; P=Pond./Sugar Pine; O=Other]	F__ C__ R__ P__ O__	F__ C__ R__ P__ O__	F__ C__ R__ P__ O__	F__ C__ R__ P__ O__	F__ C__ R__ P__ O__	F__ C__ R__ P__ O__	F__ C__ R__ P__ O__	F__ C__ R__ P__ O__	F__ C__ R__ P__ O__	F__ C__ R__ P__ O__	F__ C__ R__ P__ O__	F__ C__ R__ P__ O__	
<b>Dist. to structure (ft)</b>													
<b>DBH (inch)</b>													
<b>Dist to closest tree (ft)</b>													
<b>Closest tree type</b>	Con __ HW __	Con __ HW __	Con __ HW __	Con __ HW __	Con __ HW __	Con __ HW __	Con __ HW __	Con __ HW __	Con __ HW __	Con __ HW __	Con __ HW __	Con __ HW __	
<b>Crown base height (ft)</b>													
<b>Tree height (ft)</b>													
<b>Crown-to-crown contact w/ other trees</b>	Y__ N__	Y__ N__	Y__ N__	Y__ N__	Y__ N__	Y__ N__	Y__ N__	Y__ N__	Y__ N__	Y__ N__	Y__ N__	Y__ N__	
<b>Ladder fuel max height category (ft)</b>	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __	0 ft __ < 2 __ 2-5 __ > 5 __
<b>Slope category (%)</b>	0-20 __ 21-40 __ > 40 __	0-20 __ 21-40 __ > 40 __	0-20 __ 21-40 __ > 40 __	0-20 __ 21-40 __ > 40 __	0-20 __ 21-40 __ > 40 __	0-20 __ 21-40 __ > 40 __	0-20 __ 21-40 __ > 40 __	0-20 __ 21-40 __ > 40 __	0-20 __ 21-40 __ > 40 __	0-20 __ 21-40 __ > 40 __	0-20 __ 21-40 __ > 40 __	0-20 __ 21-40 __ > 40 __	
<b>NOTES</b>													

Photos looking away from structure(s) in cardinal directions? \_\_\_\_ Yes \_\_\_\_ No

**0-150 Foot Treatment – Harvested Stumps – Structure # 1** (Note: All measurements rounded to nearest foot/inch)

Harvested Stumps	1	2	3	4	5	6	7	8	9	10	11	12
<b>Stump Type</b>	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___
<b>Dist. to structure (ft)</b>												
<b>Stump Diameter Category (inch)</b>	< 10___ 10-20___ 21-30___ 31-40___ > 40___	< 10___ 10-20___ 21-30___ 31-40___ > 40___	< 10___ 10-20___ 21-30___ 31-40___ > 40___	< 10___ 10-20___ 21-30___ 31-40___ > 40___	< 10___ 10-20___ 21-30___ 31-40___ > 40___	< 10___ 10-20___ 21-30___ 31-40___ > 40___	< 10___ 10-20___ 21-30___ 31-40___ > 40___	< 10___ 10-20___ 21-30___ 31-40___ > 40___	< 10___ 10-20___ 21-30___ 31-40___ > 40___	< 10___ 10-20___ 21-30___ 31-40___ > 40___	< 10___ 10-20___ 21-30___ 31-40___ > 40___	< 10___ 10-20___ 21-30___ 31-40___ > 40___
<b>Dist to closest tree 1 (ft)</b>												
<b>Closest tree type</b>	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___
<b>Dist to closest tree 2 (ft)</b>												
<b>Closest tree type</b>	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___
<b>Dist to closest tree 3 (ft)</b>												
<b>Closest tree type</b>	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___	Con ___ HW ___
<b>Ladder fuel max height category (ft)</b>	0 ft ___ < 2 ___ 2-5___ > 5 ___	0 ft ___ < 2 ___ 2-5___ > 5 ___	0 ft ___ < 2 ___ 2-5___ > 5 ___	0 ft ___ < 2 ___ 2-5___ > 5 ___	0 ft ___ < 2 ___ 2-5___ > 5 ___	0 ft ___ < 2 ___ 2-5___ > 5 ___	0 ft ___ < 2 ___ 2-5___ > 5 ___	0 ft ___ < 2 ___ 2-5___ > 5 ___	0 ft ___ < 2 ___ 2-5___ > 5 ___	0 ft ___ < 2 ___ 2-5___ > 5 ___	0 ft ___ < 2 ___ 2-5___ > 5 ___	0 ft ___ < 2 ___ 2-5___ > 5 ___
<b>Slope category (%)</b>	0-20___ 21-40___ > 40___	0-20___ 21-40___ > 40___	0-20___ 21-40___ > 40___	0-20___ 21-40___ > 40___	0-20___ 21-40___ > 40___	0-20___ 21-40___ > 40___	0-20___ 21-40___ > 40___	0-20___ 21-40___ > 40___	0-20___ 21-40___ > 40___	0-20___ 21-40___ > 40___	0-20___ 21-40___ > 40___	0-20___ 21-40___ > 40___
<b>NOTES</b>												