

Calistoga NW FSC Community FireWise Evaluation

March, 2020

Table of Contents

Table of Contents.....	2
A. Introduction.....	5
B. Values at Risk.....	6
C. Topography.....	7
Orientation of the canyons.....	9
D. Weather.....	9
1.Temperatures and Humidities.....	9
2.Winds.....	9
E. Vegetation.....	10
F. Predicted Fire Behavior.....	14
1.Predicted Flame Lengths.....	15
2.Predicted Crown Fire Activity.....	18
G. Fire History.....	20
H. Access.....	22
I. Hazard Ranking.....	23
J. Land Use Distribution and Neighborhoods.....	24
Neighborhood Characteristics	27
Neighborhood 1 – West of Highway 128 Neighborhood.....	29
Pattern of development and how it relates to fire safety: This neighborhood more than half of the structures in the fire safe Council, with a land use that is a mixture residential parcels ranging from one to 20 acres in size, with narrow but long parcels located adjacent to Highway 128. Larger parcels with vineyards or single dwellings are the norm in the north and western part of the neighborhood. Each parcel is large enough to influence fire behavior around the structure. Vineyard parcels range from 40 to 120 acres, large enough for possible temporary refuge areas.	29
Access: This neighborhood is served by Highway 128, with only a few spur roads to the east. Long driveways are the rule, expect for a few that are accessed directly from Highway 128. Some residences are accessed via shared driveways. Most have locked gates. Highway 128 has two lanes and has several locations for turnouts and is not a constraint for access on the south but becomes more narrow on the north. The southern segment of Highway 128 leads to the	

commercial district of the City of Calistoga, which is likely to be congested and could block exits during evacuation events.	30
Terrain: The terrain is not excessively steep, sloping up to the county border on the west and south. Slopes are gentle in the north, especially near Blossom Creek and near the southern segment of Highway 128. No topographic feature would block or promote fire spread during a Diablo wind event.....	30
Possible Projects for Napa FireWise: This neighborhood would benefit from ensuring roadside vegetation is treated every year, and that signs are installed that aid locating streets and structures and indicating access and water supply.	30
Pattern of development and how it relates to fire safety: This neighborhood consists of approximately 40 structures in residential parcels ranging from 3 to 200+ acres in size, with larger parcels located on the western portion of the neighborhood. Each parcel is large enough to influence fire behavior around the structure. Vineyard parcels range from 40 to 120 acres, large enough for possible temporary refuge areas.	31
Terrain: Terrain consists of undulating, rolling hills, and small, broad valleys. The steepest terrain is where the slopes lead sharply up to the county border. The ridgeline slightly east of the border has a gap at Petrified Forest Road, where winds could funnel through during a Diablo wind event.....	31
Adjacent Fuels: Vegetation beyond 100 feet from structures are either vineyards or Douglas fir forest with varying levels of understory trees and shrubs. The vineyards comprise a fire safe condition, whereas the Douglas fir forests could fuel an intense fire under extreme weather conditions.	32
Possible Projects for Napa FireWise: This neighborhood would benefit from ensuring roadside vegetation is treated every year, and trees that are likely to block passage should be pruned or removed. Signs should be installed that aid locating streets, structures and indicating access and water supply.	32
Access would also be improved by widening areas for turnouts wherever possible.	32
NEIGHBORHOOD #3: PETRIFIED FOREST ROAD NEIGHBORHOOD.....	33
Pattern of development and how it relates to fire safety: Most of the parcels in this neighborhood are large, and almost all of the parcels south of Petrified Forest Road are associated with commercial enterprises. Residential structures are more common east of the junction with Franz Valley School Rd. This neighborhood includes approximately 30 residential structures in parcels ranging from one to 20 acres in size. Each parcel is large enough to influence fire behavior around the structure. Vineyard parcels range from 40 to 120 acres, large enough for possible temporary refuge areas, however, most are remote.....	33

Terrain: The terrain slopes upward to the south. Several minor valleys trend upward to the southwest, and a more pronounced north-south trending valley follows Cyrus Creek. The eastern end of this neighborhood has more gentle terrain, while the unpopulated southwestern corner of this neighborhood descends sharply down south-facing rugged slopes.....	34
Adjacent Fuels: Vegetation on the south side of this neighborhood is dominated by Douglas fir forests, dense oak woodlands, with varying levels of understory trees and shrubs. The vineyards comprise a fire safe condition, whereas the Douglas fir forests and oak woodlands could fuel an intense fire under extreme weather conditions. The southwestern portion of the neighborhood, as well as other parcels have large patches of brush which can be expected to burn with great intensity. Fortunately, these patches are distant from structures.	34
Possible Projects for Napa FireWise: This neighborhood would benefit from ensuring roadside vegetation is treated every year, and trees that are likely to block passage should be pruned or removed. Signs should be installed that aid locating streets, structures and indicating access and water supply.	34
K. Recommended Projects.....	35

Calistoga NW FSC Community FireWise Evaluation

A. Introduction

Because the Calistoga Fire Safe Council (FSC) is located in the interface between wildlands and developed areas, fire hazard is a special concern. Fires may spread from wildlands to the homes, possibly damaging structures or even threatening lives. Conversely, wildlands are subject to increased ignition potential from human activities, and most fires in the coastal mountains are human caused.

This evaluation serves as a platform for recommendations for projects to minimize threat to life safety and damage from wildfire to homes and natural resources. It is based on a review of the terrain, weather, fuels and fire history of the area, compared to the values at risk, and likely scenarios of fire ignition and spread.

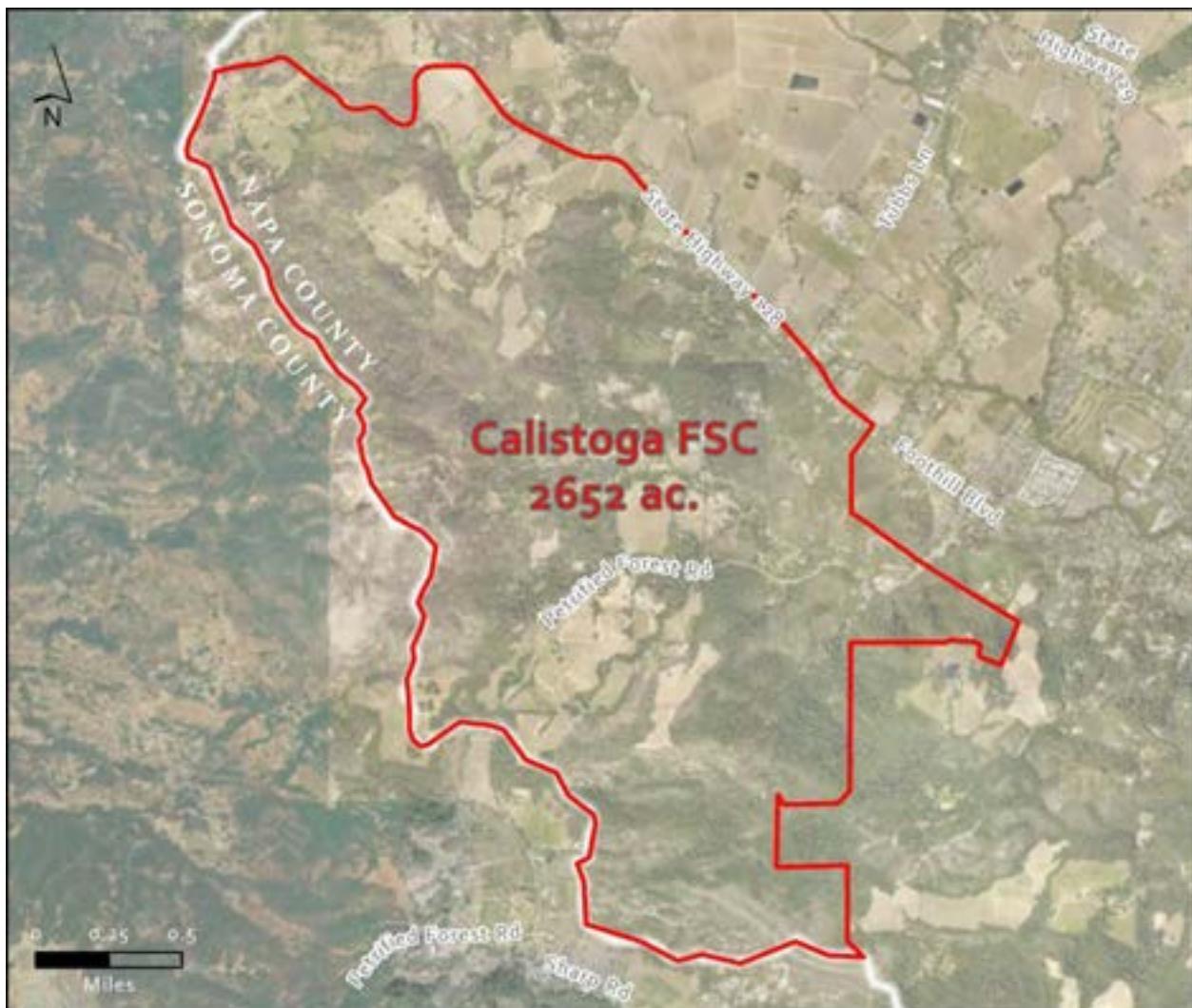


Figure 1. Area of Interest – Calistoga NW FSC Community neighborhood boundary (shown in red).

B. Values at Risk

The most important values at risk are life safety, then improvements to property (residents and vineyards), then natural resources. Because all the evacuation routes are long and involve poor road conditions, the threat to human life is significant.

Obviously, homes in the Calistoga NW FSC are at risk from wildfire. Structures in the Calistoga neighborhood are generally older, dating before the requirement for ignition-resistant construction. Most roofs are less flammable; however, wood siding, decks, and unprotected vents that are part of most homes all make the buildings prone to ignition.

Homes: Residential structures are mostly made of wood because of their age. They have wood porches and decks, though wood fences are a rarity. The presence of ignition-resistant construction is closely related to the age of the structures; structures built after 1996 have features that prevent ignition such as non-flammable roofs, double-paned windows, and stucco siding. Many older structures have been remodeled and a few property owners have installed personal fire suppression systems involving various water sprinkler strategies.

Large wineries and vineyards are located throughout the Calistoga NW FSC and constitute a value at risk. Some vineyards/wineries are ignition resistant due to construction material used and defensible space, whereas other vineyards/wineries have structures on the property that are made of wood and are located in a heavily vegetated canyon setting.

While the vineyards themselves may moderate fire behavior and increase survivability of nearby structures, wildfire is a not-so-obvious risk to vineyards. Vineyards are at risk from smoke taint in the summer, when the possibility of a fire is highest. The edges of vineyards that abut wildlands are apt to be damaged; this is especially true where patches of brush and woodlands break up the vineyards.

	Number	Percent
Total Number of Structures/Buildings	271	
Addressed Buildings	134	49%
Non-Addressed Structures	127	47%
Outbuildings	10	4%
Buildings Assessed After 2017 Fires	45	17%
Buildings Red Flagged	38	14%
Buildings Yellow Flagged	7	3

Table 1. Number of structures within Calistoga NW FSC Community neighborhood boundary (Napa County GIS Open Data Portal, accessed in December, 2019).

Category	Parcel Count	Total Area (acres)
Commercial		
MOTEL – B & B	2	4.0
Industrial		
LIGHT INDUSTRIAL	1	7.1
Residential		
RURAL RES < 5 AC W/1 RES	68	119.9
RURAL RES < 5 AC W/2 SFRS	3	4.6
RURAL RES < 5 AC W/3 SFRS	1	1.9
RURAL RES > 5 AC W/1 RES	19	285.6
RURAL RES > 5 AC W/2 SFRS	10	159.5
RURAL RES > 5 AC W/3 SFRS	1	4.3
Vacant		
VACANT LAND R/W	1	0.2
VACANT LAND RURAL	42	680.7
VACANT RURAL W/MISC IMPS	3	48.0
Vineyard/Winery		
CONT VINE W/WINERY W/2 SFRS	1	42.9
CONTRACT LAND-VINEYARD	2	82.4
CONTRACT VINEYARD W/1 RES	1	20.8
VINEYARD < 5 AC W/1 RES	1	3.8
VINEYARD > 5 AC W/1 RES	5	66.0
VINEYARD > 5 AC W/2 SFRS	2	65.5
VINEYARD > 5 AC W/4 SFRS	1	47.4
VINEYARD LAND >5 AC	11	686.6
VINEYARD LAND W/MISC IMPS	2	105.9
WINERY/VINEYARD/1 RES	1	87.3
WINERY/VINEYARD/2 SFRS	1	37.3
Grand Total	179	2,561.6

Table 2. Number of parcels and county land use within Calistoga NW FSC Community neighborhood boundary (Napa County GIS Open Data Portal, accessed in December 2019).

C. Topography

Topographic features – such as slope and aspect (orientation with respect to sun and wind) and the overall form of the land – have a profound effect on fire behavior. Topography affects a wildfire's intensity, direction, and rate of spread. An area's topography also affects local winds, which are either "bent" or intensified by topographic features. Topographic features can also induce daily upslope and downslope winds. The speed, regularity, and direction of these winds

(and other winds) directly influence the direction of wildfire spread and the shape of the flame front.

For example, fires burning on flat or gently sloping areas tend to burn more slowly and to spread more horizontally than fires burning on steep slopes. This makes ridgeline positions more vulnerable than those at the bottom of a slope.

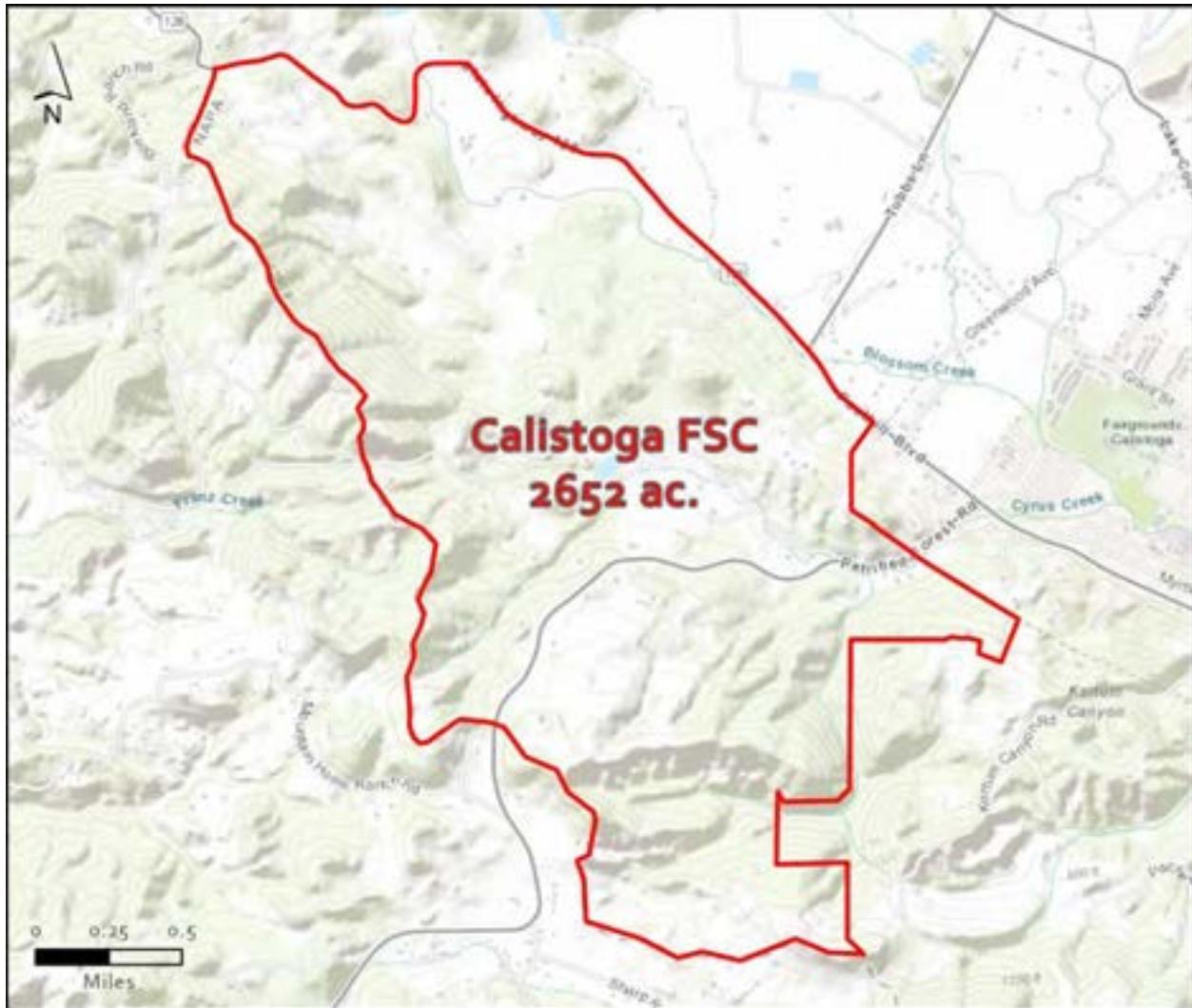


Figure 2. Topography and watershed delineation map. Calistoga NW FSC Community neighborhood boundary shown in red.

Calistoga NW FSC and its environs rise from the valley floor to the western county boundary along a north-south trending ridge, from approximately 400 to 1,400 ft in elevation. The topography is divided. Most slopes are steep, but some broad plateaus are located throughout and many have vineyards on it.

Orientation of the canyons

- Cyrus Creek forms an east-west running canyon in the southern portion of the Calistoga NW FSC before turning sharply north until it meets the Petrified Forest Road.
- Petrified Forest Road bisects the Calistoga NW FSC and runs from the southwest to the east, following milder slopes that flank a seasonal creek just north of the road.
- North of Franz Valley School Road, the terrain is dominated by rolling terrain except for to the west where steep slopes rise sharply to the county boundary.

More details of the terrain follow in the discussion of weather.

D. Weather

Weather conditions significantly impact both the potential for ignition and the rate, intensity, and direction in which fires burn. The most important weather factors used to predict fire behavior are wind, temperature, and humidity.

1. Temperatures and Humidities

Summer days are usually comfortable; temperatures normally range from lows in the 40s and to highs in the 90s, with an occasional high reaching a maximum of 105 degrees Fahrenheit. Humidities can drop to the single digits in the summer and fall.

Portions of the Calistoga NW FSC neighborhood lie in a relatively protected area and would be subject to occasional episodes of several still, stagnant air formed by stationary highs during summer months. This overall weather pattern – characterized by continuous high temperatures and low relative humidities – enhances the possibilities of ignition, extreme fire behavior and extreme resistance to fire control.

2. Winds

The most important influence on fire behavior is wind. Wind can greatly affect the rate of a fire's spread and the output of a fire. Wind increases the flammability of fuels both by removing moisture through evaporation and by angling the flames so that they heat the fuels in the fire's path. The direction and velocity of winds can also control the direction and rate of the fire's spread. Winds can carry embers and firebrands downwind that can ignite spot fires ahead of the primary front. Gusty winds cause a fire to burn erratically and make it more difficult to contain.

Wind will tend to follow the pattern of least resistance and is therefore frequently deflected and divided by landforms. Canyon slopes produce pronounced daily up-canyon and down-slope winds caused by differential heating and cooling of air during the day. This occurs Napa Valley-wide and on a local scale.

Regional westerly winds are blocked by the ridge on the western county border; only the canyon formed by Cyrus Creek in the south is oriented such that westerly winds would easily flow into the Napa Valley.

The winds that create the most severe fire danger typically blow from the north, usually in October. Winds from the east and north bring low humidities and elevated fire danger and can wreak havoc in the Napa Valley, causing fire to spread to the south. These winds are the same ones that blew on the largest fires in Napa history; the Silverado Fire in 1983 and the 1964 C. Hanly Fire occurred under this type of event. These events generally last from 15 to 35 hours, but in 2000, 2003, 2005, 2017, 2018, 2019, these events in October and November lasted for 5 to 14 days. This type of wind could “push” a fire from the vineyards on the valley floor to the upper portions of the Calistoga NW FSC area.

The east-facing aspect of the Calistoga NW FSC and its placement above the vine-covered valley floor moderates its risk from the Diablo winds. This is because these foehn or subsiding winds accelerate with decreasing elevation, and conversely, slow when moving upslope. So, while communities on the east end of the Napa Valley face greater risk during northeasterly wind episodes, communities on the western slopes are less at risk.

E. Vegetation

Based on a state-wide map of vegetation, there are seven main vegetation types within the Calistoga NW FSC neighborhood. These include:

- Montane Hardwood (Oak Woodland)
- Cropland (Vineyards/Winery)
- Montane Chaparral (Brush)
- Douglas fir (Coniferous Forest)
- Annual Grasslands
- Redwood (Coniferous Forest)
- Montane Hardwood-Conifer (Mixed Oak Woodland)

In addition, there are small portions of the Calistoga NW FSC categorized as water or barren. Along with the mapped vegetation is the landscaped environment surrounding buildings and homes, however these are not mapped in this database, which is an indication of the relatively small footprint of development in the area of the Fire Safe Council.

These mapped areas do not account for the changes caused by the 2017 Tubbs Fire. The northwestern portion of the Fire Safe Council burned with varying intensity, causing dramatic changes in some places. In general, the vegetation in the path of the fire is more open, comprised of sprouting hardwoods (especially California Bay), and far fewer Douglas fir trees. Patches of grass have expanded, and are more common in hardwood stands, as well.

Each vegetation type burns differently, based on the amount of biomass available to burn, the distribution of biomass in the vegetation, as well as the moisture and oil content of the foliage and dead material. However, in all cases, extreme weather conditions experienced in the Tubbs Fire can cause all vegetation to burn with greater-than predicted severity.

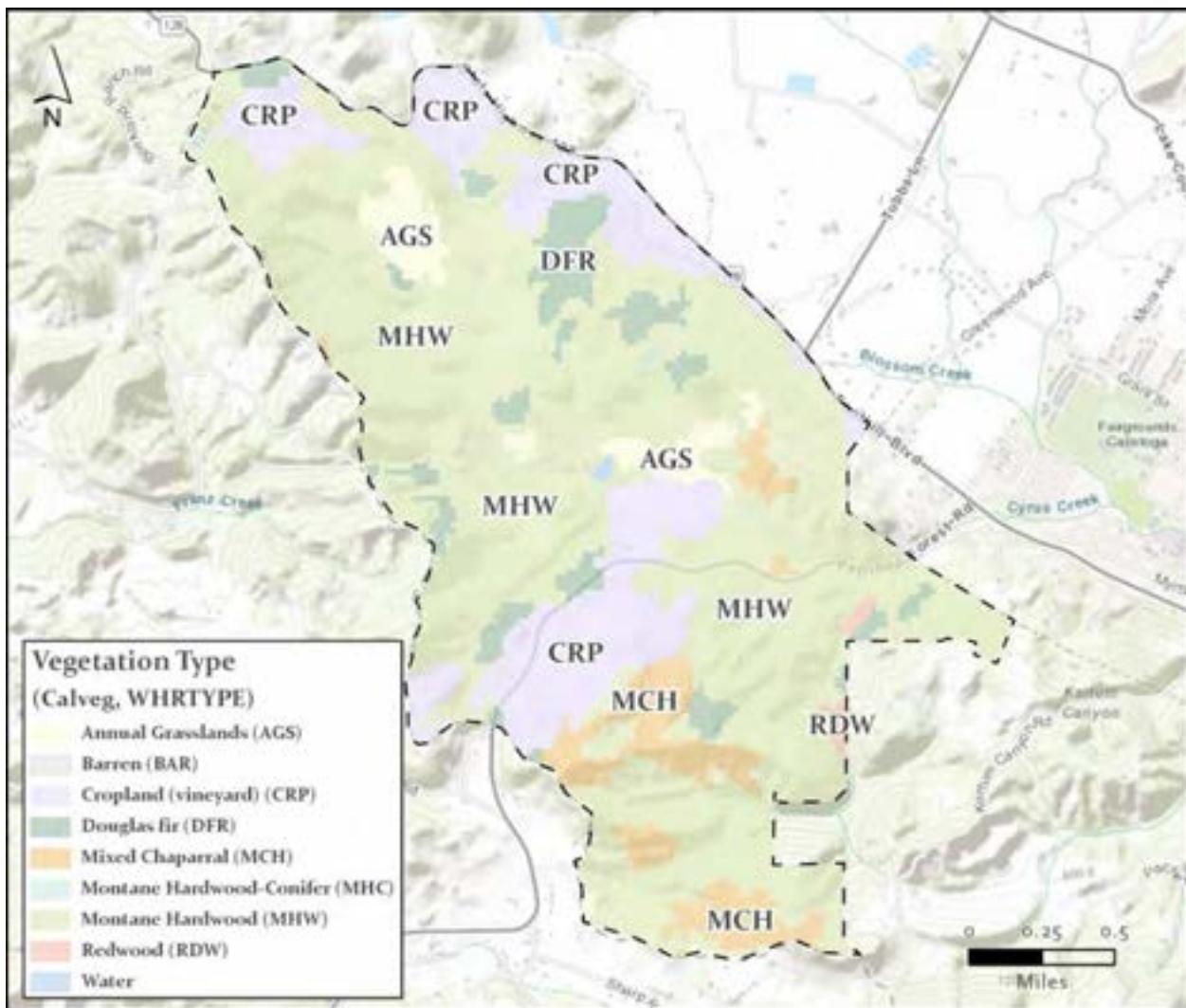


Figure 3. Vegetation map – Calistoga NW FSC Community neighborhood boundary (shown in red) (list source).

Montane Hardwood/Oak Woodlands: The majority (66%) of the Calistoga NW FSC is oak woodland, which occurs throughout the FSC in clumps, on average, 10 acres in size, the largest stand measuring 186 acres.

Dense canopies, with little or no grass or shrubs under the canopies, typify these oak woodlands. The tree canopy in the lower reaches of the drainages is dominated by coast live oak, but also includes California bay, madrone, California buckeye, Douglas fir and occasional pines.

Fire intensity, flame lengths, and scorch heights are usually low in oak woodlands. Slow-burning surface fires (approximately two-feet per minute) that are carried in the compact leaf litter layer. Low flame heights (less than one foot) are the rule. Only under severe weather conditions involving high temperatures, low humidities, and high winds do the fuels pose fire hazards in this vegetation type.

Leisurely spread rates, combined with the relatively short flame lengths of the predicted fire behavior produce a manageable, moderate fire hazard.

However, when shrubs are allowed to develop under the hardwoods, these fuels would pose fire hazards under severe weather conditions, e.g. those conditions involving high temperatures, low humidities, and high winds. If the shrubs develop under oaks, torching is likely to occur because of the ladder fuels that allow a fire to burn from the shrub to the tree crowns. Foliage of both bay and coast live oak can be very flammable when fire reaches the crowns.

Cropland/Vineyards: Less than a quarter (17%) of the land in the Calistoga NW FSC is mapped as cropland/vineyards. These occur in large patches, located in the center and north. The main areas include:

- Theorem Vineyards – Off of Petrified Forest Road to the west and south
- Heritage School Vineyards – Between Franz Valley School Road and Petrified Forest Road
- Grgich Vineyard spans Petrified Forest Road and Franz Valley School Rd.
- Blossom Creek Vineyard is on the northwest portion of the Fire Safe Council, west of State Highway 128

Fires are usually benign in vineyards. The biomass is concentrated in live vines, with a mowed or bare soil surface. A fire can spread quickly through the vineyard where there is a ground cover. However, this situation is rare. Vineyards were instrumental in stopping the Howell Mountain fire in 1983, formed the edges of fires in the Tubbs, Nunns, and Kincade Fires, but were part of the contagion in the Cavedale Fire in Sonoma in 1996. Vineyards often have access roads on the perimeter and within the interior, further aiding containment.

Montane Chaparral/Brush: Five relatively large patches of land are mapped as brush. These are mainly in the central and southern portion of the Calistoga NW FSC. The average size of these areas is 25 acres, with the largest at 85 acres and the smallest at 3 acres. In total, these areas account for 6.5% of the area. While only these patches were mapped as Montane Chaparral, brush exists throughout and often contributes to other vegetation types described in this document.

Brush produces severe fire behavior, with flames longer than 20 feet in length. Intense, fast-spreading fires in chaparral burn the foliage as well as the live and dead fine woody material in the brush crowns. The foliage is highly flammable and dead woody material in the stands significantly contribute to increased fire intensity.

This fuel type constitutes the highest hazard. Direct attack is not possible, and containment efforts would need to rely on backfiring or suppression strategies other than line building because the perimeter of the fire is likely to grow faster than a line could be built. In addition, spotting is likely in chaparral which will present even more challenges to suppression efforts.

Douglas Fir: Areas of Douglas fir were mapped throughout the Calistoga NW FSC, but this vegetation type mainly occurs in a large patch just to the south of Blossom Creek off of Highway 128 (in the north). There are also patches along the creek north of the Petrified Forest Road and in the center of the area near the southern vineyards and adjacent to two patches of Redwood. In total, these areas account for about 6% of the total area.

These dense, conifer forests are often found on north-facing slopes and do not pose a significant fire hazard under normal conditions. However, when hot, dry weather occurs, these forests offer a large fuel load to burn and can exhibit greater fire intensity. Of all the vegetation types in the Calistoga NW FSC neighborhood, dense, coniferous forests are most likely to burn as a crown fire. When a fire reaches tree crowns, embers are distributed throughout adjacent areas (including vulnerable residential neighborhoods). Dead material from dying oaks increases fire intensity.

Annual Grasslands: Accounting for less than 4% of the Calistoga NW FSC neighborhood, annual grasslands were mapped in two main areas: in the center of the area along Franz Valley School Road and in a large patch to the north. At the time of mapping, these areas were likely meadows. However, subsequently, all these areas have been planted with vineyards and/or developed into residential homes.

Redwood Forests: Representing less than 1% of the total Calistoga NW FSC neighborhood, Redwood can be found along Cyrus creek at the very southeastern portion of the area.

These dense, conifer forests are often found on north-facing slopes and do not pose a significant fire hazard under normal conditions. However, when hot, dry weather occurs, these

forests to offer a large fuel load to burn and can exhibit greater fire intensity. Of all the vegetation types in the Calistoga NW FSC neighborhood, dense, coniferous forests are most likely to burn as a crown fire. When a fire reaches tree crowns, embers are distributed throughout adjacent areas (including vulnerable residential neighborhoods). Dead material from dying oaks increases fire intensity.

Landscaping: Landscaped areas – being closest to homes – may make the greatest impact on survivability of a house during a fire arising in wildlands. Landscaped areas either (1) are moist, thus will not likely burn; (2) contain large amounts of fuel which will burn with great intensity; or (3) are landscaped with fire resistant plants, and only burn slowly with little heat release.

While research results regarding fire resistance of landscape plants are meager, several important generalities have surfaced. First, the overall volume of biomass as well as the spacing and design of the garden is more critical than the species selected. Horizontal spaces between planting masses and the house are important components of a fire safe landscape. Similarly, vertical spacing between tree branches, shrubs, ground cover and the structure (particularly windows) are also part of a well-designed garden.

Maintenance of landscaped areas is necessary to remove dead material and to maintain vertical and horizontal spaces. Neglect of landscape maintenance can lead to a significant worsening of the fire hazard closest to the structure.

Landscaping in the Calistoga NW FSC is generally consistent with fire safety principles. A few residences in each neighborhood have abundant vegetation that can endanger adjacent and nearby residents if they are within a few hundred feet of each other.

Vegetation Type	Area (acres)	Percent
Annual Grassland (AGS)	95.18	3.59%
Barren (BAR)	0.70	0.03%
Cropland (CRP)	441.82	16.65%
Douglas fir (DFR)	165.97	6.25%
Montane Chaparral (MCH)	171.79	6.47%
Montane Hardwood-Conifer (MHC)	5.63	0.21%
Montane Hardwood (MHW)	1,759.12	66.28%
Redwood (RDW)	11.18	0.42%
Water	2.67	0.10%

Table 3. Vegetation acres by type within Calistoga NW FSC Community neighborhood boundary (Napa County GIS Open Data Portal, accessed in December 2019).

F. Predicted Fire Behavior

Flame lengths are expected to be long because of the combination of heavy fuels, especially in the chaparral, and in especially dry conditions, in the redwood forests. Where a well-developed

understory is present under the oak canopies, fires are also expected to burn with high intensity.

Fires can also be expected to burn fast when they are propelled by dry grass and chaparral. Vineyards can moderate both the fire intensity and fire spread but would not provide good suppression opportunities for safe evacuation because few abut the road.

The distribution within an area of expected flame lengths can be predicted using public-domain software and data. FlamMap was used to model fire behavior using a nation-wide dataset called LANDFIRE.

However, the map of the fuels was done prior to the Tubbs Fire; the area that was burned is not accurately modeled. Those areas in the fire's footprint that are covered with grass are expected to burn faster and standing material may increase fire flame lengths, whereas the areas with tree sprouts and young brush will have slower rates of spread.

1. Predicted Flame Lengths

Long flame lengths can be expected in coniferous and oak forests where understory is present. Vineyards and areas of well-maintained defensible space can be expected to burn with low intensity even under the most extreme conditions. Flame length most directly relates to the ability of a firefighter to safely attack a fire; flames longer than eight feet prevent safe, effective direct attack. Flame length is also most closely related to structural damage – the higher the flame length, the more likely a structure loss.

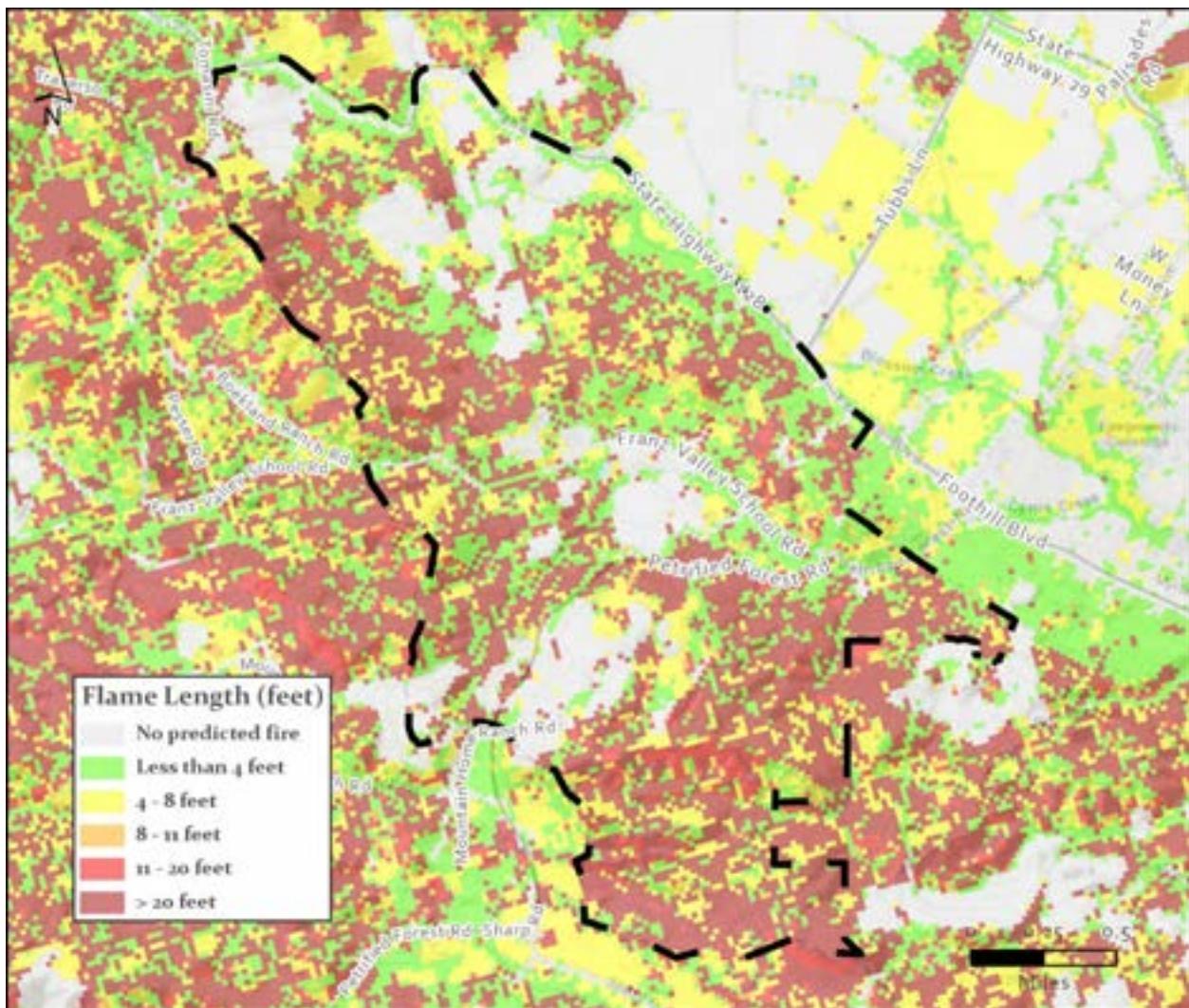


Figure 4. Predicted flame length (feet) map (based on LANDFIRE landscape version 2.0 with a Northeast wind at 15mph with low fuel moistures). Calistoga NW FSC Community neighborhood boundary (shown in black).

Flame lengths over 20 feet account for 38% of the predicted fire behavior. This occurs throughout the Calistoga NW FSC neighborhood but is most pronounced on the south-facing southern portion of the area and steep western (but east facing) slopes along the county boundary. These areas are dominated by Oak Woodland, Montane Chaparral, Douglas fir, and a mix of these vegetation types.

Predicted Flame Length	Acres	Percent
No predicted fire	458.80	17%
Less than 4 feet	636.05	24%
4-8 feet	390.30	15%
8-11 feet	33.36	1%
11-20 feet	136.77	5%
Greater than 20 feet	998.10	38%

Grand Total	2,653.38
--------------------	----------

Table 4. Predicted flame length by category and area (in acres) within Calistoga NW FSC Community neighborhood boundary (based on LANDFIRE landscape version 2.0 with a Northeast wind at 15mph with low fuel moistures).

Flame lengths were lowest surrounding the vineyards (where no fire was predicted due to its classification as agricultural land) and along the valley near Highway 128. These low flame lengths accounted for 24% of the area. These areas exhibit no to low slope and are dominated by Oak Woodlands next to open areas.

Very little moderate fire behavior was predicted. This indicates there is a stark difference between relatively low and high fuel areas.

2. Predicted Crown Fire Activity

While both the coniferous and oak forests can torch, hardwoods are less likely to have fire reach to the tree crowns, unless vegetation is burning underneath. Crowning potential is crucial. When fires spread into crowns, thousands of embers are produced and lofted into ignitable fuels, often overwhelming fire suppression personnel.

Very few areas are predicted to have fire spread within the tree canopy (tree-to-tree), which is actually pretty rare and virtually unheard of in hardwoods. Areas with higher density of coniferous forests are most at risk to torching and to crown fires.

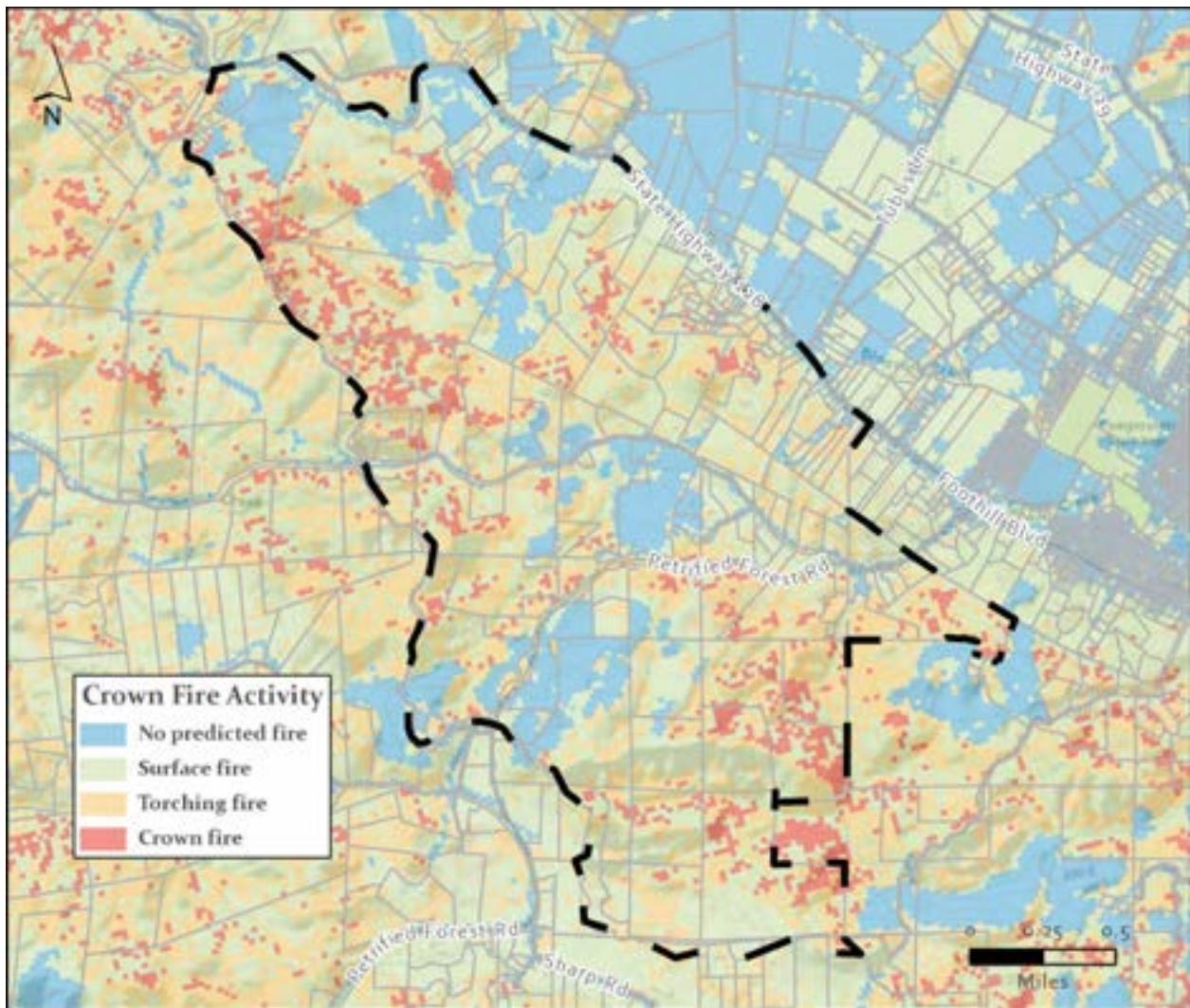


Figure 5. Predicted crown fire activity map (based on LANDFIRE landscape version 2.0 with a Northeast wind at 15mph with low fuel moistures). Calistoga NW FSC Community neighborhood boundary (shown in black).

Predicted Flame Length	Acres	Percent
No predicted fire	458.80	17%
Surface fire	1,124.87	42%
Torching fire	815.07	31%
Crown fire	254.64	10%
Grand Total	2,653.38	

Table 5. Predicted flame length by category and area (in acres) within Calistoga NW FSC Community neighborhood boundary (based on LANDFIRE landscape version 2.0 with a Northeast wind at 15mph with low fuel moistures).

A combination of no predicted fire and surface fire accounts for approximately 60% of the Calistoga NW FSC neighborhood. These areas are scattered throughout but are most pronounced in the areas of vineyards and within the Oak Woodland vegetation type.

In the remainder areas, torching and crown fire are predicted. These areas are concentrated on the eastern facing, steep slopes along the county boundary and in the southern section along Cyrus Creek (both in the east-west oriented canyon and north of it (again, east facing slopes).

Because of a lack of access routes to either of these locations, containment would prove challenging. However, because they are remote, they do not pose an immediate threat to values at risk within the Calistoga NW FSC neighborhood.

With that said, there are small areas surrounding the vineyards that do predict crown fire. These locations should be targeted and evaluated for fuel reduction projects.

G. Fire History

Large fires have visited the northern portion of the Calistoga NW FSC twice in the recent past. In 1964, the C. Hanly fire burned through the northern section of the Calistoga NW FSC. In 2017 the Tubbs fire burned south to the Petrified Forest Road, covering almost half of the area in the Fire Safe Council. Prior to 1960, another small, unnamed fire also burned in the same area.

The Napa Valley has a recurring history of large fires (over 10,000 acres in size), which typically burn for several days. The typical period between such large fires is approximately 20-30 years. Like much of California, fires in Napa County are almost entirely caused by human-caused accidental ignitions.

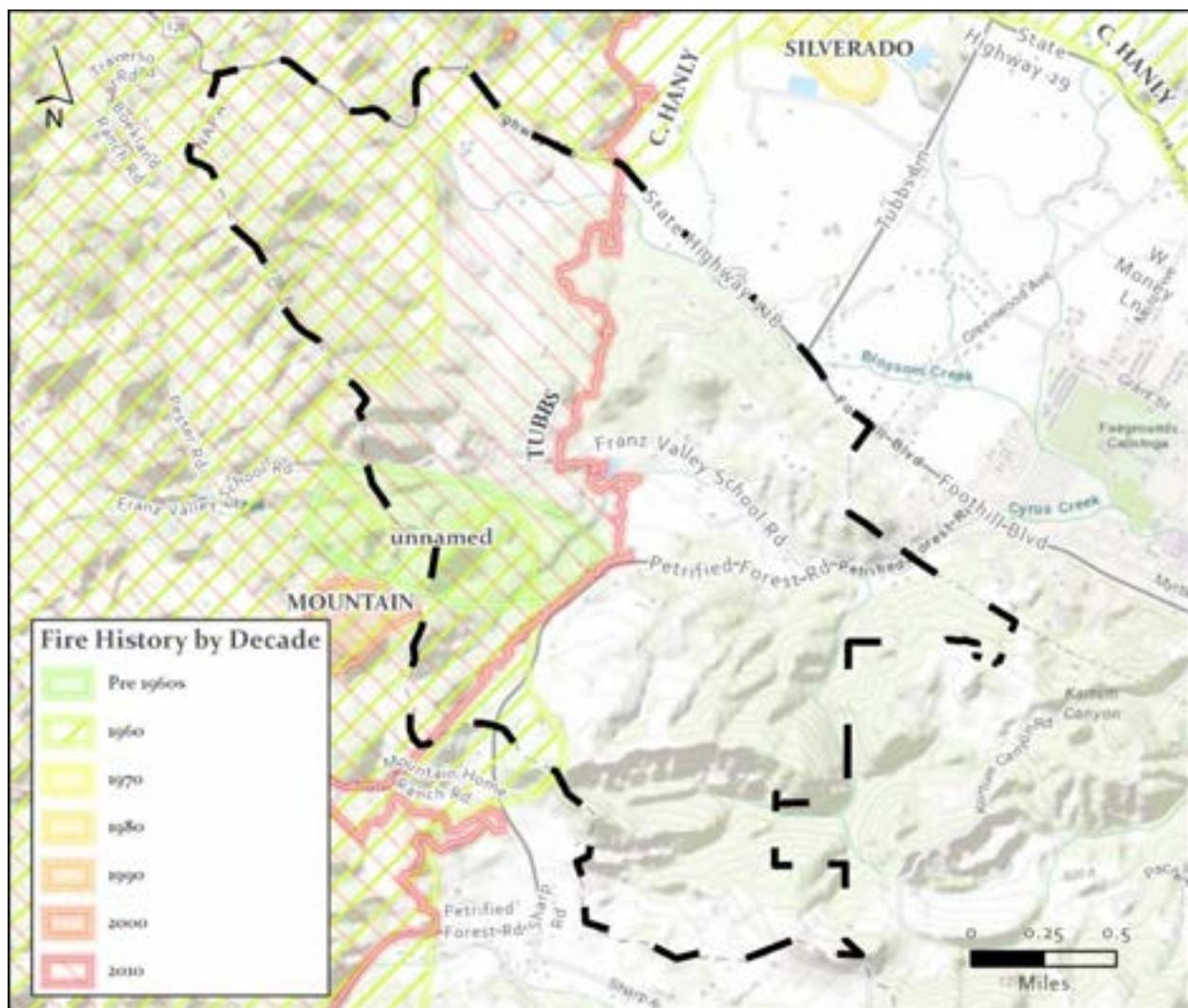


Figure 6. Location of Tubbs Fire in relation to Calistoga NW FSC (CALFIRE FRAP, 2018). Calistoga NW FSC Community neighborhood boundary shown in black.

In the past, fires did not involve large numbers of structures because of the historic rural nature of Napa County; however, structures are now a common concern whenever wildland fires of any size occur.

In 2019, the Kincade fire burned in nearby Sonoma County, consuming over 77,000 acres of land. In 2015, the Valley fire (not shown on map) burned over 60,000 acres and destroyed several hundred structures in Lake and Napa County and caused one fatality. Many other, smaller fires burned into the area including the Silverado, P.G.&E. #10 and #4, Mountain, and other fires.

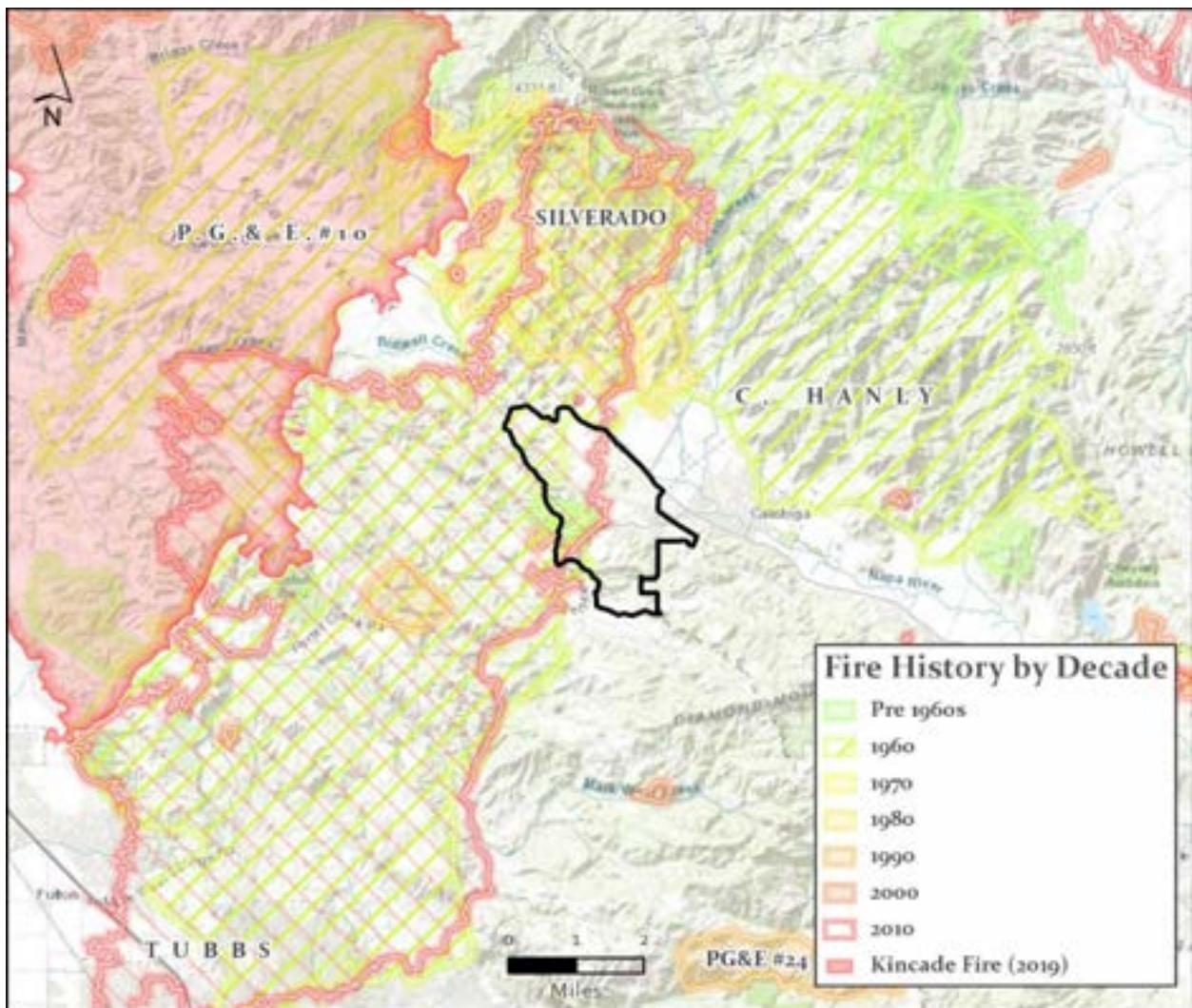


Figure 7. Regional fire history map (CALFIRE FRAP, 2018). Calistoga NW FSC Community neighborhood boundary shown in black.

The cause of over 99% of the fires in Napa County is human activity. For example, almost a quarter of most wildfires reported were of undetermined or miscellaneous cause. Almost one-third of the fires were caused by equipment use – such as workers abating weeds for fire hazard reduction which accidentally cause fires. Vehicles caused 17% of the fires; arson caused

3%. Other causes such as smoking, electrical power lines, and debris burning caused the remaining fires. Historically, 80% of wildland fires in California have started within 10 ft from a road.

H. Access

Access to and from, and within the Calistoga NW FSC neighborhood is a serious concern. All neighborhoods within the Firesafe Council are accessed by Highway 128, Foothill Boulevard, Petrified Forest Road, and Franz Valley School Road. All roads within the firesafe council lead down to Highway Foothill Boulevard/Highway 128 or Petrified Forest Road. Thus, congestion on these two-lane roads is expected to be significant during an evacuation.

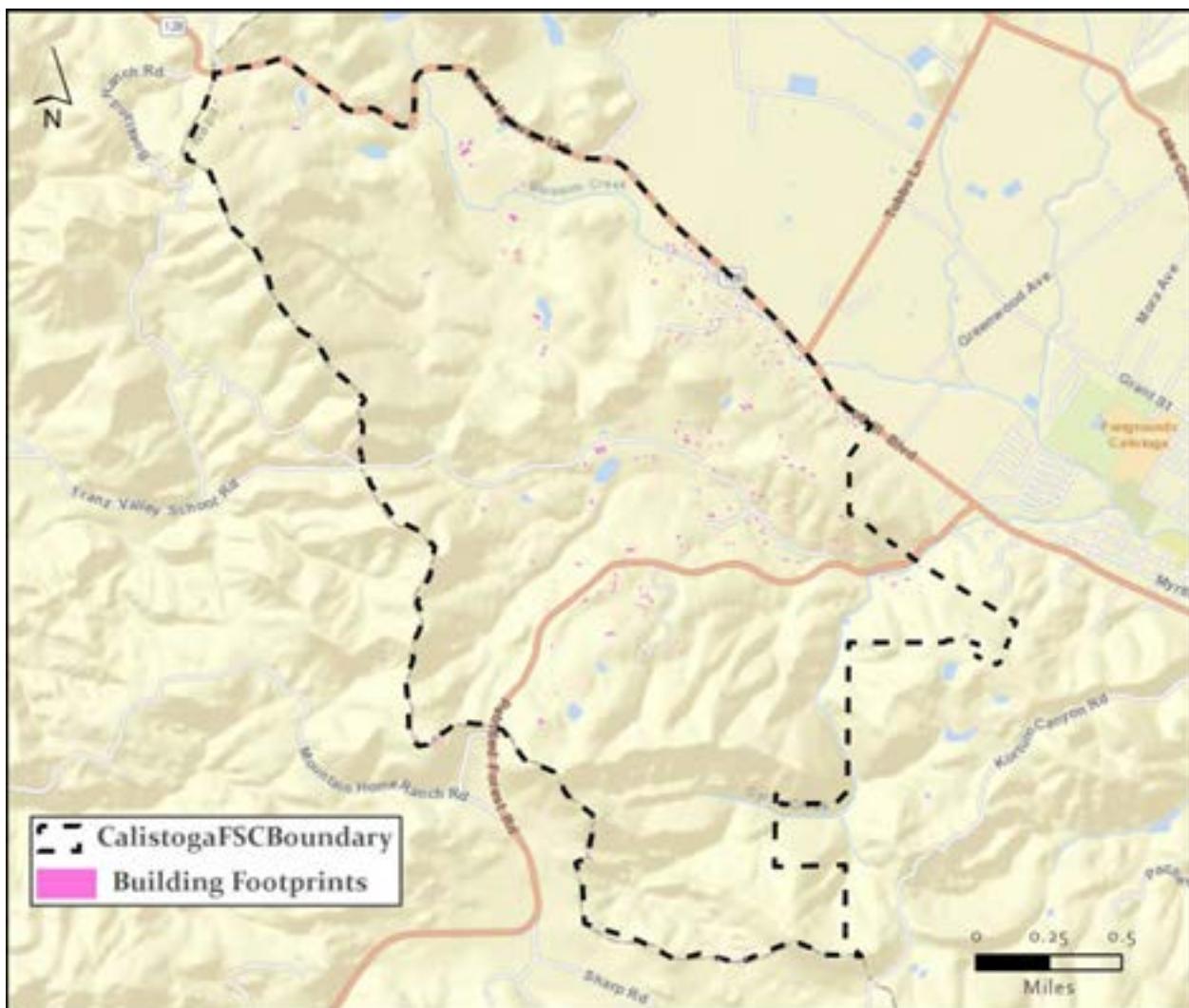


Figure 8. Access and terrain of Calistoga NW FSC Community neighborhood (shown with dashed black line).

Access in all neighborhoods is challenged by topography. Most lengths of the road are barely two lanes with no shoulders. Pavement (road surface) is generally in good shape, some curves are simultaneously sharp and steep.

Driveways in all neighborhoods are generally long. Some residences are served by long shared driveways behind locked gates. Locked gates are common and can further delay emergency response. Locked gates also discourage/prevent inspection by local fire authorities.

Regardless of the condition of the roadbed, access can be blocked by its roadside vegetation. Trees can fall, blocking passage or vegetation can burn with such intensity that emergency response and evacuation cannot occur.

Most roadsides have abundant roadside vegetation. This vegetation could block the road while burning, and after, as trees fall (a common event during a fire). Roadside vegetation has been maintained throughout many lengths of roads; however, one blockage would be significant.

Road Name	Number of Address Pt on Road	Percent of Address within FSC Boundary
Bentley Dr	6	4%
Firview Dr	10	6%
Foothill Blvd	21	13%
Franz Valley Rd	6	4%
Franz Valley School Rd	29	18%
Kortum Canyon Rd	1	1%
Petrified Forest Rd	29	18%
Shaw-Williams Rd	6	4%
State Highway 128	53	33%
Grand Total	161	

Table 6. Number of addresses by road within Calistoga NW FSC Community neighborhood boundary (Napa County GIS Open Data Portal, accessed in December 2019). Data differences from building data due to different dataset used.

I. Hazard Ranking

The entirety of the Calistoga NW FSC is within CAL FIRE's State Responsibility Area (SRA). Through CAL FIRE's fire hazard assessment of the state, they determined over 80% of the Calistoga NW FSC neighbor is categorized as a **Very High Fire Hazard Severity Zone**. A small area along Highway 128 was categorized as High, while portions along eastern Petrified Forest Road and in the northern part of the fire safe council were categorized as Moderate. These areas are notable because they have low slopes and are dominated by vineyards.

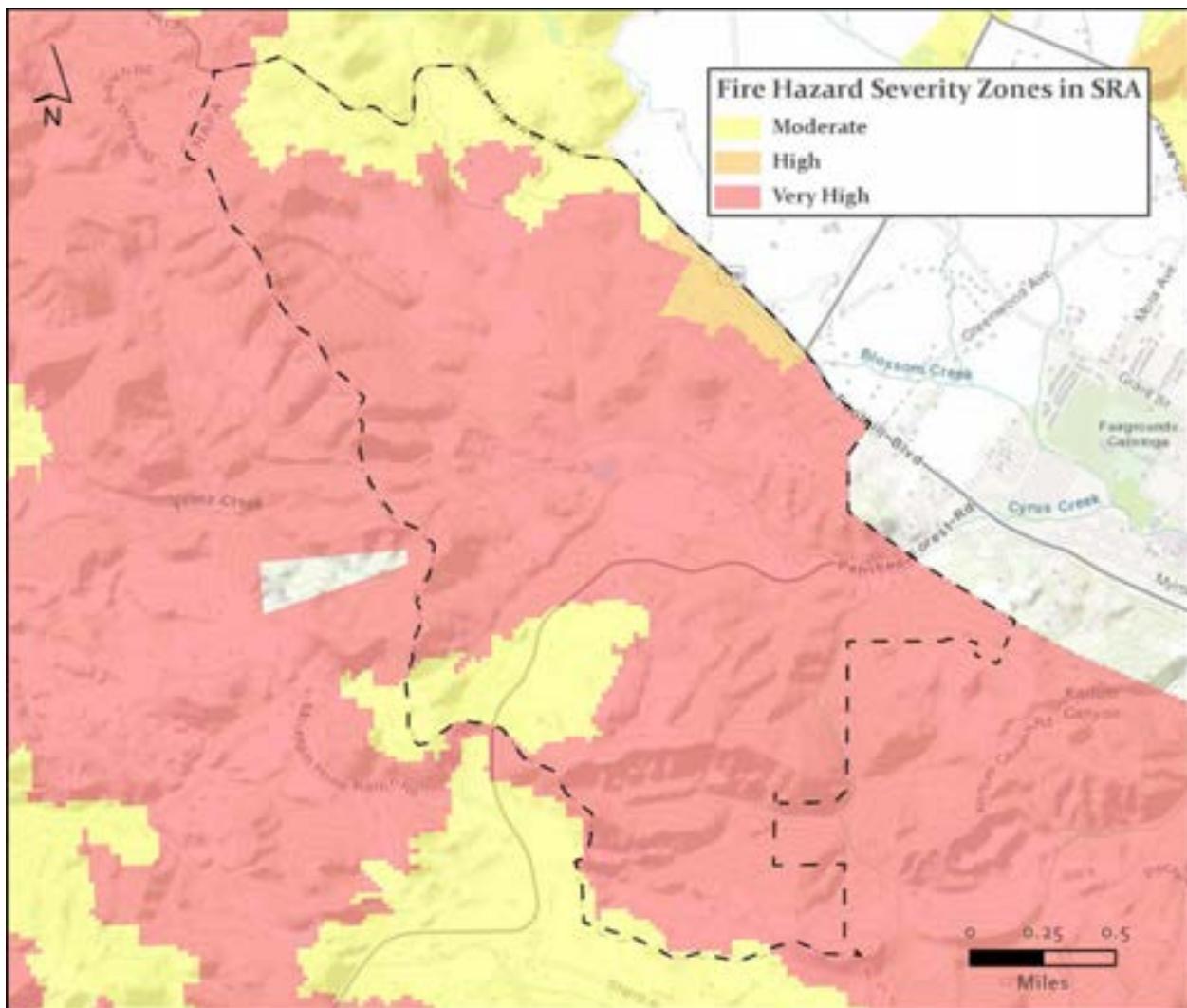


Figure 9. Distribution of Fire Hazard Severity Zones (CALFIRE, 2007). Calistoga NW FSC Community neighborhood shown in black.

Fire Hazard Severity Zone (CAL FIRE)	Acres	Percent
Moderate	386	15%
High	54	2%
Very High	2,210	83%

Table 7. Fire hazard severity zone by area (acres) within Calistoga NW FSC Community neighborhood boundary (CAL FIRE, 2007 – current version).

J. Land Use Distribution and Neighborhoods

Residential development, on large lots is generally scattered following the winding road network. Vineyards are located among residences, and some are newly developed large lots on the edge of the community.

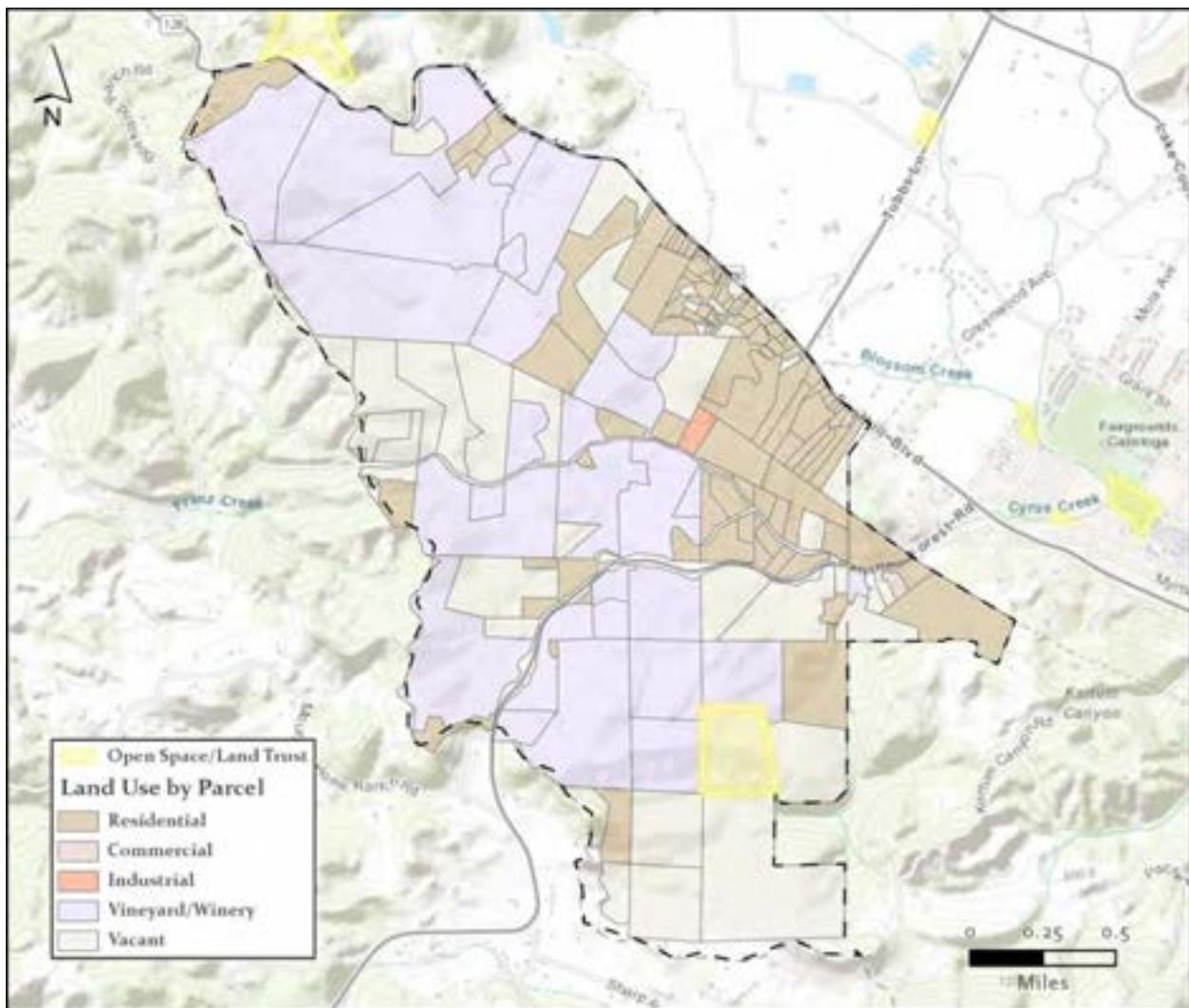


Figure 10. Land use by parcel within the Calistoga NW FSC Community neighborhood (Napa County, 2020).

The majority of the Calistoga NW FSC is comprised of land designated as Vineyard and/or Winery (with or without residences). These parcels account for approximately 49% of the area.

Undeveloped wildlands (approximately 29% Vacant land) accounts for most of the other areas within the Calistoga NW FSC. These lands are adjacent to lands held by vineyards to the south and east along Franz Valley School Road. One of these parcels is owned by a land trust and will likely remain wildland, however, all other Vacant lands are privately held and could change land use, likely to either residential or vineyards. Changes in land both would likely improve the fire safety of the area (assuming the new residential area is constructed with ignition-resistant practices and landscaping is maintained).

Residential parcels account for approximately 23% of the Calistoga NW FSC and are concentrated in the lower valley areas to the east, along Highway 128 and Petrified Forest Road. These lots are generally smaller than the Vineyard or Vacant lots.

Most Vineyard and Vacant parcels are large enough that the landowners can influence fire behavior to protect their structures; structures are rarely within 100-ft of the neighboring parcel.

Category	Parcel Count	Total Area (acres)	Percent
Commercial	2	4.0	0.16%
Industrial	1	7.1	0.28%
Residential	102	575.8	22.48%
Vacant	46	729.0	28.46%
Vineyard/Winery	28	1,245.8	48.63%
Grand Total	179	2,561.6	

Table 8. Acres by broad land use and percent of total within Calistoga NW FSC Community neighborhood. See Table 2 for more details.

Neighborhood Characteristics

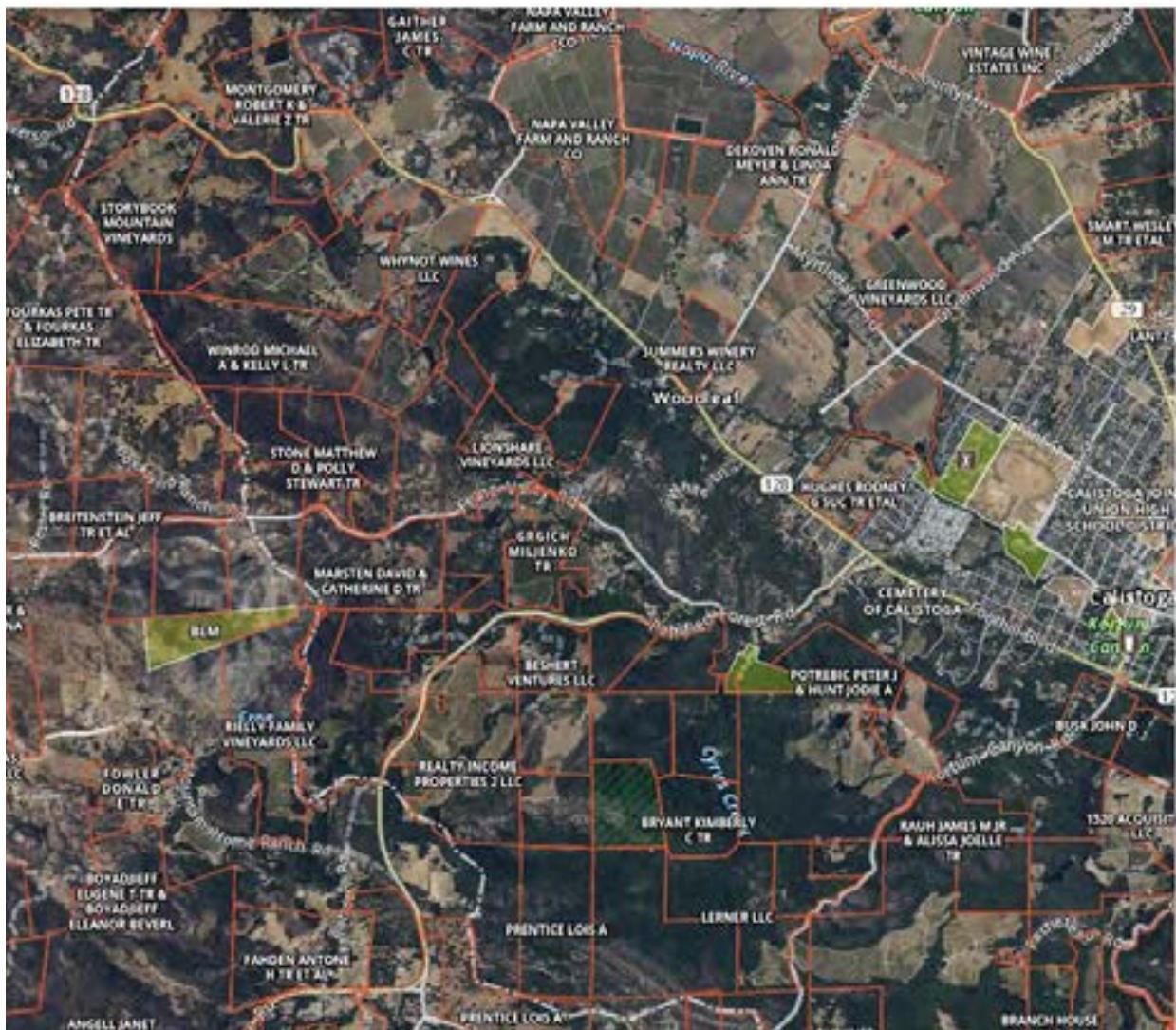


Figure 11. Neighborhoods within the Calistoga NW FSC Community neighborhood boundary.

This analysis delineated three neighborhoods based on the development pattern (lot size, street width, age of construction, land use) and roadways. These are:

1. Petrified Forest Road.

2. Franz Valley School Rd.

3. West of Highway 128

Neighborhood 1 – West of Highway 128 Neighborhood

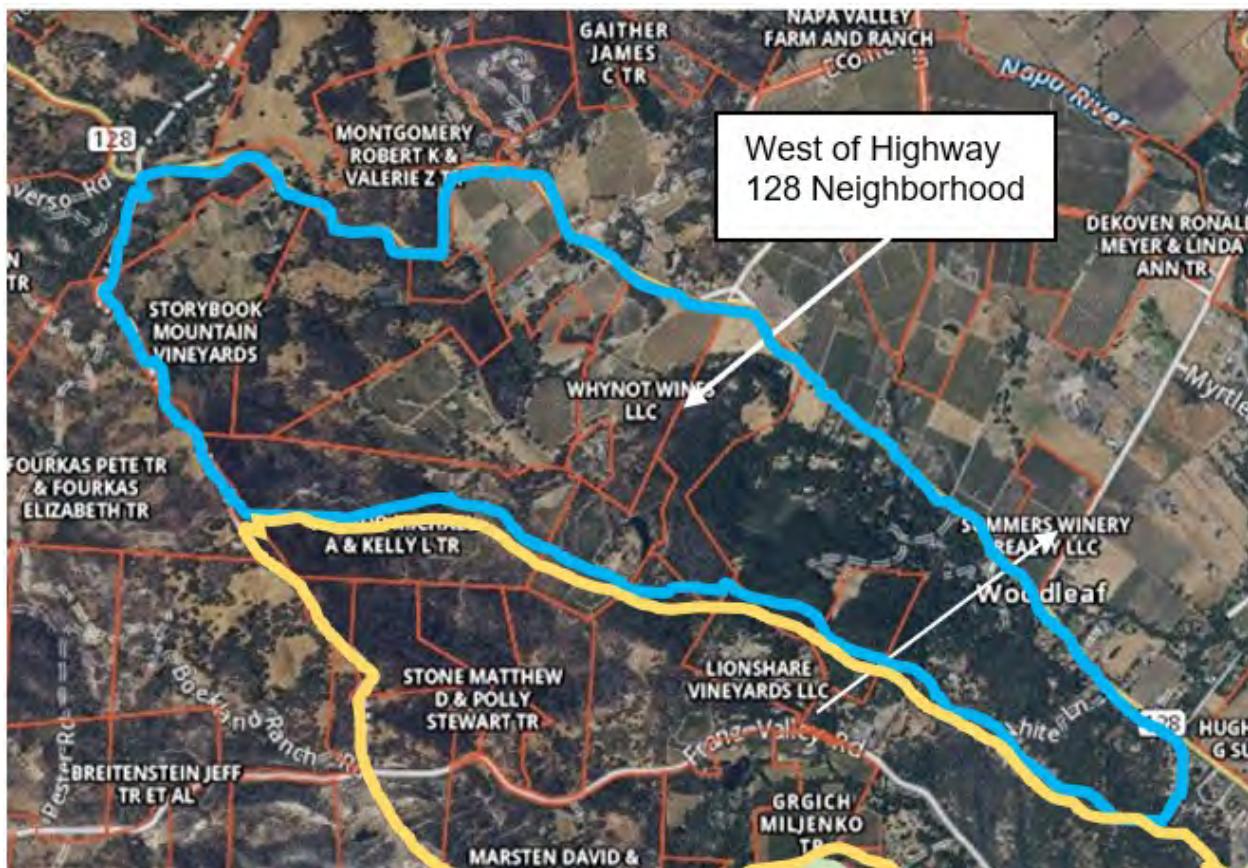


Figure 12. Neighborhood 1: West of Highway 128 Neighborhood within the Calistoga NW FSC

Pattern of development and how it relates to fire safety: This neighborhood more than half of the structures in the fire safe Council, with a land use that is a mixture residential parcels ranging from one to 20 acres in size, with narrow but long parcels located adjacent to Highway 128. Larger parcels with vineyards or single dwellings are the norm in the north and western part of the neighborhood. Each parcel is large enough to influence fire behavior around the structure. Vineyard parcels range from 40 to 120 acres, large enough for possible temporary refuge areas.

Access: This neighborhood is served by Highway 128, with only a few spur roads to the east.

Long driveways are the rule, except for a few that are accessed directly from Highway 128. Some residences are accessed via shared driveways. Most have locked gates. Highway 128 has two lanes and has several locations for turnouts and is not a constraint for access on the south but becomes more narrow on the north. The southern segment of Highway 128 leads to the commercial district of the City of Calistoga, which is likely to be congested and could block exits during evacuation events.

Terrain: The terrain is not excessively steep, sloping up to the county border on the west and south. Slopes are gentle in the north, especially near Blossom Creek and near the southern segment of Highway 128. No topographic feature would block or promote fire spread during a Diablo wind event.

Defensible Space Conditions: Some residential yards are exemplary. Most residents are in compliance with fire safety regulations regarding defensible space.

Adjacent Fuels: Vegetation beyond 100 feet from structures are either vineyards or a mixture of Douglas fir forest with varying levels of understory trees and shrubs. The vineyards comprise a fire safe condition. The parcels in the northern portion of the neighborhood have burned in the 2017 Tubbs Fire, with grass and sprouting bay trees, many cleared properties, some with standing dead trees. A mixture of small farms, as well as hardwoods with a Douglas fir understory is found near the highway.

Unusual wind conditions, cause, likely spread: Highway 128 is a likely source of roadside ignitions due to the high level of traffic.

Possible Projects for Napa FireWise: This neighborhood would benefit from ensuring roadside vegetation is treated every year, and that signs are installed that aid locating streets and structures and indicating access and water supply.

NEIGHBORHOOD #2: FRANZ VALLEY SCHOOL ROAD NEIGHBORHOOD

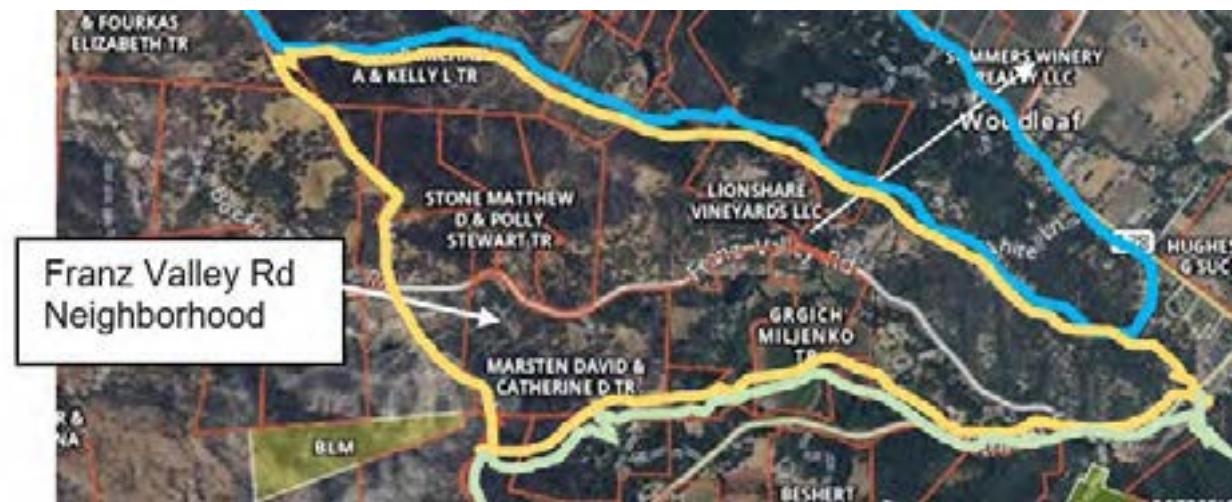


Figure 13. Franz Valley School Road Neighborhood

Pattern of development and how it relates to fire safety: This neighborhood consists of approximately 40 structures in residential parcels ranging from 3 to 200+ acres in size, with larger parcels located on the western portion of the neighborhood. Each parcel is large enough to influence fire behavior around the structure. Vineyard parcels range from 40 to 120 acres, large enough for possible temporary refuge areas.

Access: This neighborhood is served by one long through road, with only one named spur road (Shaw-Williams Rd). Long driveways are the rule on the majority of the neighborhood, except for a few on the east, where short driveways exist near the junction of Petrified Forest Road and Franz Valley School Road. Many of the parcels near Petrified Forest Road are access via Franz Valley School Road. A few residences are accessed via shared driveways. Almost all have locked gates. The main road is two lanes but has no turnouts; this is problematic throughout.

Franz Valley School Road itself is narrow, with infrequent turnouts.

Terrain: Terrain consists of undulating, rolling hills, and small, broad valleys. The steepest terrain is where the slopes lead sharply up to the county border. The ridgeline slightly east of the border has a gap at Petrified Forest Road, where winds could funnel through during a Diablo wind event.

A shallow westerly-trending valley follows the northern fork of Cyrus Creek, with slopes becoming more distinct further west.

Defensible Space Conditions: Some residential yards are exemplary. Most residents are in compliance with fire safety regulations regarding defensible space.

Adjacent Fuels: Vegetation beyond 100 feet from structures are either vineyards or Douglas fir forest with varying levels of understory trees and shrubs. The vineyards comprise a fire safe condition, whereas the Douglas fir forests could fuel an intense fire under extreme weather conditions.

The parcels in the western half of the neighborhood burned in the 2017 Tubbs Fire, with grass and sprouting bay trees, many cleared properties, some with standing dead trees.

Several trees lean over the road and could block passage during an extreme wind event.

Unusual wind conditions, cause, likely spread: The topographic gap between two knolls at the county border could accelerate dry winds, embers to the west during an east wind event.

Possible Projects for Napa FireWise: This neighborhood would benefit from ensuring roadside vegetation is treated every year, and trees that are likely to block passage should be pruned or removed. Signs should be installed that aid locating streets, structures and indicating access and water supply.

Access would also be improved by widening areas for turnouts wherever possible.

NEIGHBORHOOD #3: PETRIFIED FOREST ROAD NEIGHBORHOOD



Figure 14. Petrified Forest Road Neighborhood

Pattern of development and how it relates to fire safety: Most of the parcels in this neighborhood are large, and almost all of the parcels south of Petrified Forest Road are associated with commercial enterprises. Residential structures are more common east of the junction with Franz Valley School Rd. This neighborhood includes approximately 30 residential structures in parcels ranging from one to 20 acres in size. Each parcel is large enough to influence fire behavior around the structure. Vineyard parcels range from 40 to 120 acres, large enough for possible temporary refuge areas, however, most are remote.

Access: This neighborhood is served by one long through road, no named spur roads. Long driveways are the rule. Some residences are accessed via shared driveways, often with locked gates. Many of the landowners on the north side gain access through Franz Valley School Road because of steep terrain. Commercial properties also often have locked gates. Petrified Forest Road is wide, with generous turnouts, however, the northern slope is quite steep, and the grade west of the junction with Franz Valley School Road is quite steep, which is a hazard both for travelers going up or down the grade. Petrified Forest Road ends in the commercial district of the City of Calistoga, which is likely to be congested and could block exits during evacuation events.

Terrain: The terrain slopes upward to the south. Several minor valleys trend upward to the southwest, and a more pronounced north-south trending valley follows Cyrus Creek. The eastern end of this neighborhood has more gentle terrain, while the unpopulated southwestern corner of this neighborhood descends sharply down south-facing rugged slopes.

Defensible Space Conditions: Some residential yards are exemplary. Most residents are in compliance with fire safety regulations regarding defensible space.

Adjacent Fuels: Vegetation on the south side of this neighborhood is dominated by Douglas fir forests, dense oak woodlands, with varying levels of understory trees and shrubs. The vineyards comprise a fire safe condition, whereas the Douglas fir forests and oak woodlands could fuel an intense fire under extreme weather conditions. The southwestern portion of the neighborhood, as well as other parcels have large patches of brush which can be expected to burn with great intensity. Fortunately, these patches are distant from structures.

Unusual wind conditions, cause, likely spread: Several of the narrow canyons are aligned with northeast winds, and would like funnel dry winds, embers and heat the slopes and vegetation on the south side of Petrified Forest Road. The grade of Petrified Forest Road could cause vehicular accidents, which can cause wildfires. The steep grade to the north is a similar concern for wildfires caused by vehicular accidents.

Possible Projects for Napa FireWise: This neighborhood would benefit from ensuring roadside vegetation is treated every year, and trees that are likely to block passage should be pruned or removed. Signs should be installed that aid locating streets, structures and indicating access and water supply.

K. Recommended Projects

Several projects were recommended to enhance the fire safety within Calistoga NW FSC.

Some span the entirety of the firesafe council area, while others are specific to a neighborhood. Those projects that are common to all neighborhoods are not described in the neighborhood-specific description of projects.

There are nine recommended projects. These projects include actions such as installation of compliant signs, widening roads in places to create turnouts, establishing alternative evacuation routes, establishing a communication system, and identifying temporary refuge areas for residents along the main roads. One project targets increasing education about fire safe landscaping and retrofitting options. The other projects are distributed in all of the three neighborhoods. The following table indicates the justification of treatments in terms of specific goals, spanning from Assist Evacuation and Emergency Response, Reduce Ignition Potential, Reduce Property Damage, to Assist Fire Containment. Most projects are aimed at helping evacuation and emergency response and supporting fire containment.

	PROJECTS FOR CALISTOGA NW FIRESAFE COUNCIL	<u>Help Evacuation and Access</u>	<u>Reduce Ignitions</u>	<u>Reduce Property Damage</u>	<u>Assist Containment</u>	<u>Neighborhood</u>
Project 1	Remove hazard trees along roads	X		X	X	Franz Valley School Rd, West of Highway 128
<i>Area</i>	Roadside, where leaning and/or failing trees exist					
<i>Goal</i>	Provide safe evacuation and response during an emergency					
<i>Actions</i>	Encourage/promote vegetation management by County to remove hazard trees along roads					
<i>Participants</i>	Willing members of FSC					
<i>Schedule</i>	Now, any time					
Project 2	Call 'em All/Nixel Sign-up	X				All neighborhoods
<i>Area</i>	Throughout FSC					
<i>Goal</i>	Alert community members of emergencies, and communicate disconcerting non-emergencies					
<i>Actions</i>	Obtain phone numbers of volunteers, subscribe to service					
<i>Participants</i>	Every resident					
<i>Schedule</i>	Now, any time					
Project 3	Install knox-box facilities at base of roads, using Diamond Mountain's as an example	X		X	X	Franz Valley School Rd, West of Highway 128
<i>Area</i>	At base of White Lane, Shaw-Williams Rd., Firview/Bentley Dr.					
<i>Goal</i>	Allow emergency responders to respond and follow directions using aerial observations					
<i>Actions</i>	FSC to purchase box and knob-box, and deliver to Napa Co FD					

Participants	Willing members of Franz Valley School Rd, West of Highway 128 neighborhoods					
Schedule	Now, any time					
Project 4	Expand roadside turnouts	X	X		X	Franz Valley School Rd, West of Highway 128
Area	Narrow stretches of Franz Valley School Rd, Highway 128					
Goal	Provide opportunities for simultaneous evacuation and emergency response, and/or passage past disabled vehicles during evacuation					
Actions	Re-grade roadside, consult with County Public Works					
Participants	Property owners, and/or vendors for machinery					
Schedule	Best in the fall, OK anytime but avoiding nesting season and red flag days					
Project 5	Hold educational presentations or provide material regarding defensible space and fire-resistant landscaping choices, and retrofit options	X	X	X	X	All neighborhoods
Area	Throughout FSC					
Goal	Guide vegetation to be more fire-safe (see also Project #13), provide residents resources for more ignition-resistant structures					
Actions	Identify residents' information gaps, gather already-existing material, organize material, publish					
Participants	1-3 volunteers					
Schedule	Now, any time					
Project 6	Shift forest species composition to woodland from conifer		X	X	X	All neighborhoods

Area	Wildland areas with conifers					
Goal	Modify fuel characteristics of forest to burn with less intensity					
Actions	Plant oak trees (with funding from NCRS), thin Douglas fir trees					
Participants	Private landowners, private contractors, volunteers					
Schedule	Plant oaks in early winter when soil is saturated, thin trees best in fall, but anytime, avoiding nesting season and high fire danger					
Project 7	Install Signage: Street, addresses, access, water	X		X	X	All neighborhoods
Area	Entire FSC					
Goal	Inform responders of features that encourage entry and successful response					
Actions	Purchase signs in bulk and install, customize signs					
Participants	All parcels					
Schedule	Now, any time					
Project 8	Create shaded fuelbreak on both sides of Petrified Forest Road	X	X	X	X	Petrified Forest Road, Franz Valley School Rd.
Area	50-100 feet on both sides of Petrified Forest Road, especially east of 255/263 Petrified Forest Rd.					
Goal	Calm fire behavior in strategic location, aid containment					
Actions	Request permit from landowners, develop treatment Rx agreeable to all, contract work					
Participants	Selected parcel owners along border, access routes					
Schedule	Best in the fall, OK anytime but avoiding nesting season and red flag days					

Project 9	Roadside Treatments	X	X	X	X	All neighborhoods
<i>Area</i>	30-ft both sides of Petrified Forest Rd., Franz Valley School Rd., Highway 128					
<i>Goal</i>	Enable passage of evacuees and emergency vehicles, aid containment					
<i>Actions</i>	In wildlands, chip all dead material, remove (cut, pull, and/or spray) understory shrubs, prune lower branches of trees					
<i>Participants</i>	Hand crews (CDC), property owners, and/or vendors for machinery					
<i>Schedule</i>	Best in the fall, OK anytime but avoiding nesting season and red flag days					