Calistoga FSC Community FireWise Evaluation

June 15, 2020

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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 elevated levels of human activities, and most fires in the coastal mountains are human caused.

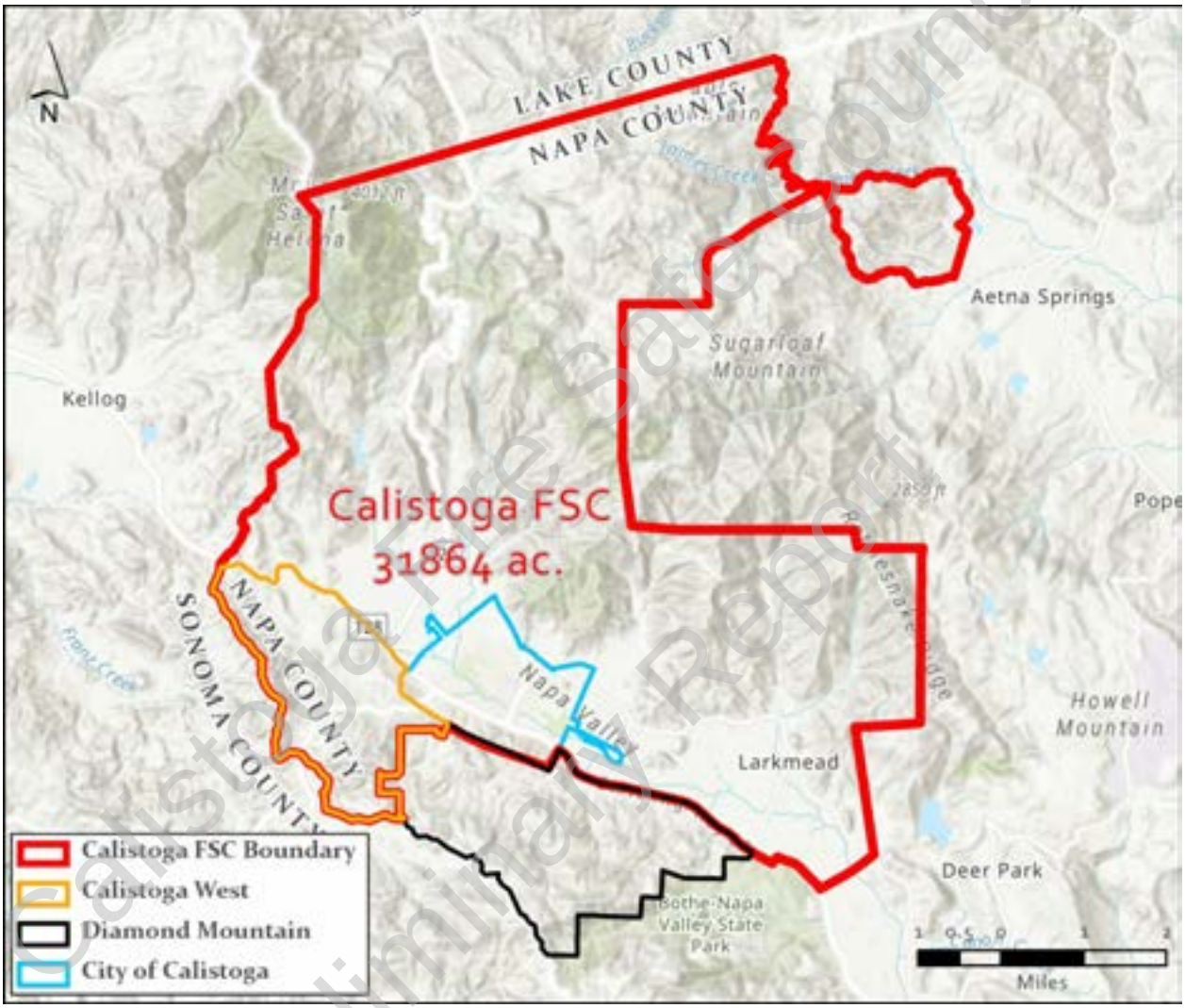


Figure 1. Area of Interest – Calistoga FSC Community neighborhood boundary (shown in red). The smaller area outlined in black is the Diamond Mountain FSC boundary (excluded from this evaluation). The City of Calistoga is also included in this evaluation and is shown in bright blue.

This evaluation serves as a foundation for recommendations for projects to minimize threat from wildfire to life safety and damage 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.

The area covered in this evaluation excludes the area outlined in black that denotes the Diamond Mountain area (Figure 1). Please see the *Diamond Mountain FSC Community FireWise Evaluation* documents for treatment recommendations and further details on Diamond Mountain.

B. Values at Risk

The most important values at risk are life safety, then improvements to property (residences and vineyards), then natural resources. There are approximately 2500 residences in the Calistoga FSC (although this is a lower estimate because the database did not account for residences in mobile home parks). Because many of the evacuation routes are long and involve poor road conditions, the threat to human life is significant.

Obviously, homes in the Calistoga FSC are at risk from wildfire. There are 2468 addressed buildings in the Calistoga FSC. Structures in the Calistoga neighborhood include older buildings which date back to 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, especially in canyons and heavily vegetated areas.

Figure 2. Typical structures in the valley floor of the Calistoga FSC

Homes: 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. However, many residential structures are mostly made of wood because of their age. They have wood porches and decks, though wood fences are a rarity. Many older structures have been remodeled and a few property owners have installed personal fire suppression systems involving various water sprinkler strategies.

Figure 3. Ignition-prone wood deck

Figure 4. Ignition-prone mobile homes

Calistoga City has an unusually large number of mobile homes, which are vulnerable to wildfire. The construction materials, and short distances between structures lend to their being more ignition prone. These locations are also challenged by lack of access that could hamper safe evacuation.

Many large wineries and vineyards are located throughout the Calistoga FSC and constitute a value at risk. 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. In addition, vineyards on steep slopes may not till between vines; in these cases the grass/vine vegetation spreads fire rapidly and produces enough heat to damage the vines.

Figure 5. Vineyards with access road

Many wineries are ignition resistant due to construction material used and defensible space, whereas a few vineyards/wineries have structures on the property that are made of wood and are located in a heavily vegetated canyon setting.

Figure 6. Older winery, built prior to ignition-resistant construction requirements

Figure 6. Vineyards on slopes of the Calistoga FSC

Vineyards/wineries within the Calistoga FSC include 55 listed places in Napa County's database (including those within the City of Calistoga). Not all wineries/vineyards will be listed here, however, some of the largest in terms of parcel size include Araujo Estates Winery (Pickett Rd), Jericho Canyon Winery (Old Lawley Toll Rd), Davis Estates (Silverado Trl), Storybook Mountain Vineyard (Highway 128), Carver Sutro Winery (Palisades Rd), Sterling Vineyards (Silverado Trl), Kelly Fleming Wines (Pickett Rd), Fisher Winery (Silverado Trl), Last Resort Winery (Aetna Springs Rd), Theorem Vineyards (Petrified Forest Rd), Heritage School Vineyards (between Franz Valley School Road and Petrified Forest Rd), Grgich Vineyard (between Petrified Forest Rd and Franz Valley School Rd), and Blossom Creek Vineyard (State Highway 128).

Figure 8. Historic value at risk on Old Lawley Tool Road

	Entire Area Number	Entire Area Percent
Total Number of Structures/Buildings	4,249	
Addressed Buildings	2,468	58%
Non-Addressed Structures	1,300	38%
Outbuildings	181	4%

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

Almost two-thirds (65%) of the buildings/structures/outbuildings accounted for in Table 1 are found within the City of Calistoga.

Category	Parcel Count	Area (acres)
VACANT		
VACANT COMM W/MISC IMP	4	283.92
VACANT IND W/MISC IMPS	2	5.18
VACANT LAND COMMERCIAL	48	173.23
VACANT LAND INDUSTRIAL	30	12.41
VACANT LAND MULTIPLE	12	5.97
VACANT LAND NON-TAXABLE	88	4319.02
VACANT LAND R/W	7	1.69
VACANT LAND RURAL	231	13878.54
VACANT LAND VALUED BY S.B.E.	4	7.71
VACANT LOT W/MISC IMP	13	76.98
VACANT RURAL W/MISC IMPS	22	1333.41
VINEYARD/WINERY		
CONTRACT LAND-VINEYARD	27	1087.39
CONTRACT VINEYARD W/ WINERY	2	103.56
CONTRACT VINEYARD W/1 RES	14	476.53
CONTRACT VINEYARD W/2 SFRS	6	222.78
CONTRACT VINEYARD W/3 SFRS	1	49.61
VINEYARD < 5 AC W/1 RES	28	98.53
VINEYARD < 5 AC W/2 SFRS	6	23.21
VINEYARD > 5 AC W/1 RES	67	1601.55
VINEYARD > 5 AC W/2 SFRS	15	406.01
VINEYARD > 5 AC W/3 SFRS	2	65.78
VINEYARD > 5 AC W/4 SFRS	1	46.72
VINEYARD > 5 AC W/5 + SFRS	1	430
VINEYARD LAND < 5 AC	24	54.81
VINEYARD LAND >5 AC	48	1661.12
VINEYARD LAND W/MISC IMPS	7	176.52
WINERY	9	61.62
WINERY WITH VINEYARD	15	266.42
WINERY/VINEYARD/1 RES	8	357.9
WINERY/VINEYARD/2 SFRS	4	241.66
RESIDENTIAL		
10 TO 19 APARTMENT UNITS	11	5.43

20 TO 49 APARTMENT UNITS	4	9.82
5 TO 9 APARTMENT UNITS	26	10.97
CONDOMIN/TOWNHOUSE COMMON AREA	18	16.65
CONDOMINIUMS - TOWNHOUSES	31	1.19
CONDOMINIUMS-TOWNHOUSES	13	0.33
CONT VINE W/ WINERY W/1 RES	4	245.55
CONT VINE W/WINERY W/2 SFRS	1	40
CONTRACT NON-VINEYARD W/1 RES	2	42.42
CONTRACT NON-VINEYARD W/2 SFRS	1	60
DUPLEX	15	2.79
FOUR DWELLING UNITS	12	3.68
FOUR-PLEX	4	1
MANUFACTURED HOME PARKS	7	80.71
RURAL RES < 5 AC W/1 RES	213	980.32
RURAL RES < 5 AC W/2 SFRS	17	34.72
RURAL RES < 5 AC W/3 SFRS	1	1.8
RURAL RES > 5 AC W/1 RES	87	3018.75
RURAL RES > 5 AC W/2 SFRS	19	464.43
RURAL RES > 5 AC W/3 SFRS	2	20.1
RURAL RES > 5 AC W/4 SFRS	1	128.52
RURAL RES > 5 AC W/5 MORE SFRS	1	14.24
SFR-DIRECT ENTRY SALES PROG	1	0.08
SINGLE FAMILY RESIDENTIAL	971	417.97
THREE DWELLING UNITS	14	3.25
TRIPLEX	6	0.74
TWO DWELLING UNITS	53	23.75
VACANT LOT RESIDENTIAL	128	130.48
OTHER		
CONTRACTS LAND-NON-VINEYARD	3	253.18
IMPRVD LAND NON-TAXABLE	20	1006.38
COMMERCIAL		
COMMERCIAL IMPROVED	96	140.42
MOTEL - B & B	59	311.81
OFFICE	4	0.8
RETAIL	8	1.89
INDUSTRIAL		
AUTOMOBILE RELATED	4	1.98
HEAVY INDUSTRIAL	1	22.41
INDUSTRIAL	3	17.12
LIGHT INDUSTRIAL	1	6.54

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

Parcels categorized as Vacant account for 57% of the FSC boundary with approximately 20,000 acres. The next combined category of Vineyard/Winery accounts for 21% of the FSC. The next largest category, Residential, occupies 16% of the area. Commercial, Industrial, and Other make up the

remaining 5%. Of these, high-density residential parcels comprise approximately 130 acres, of which the largest acreage lies in 80 acres of mobile home parks.

Figure 9. Mobile home parks comprise 80 acres of land in the Calistoga FSC.

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", intensified, or blocked 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 ridgetop positions more vulnerable than those at the bottom of a slope. Conversely, locations in steep-sided canyons are at risk from winds funneled by the topography.

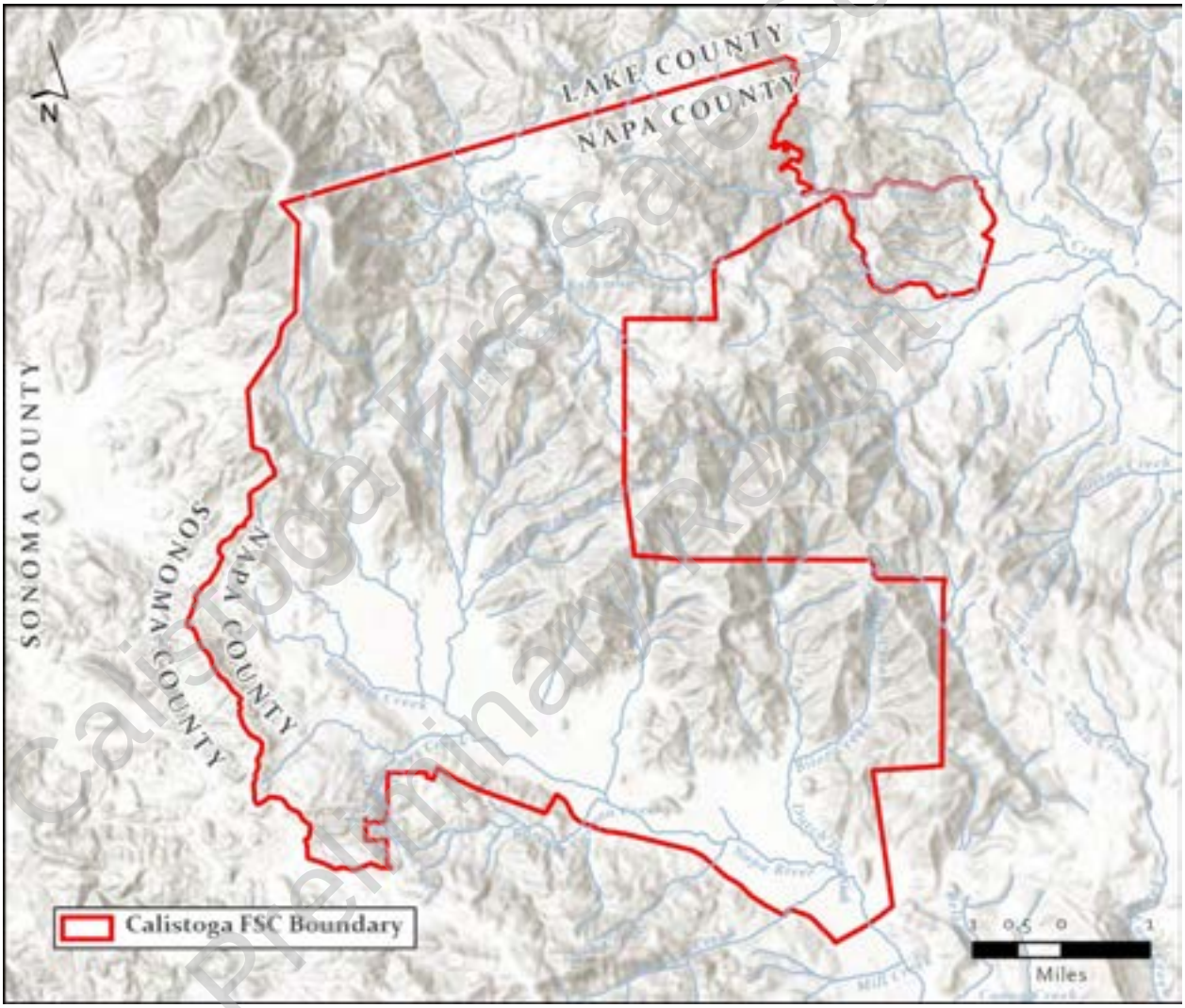


Figure 10. Topography and watershed delineation map. Calistoga FSC Community neighborhood boundary shown in red.

Calistoga FSC and its environs rise from the valley floor to the county boundary along a high north-south trending ridge, from approximately 250 to 4,200 ft in elevation. The topography includes flat valleys as well as crenelated topography, with deep, narrow canyons. Most slopes are quite steep,

but there are some broad plateaus located throughout the area on the west , and almost all have vineyards on them. Ridgelines on the east are sharp, steep, and abrupt, characterized by names like “The Palisades”.

Figure 11. Ridges (burned) in norther portion of the FSC

Orientation of the canyons

- The higher elevations around Mount Saint Helena reaching over to Sugarloaf Mountain make up a northwest to southeast oriented ridge. To the northeast of this ridge is Bear Valley and Kid Canyon. Just north of this is Table Mountain. These major landforms lead to a complicated array of drainages that lead both north to south and east to west. To the southwest of the Mount Saint Helena-Sugarloaf Mountain ridge lies the upper reach of the Napa River and its valley.
- Kimball Canyon sits just south of Red Hill and north of China Flat at [?] the very top of Napa Valley. It funnels directly into the Kimball Reservoir.
- Jericho Canyon also aligns from north to south and drains into Napa Valley.
- Moving to the east of these canyons, the drainages start to angle from the northeast to the southwest; these include Hoisting Works Canyon, Garnett Creek, Simmons Canyon, and others.
- From Simmons Canyon to the east, the large drainages again align from the north to the south, culminating into Napa Valley. These include Dutch Henry Canyon and Bitter Creek.
- 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.

Figure 12. Sharp ridge just west of Calistoga Grade.

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 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 FSC lie in a relatively protected area and would be subject to occasional episodes of still, stagnant air formed by stationary highs during summer months. This overall weather pattern – characterized by continuous high temperatures and low relative humidity – enhances the possibility 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 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 humidity 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 when the largest fires in Napa history – the 1964 Hanley Fire, the 1981 Atlas Fire, and the 2017 Tubbs Fire, Nuns Fire and Atlas Complex – occurred. These same winds spread the 2017 Tubbs fire that consumed the northern portion of the FSC, including most of the Robert Louis Stevenson State Park. 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 valley floor to the higher elevation portions of the western Calistoga FSC area.

The vine-covered valley floor moderates the risk from the Diablo winds to the western portion of the FSC. 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

There are seven main vegetation types within the Calistoga FSC neighborhoods along with four non-veg types included in the 2016 vegetation map for Napa County. The mapped classes include:

- Coniferous forest
- Oak woodlands
- Agriculture
- Shrubland
- Developed (non-veg)
- Grassland
- Riparian woodland
- Rock Outcrop (non-veg)
- Streams and reservoirs (non-veg)
- Other (non-veg)
- Wetlands

Along with the mapped vegetation/land cover is the landscaped environment surrounding buildings and homes.

Figure 13. Mixture of vegetation types in northern portion of the FSC.

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.

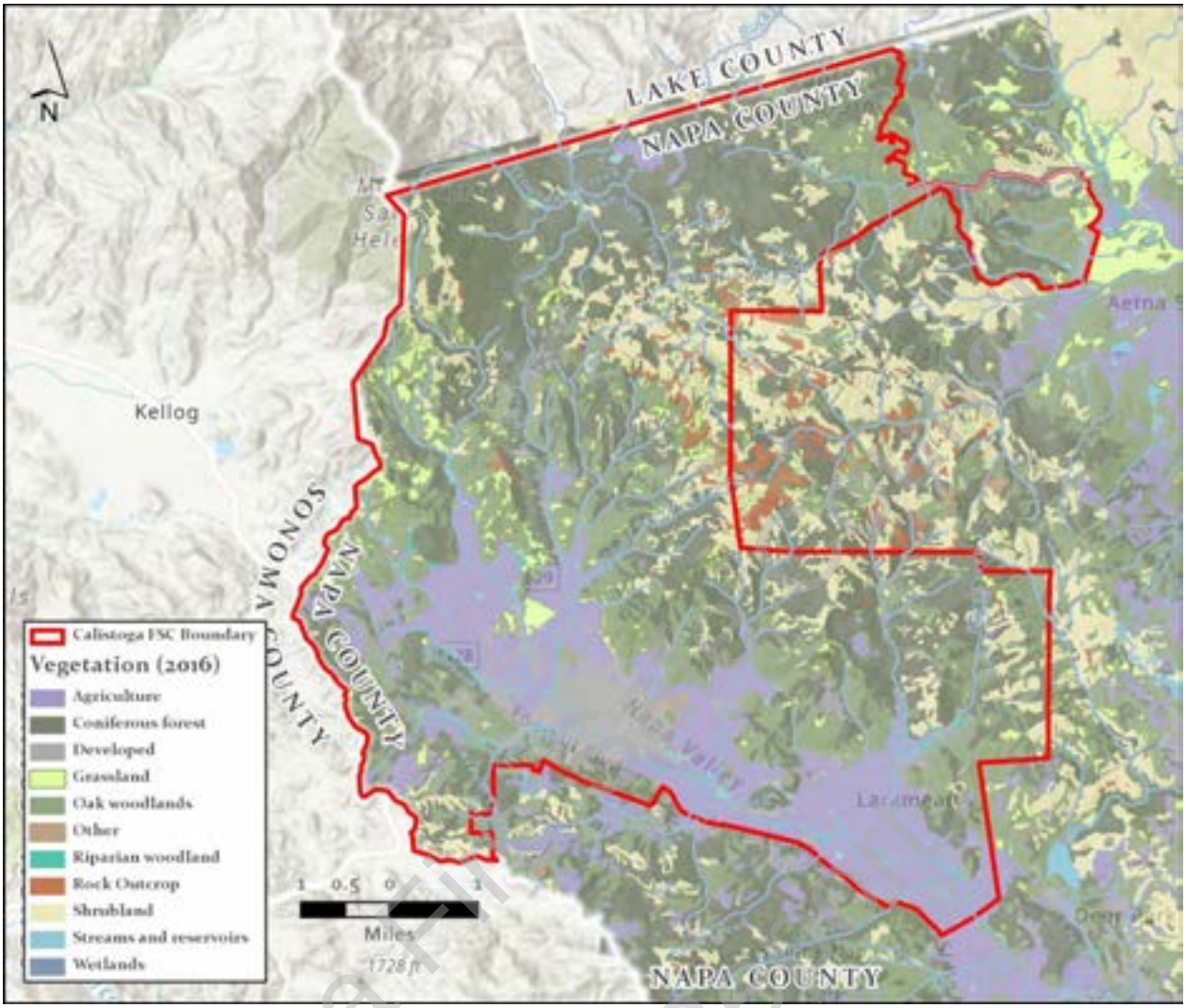


Figure 14. Vegetation map – Calistoga FSC Community neighborhood boundary (shown in red) (Napa County, 2016).

Coniferous forest: These areas include mapped Douglas-fir, Knobcone Pine, a mix of Douglas fir and Ponderosa Pine, Coast Redwood mix along with predominately Coast Redwood, Foothill Pine, McNab Cypress, and a mix of Sugar Pine and Canyon Oak. These coniferous forests occur in large patches throughout the hills within the Calistoga FSC, primarily to the north and west, and constitute about 39% of the area.

Figure 15. Dense conifers on east-facing slope.

These dense, conifer forests are often found on north- and east-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 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.

Vegetation Class	Area (acres)	Percent
Coniferous forest	12,466.80	39%
Oak woodlands	7,463.11	23%
Agriculture	4,866.51	15%
Shrubland	3,012.64	9%
Developed	1,518.64	5%
Grassland	1,414.87	4%
Riparian woodland	547.21	2%
Rock Outcrop	275.88	1%
Streams and reservoirs	179.47	1%
Other	47.50	0.1%
Wetlands	5.30	0.02%

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

Oak Woodlands: 23% of the Calistoga FSC is oak woodland, which occurs on the lower flanks of hillsides throughout the FSC. They occur in clumps, on average, 10 acres in size, the largest stand measuring 86 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, Black oak, Blue oak, California buckeye, Oregon white oak, Canyon live oak, valley oak, interior live oak, 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) are carried in the compact leaf layer. Low flame heights (less than one foot) are the rule. Only under severe weather conditions involving high temperatures, low humidity, and high winds do these 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.

Figure 16. Oak woodland with little understory.

Oak woodlands that are free of understory burn with benign fire behavior characteristics (low flame lengths, slow fire spread rate).

Figure 17. Oak woodlands with a shrubby understory burn with intensity.

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 humidity, 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.

Figure 18. Oak woodlands are now filled with young Douglas fir that can carry fire to the tree canopy and create greater damage.

Similarly, when Douglas fir seedlings and saplings become dense in the understory of the oak woodlands, fire behavior changes from being benign to quite dramatic. The small diameter trees serve as ladder fuels to promote crown fires and high severity impacts.

Agriculture (Cropland/Vineyards): 15% of the land in the Calistoga FSC is mapped as agriculture. This occurs in large sections along the Calistoga valley surrounding Napa River along with a few patches, located in high ground where flatter slopes have been converted to vineyards.

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.

Shrubland: The next largest mapped vegetation type occupies 9% of the Calistoga FSC and can be found at the lowest elevations transitioning between the conifer forests/oak woodlands to the grasslands at the valley floors. The average size of these areas is 8 acres, with the largest at 83 acres and the smallest less than an acre. While these distinct areas were mapped as Shrubland, brush exists throughout and often contributes to other vegetation types described in this document.

Figure 19. Mature shrubby vegetation.

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.

Annual Grasslands: Accounting for roughly 4% of the Calistoga FSC neighborhoods, annual grasslands were mapped throughout, but are primarily along the valley edges and in pockets in the central part of the area. Fire spread through grasslands can be quick; however, they are easy to spot and quick to put out.

Figure 20. Annual grassland patches within an oak woodland.

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, and 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.

Figure 21. Fire-safe landscaping blending into wildlands.

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 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.

F. Predicted Fire Behavior

Flame lengths are expected to be long because of the combination of heavy fuels, especially in the chaparral, and in the redwood forests under especially dry conditions. 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.

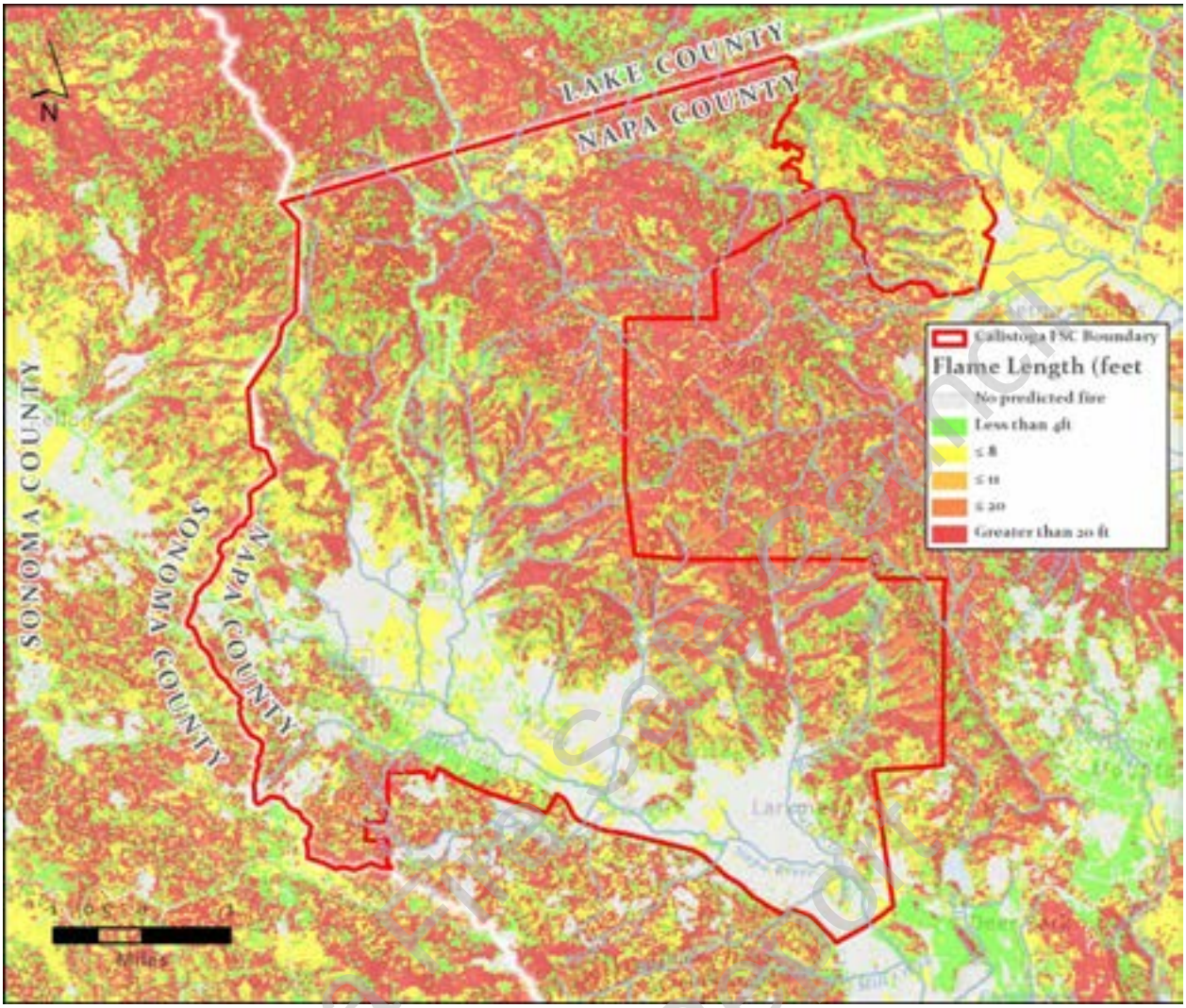


Figure 22. Predicted flame length (feet) map (based on LANDFIRE landscape version 2.0 with a Northeast wind at 15mph with low fuel moistures). Calistoga FSC Community neighborhood boundary (shown in red).

Flame lengths over 20 feet account for 32% of the predicted fire behavior. This occurs throughout the Calistoga FSC boundary but is most pronounced to the north and east and on the south-facing southern portion of the area and on steep western (but east facing) slopes along the county boundary. These areas are dominated by Coniferous forest, Oak woodland, and Shrublands, and a mix of these vegetation types.

However, close to 50% of the area is expected to experience flame lengths less than 4 feet in length (27%) or no predicted fire (22% – accounts for agriculture and developed areas that may indeed burn).

Predicted Flame Length	Acres	Percent
No predicted fire	7,000.07	22%
Less than 4 feet	8,511.02	27%
4 - 8 feet	1,769.59	6%
8 - 11 feet	719.89	2%
11 - 20 feet	3,726.88	12%
Greater than 20 feet	10,113.37	32%

Table 4. Predicted flame length by category and area (in acres) within Calistoga 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. 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.

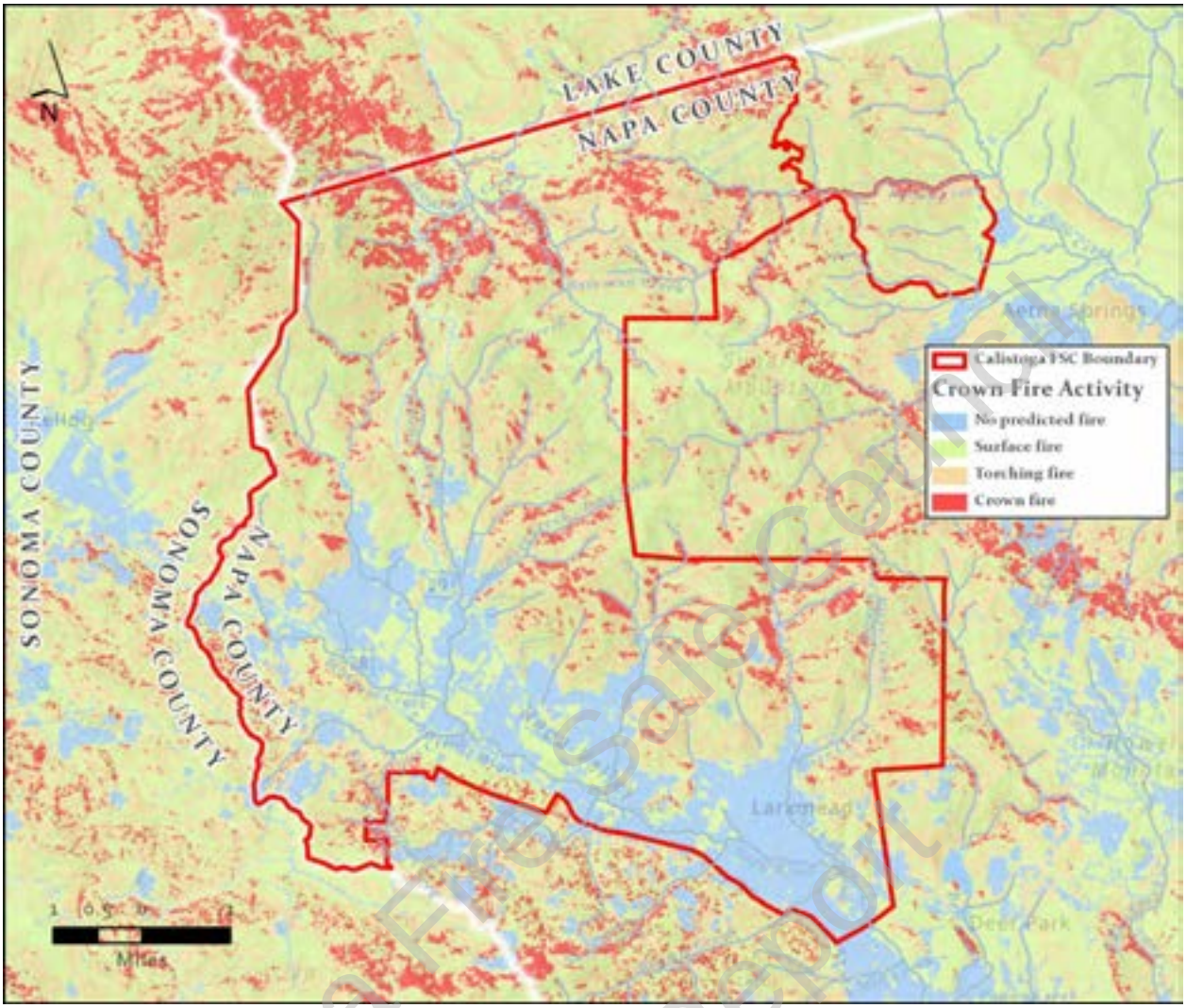


Figure 23. Predicted crown fire activity map (based on LANDFIRE landscape version 2.0 with a Northeast wind at 15mph with low fuel moistures). Calistoga FSC Community neighborhood boundary (shown in red).

Predicted Flame Length	Acres	Percent
No predicted fire	5,133.52	16%
Surface fire	13,379.67	42%
Torching fire	10,235.68	32%
Crown fire	3,091.94	10%

Table 5. Predicted flame length by category and area (in acres) within Calistoga 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 58% of the Calistoga FSC neighborhoods. These areas are scattered throughout but are most pronounced in the areas of vineyards and within the Oak Woodland vegetation type.

In the remaining areas, torching and crown fire are predicted. A relatively small area is 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. These areas are concentrated on the east- and south-facing steep slopes along the northern portion of the area between Mt Saint Helena and Sugarloaf Mountain. 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 FSC neighborhood.

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

G. Fire History

Large fires have visited the north and western portions of the Calistoga FSC numerous times in past. Mostly notably, in 1964, the 55,560-acre C. HANLEY fire burned through the northern section of the Calistoga FSC and in 2017 the 36,701-acre TUBBS fire burned down to the Petrified Forest Road and covered most of Robert Louis Stevenson St. Park. Other smaller fires have occurred in those same areas.

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.

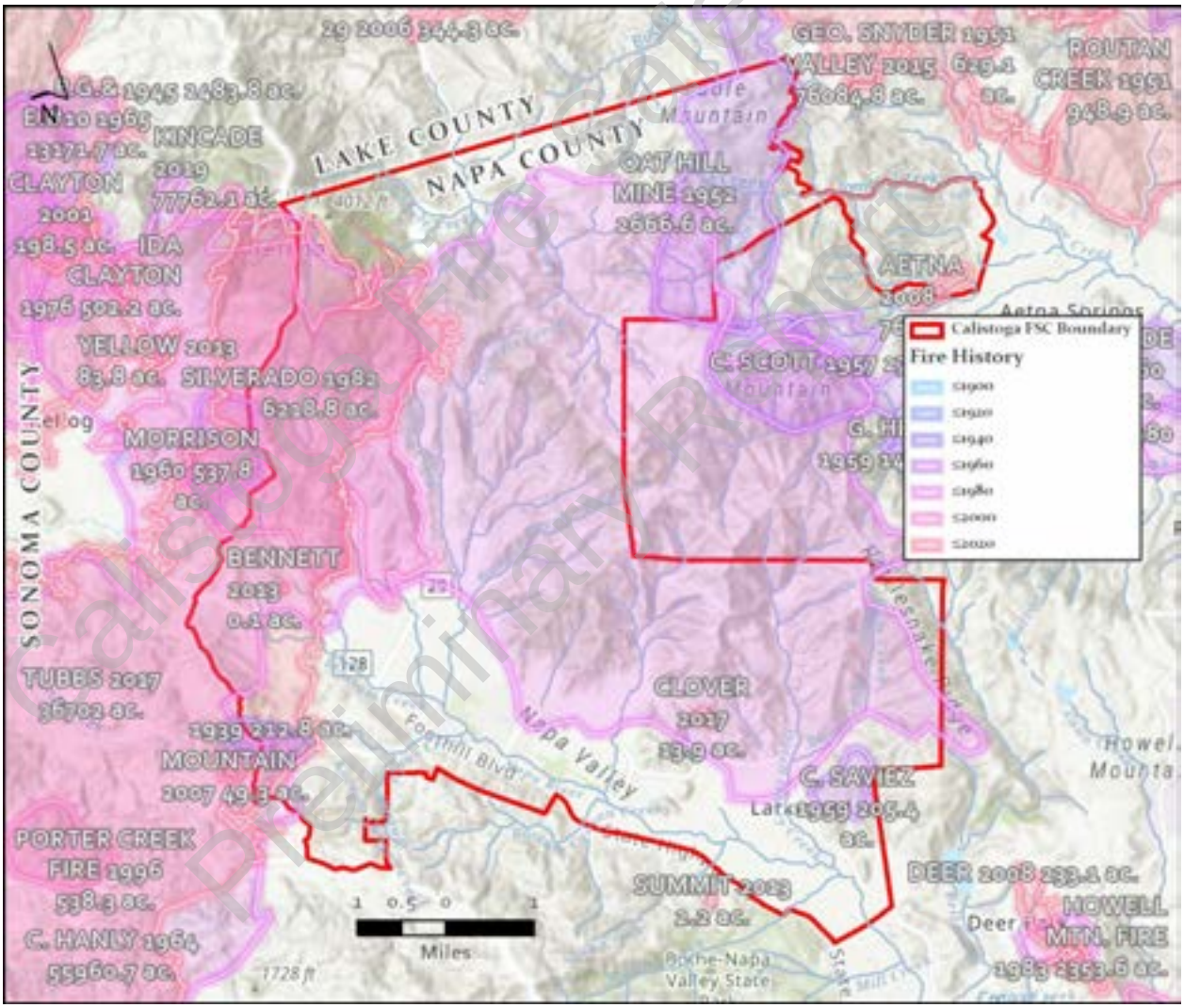


Figure 24. Fire perimeters/fire history map of Calistoga FSC (CALFIRE FRAP, 2020). Calistoga FSC Community neighborhood boundary shown in red.

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 burned over 70,000 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, AETNA, BENNETT, SUMMIT, CLOVER, and others.

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

Except for the valley floor, access to, from, and within the Calistoga FSC is generally a concern. All neighborhoods within the FSC are accessed by Highway 128 and Highway 29. A few other main roads provide access to the valley and western portion of the area. These roads include Petrified Forest Road, Franz Valley School Road, and Silverado Trail. All roads within the FSC lead down to Highway 128, the Silverado Trail, or Highway 29. Thus, congestion on these two-lane roads is expected to be significant during an evacuation.

In addition, while roads are flat and wide in the City, the Napa River blocks east-west travel. Only five streets cross the Napa River: Lincoln, Berry, Tubbs, Dunaweal, and Larkmead.

Figure 25. Access and terrain of Calistoga FSC Community neighborhood (shown with dashed black line).

Bridges are common in this FSC and could be a limitation to fire response due to narrowness and possible failure with loads of the fire trucks.

Figure 26. Unrated bridges and locked gates limit emergency response.

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 (with the exception of the top of Old Lawley Toll Road). Some curves are simultaneously sharp and steep.

Driveways in all neighborhoods outside the City 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.

In a few instances many residents or visitors must leave with poor access. This is the case with the mobile home parks and resorts such as Solage and Calistoga Ranch.

Figure 27. Gated entrances are common.

Figure 28. Width, steepness and roadbed quality are all concerns on Old Lawley Toll Road.

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.

Figure 29. Hazard trees with low branches along Lommel Road.

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.

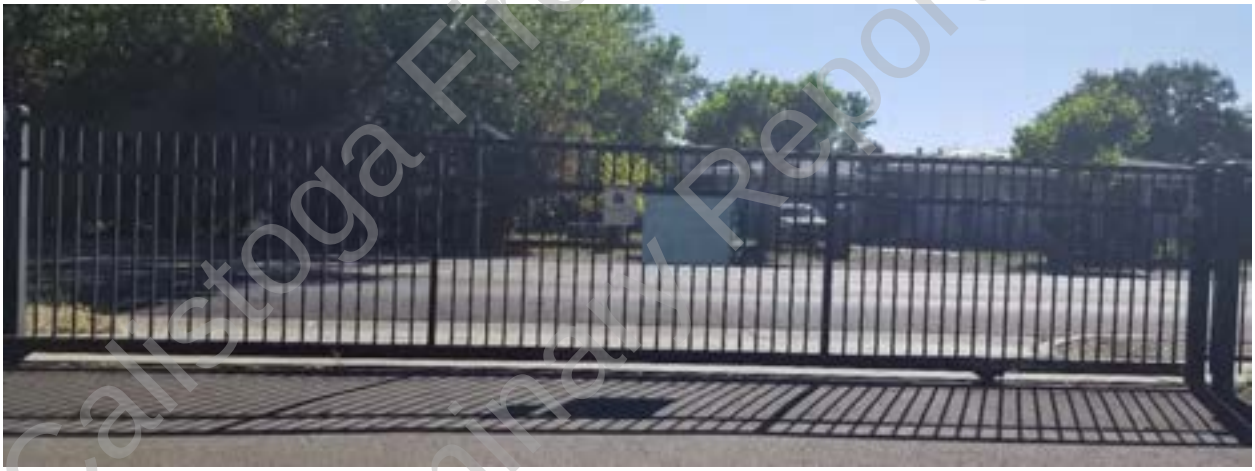


Figure 30. Emergency Access for Solage.

On the valley floor, roads are flat and wide enough for commercial vehicles, and present no fire response issues.

Figure 31. Roads on valley floor do not present a constraint for fire response.

Road Name	Number of Address Points on Road	Percent of Addresses within FSC Boundary*
Silverado Trl	94	12%
State Highway 128	92	12%
State Highway 29	87	11%
Lake County Hwy	72	9%
Old Lawley Toll Rd	45	6%
Foothill Blvd	31	4%
Tubbs Ln	31	4%
Franz Valley School Rd	29	4%
Petrified Forest Rd	29	4%
Bennett Ln	21	3%
Pickett Rd	21	3%
N St Helena Hwy	19	2%
Bale Ln	18	2%
Greenwood Ave	18	2%
Myrtledale Rd	16	2%
Dutch Henry Canyon Rd	14	2%
Dunaweal Ln	13	2%
Lommel Rd	12	2%
Firview Dr	10	1%
Rosedale Rd	10	1%
Aetna Springs Rd	9	1%
Maple Ln	9	1%
Palisades Rd	7	1%
Bentley Dr	6	1%
Franz Valley Rd	6	1%
Larkmead Ln	6	1%
N Silverado Trl	6	1%
Shaw-Williams Rd	6	1%
Aetna Springs Ln	4	1%
Evey Rd	4	1%

St Helena Hwy	4	1%
Kortum Canyon Rd	3	0.4%
Big Tree Rd	2	0.3%
Clover Flat Rd	2	0.3%
North Fork Bennett Ln	2	0.3%
Calistoga Ranch Campground	1	0.1%
Lommel Road Ext	1	0.1%
Oat Hill Rd	1	0.1%
Total Outside City of Calistoga	761	
Total Inside City of Calistoga	2,155	
Grand Total	2,916	

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

I. Hazard Ranking

Most of the Calistoga FSC is within CAL FIRE's State Responsibility Area (SRA). 26% of the area is Local Responsibility Area (LRA), Federal Responsibility Area (FRA), or otherwise not mapped by CAL FIRE. In general, throughout the state, both LRA and FRA were not given a hazard rating; however, a small portion of LRA that runs along the southwestern portion of the City of Calistoga was classified as Very High Fire Hazard Severity Zone (369 acres).

For the other portions of the Calistoga FSC where CAL FIRE did determine a fire hazard assessment, they show 67% of the Calistoga FSC neighbor is categorized as a **Very High Fire Hazard Severity Zone**. Sections along the valley floor were categorized as High and Moderate.

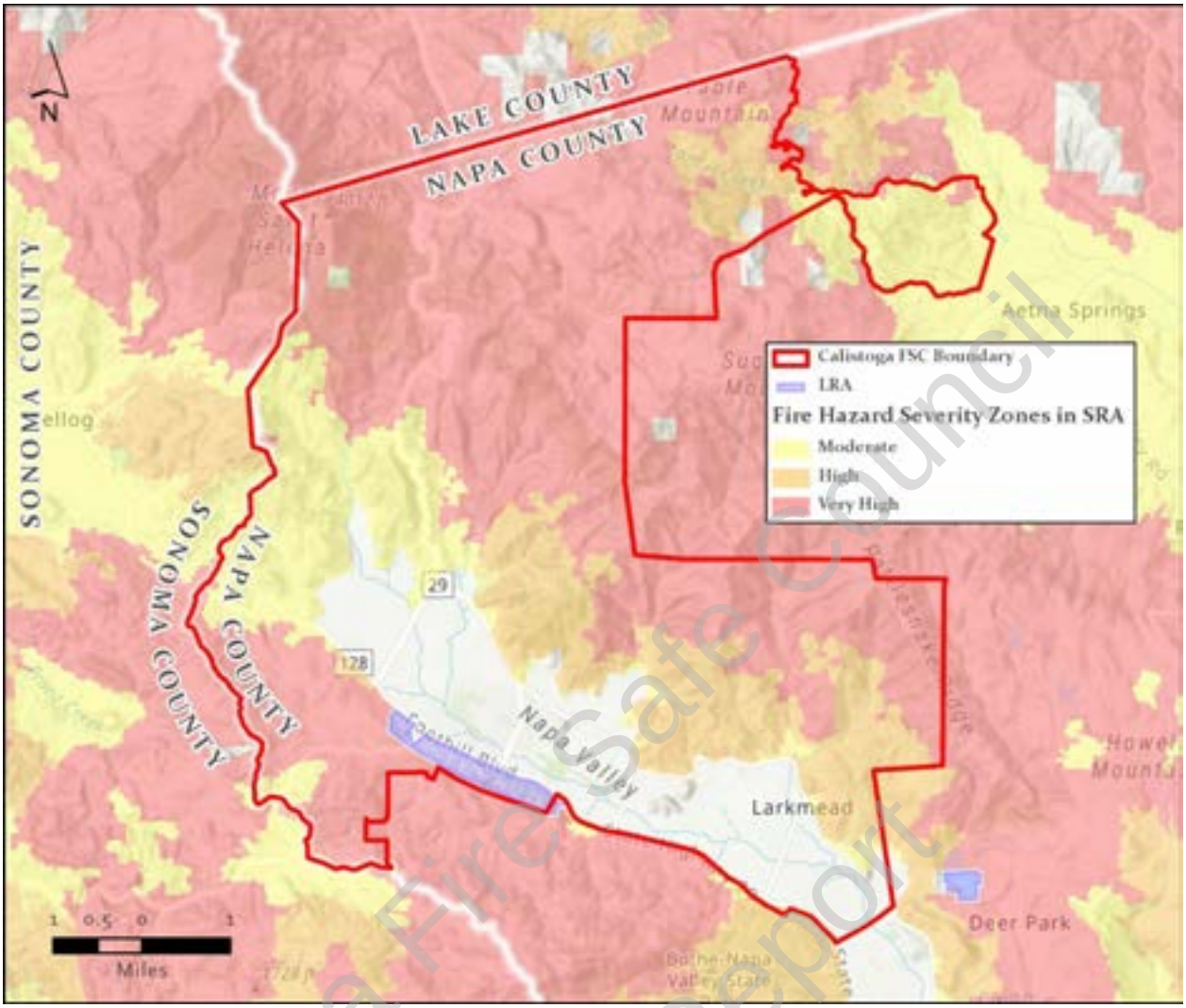


Figure 32. Distribution of Fire Hazard Severity Zones (CALFIRE, 2007). Calistoga FSC Community neighborhood shown in red.

Fire Hazard Severity Zone (CAL FIRE)	Acres	Percent
Moderate	4,918.68	17%
High	4,800.86	16%
Very High	19,729.18	67%

Table 7. Fire hazard severity zone by area (acres) within Calistoga 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.

The City of Calistoga has a greater density of homes than anywhere else within the FSC.

The majority of the Calistoga FSC is comprised of land designated as Vacant. These parcels account for approximately 57% of the area.

Vineyards/Wineries (approximately 21%) account for most of the other areas within the Calistoga FSC. These lands are adjacent to Vacant and Residential lands. Undeveloped wildlands account for a significant portion of the Calistoga FSC. Once 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 use 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 16% of the Calistoga FSC and are concentrated within the City of Calistoga and along roads. 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 feet of the neighboring parcel.

Category	Parcel Count	Total Area (acres)	Percent
VACANT	461	20,098.06	57.3%
VINEYARD/WINERY	285	7,431.72	21.2%
RESIDENTIAL	1,663	5,759.69	16.4%
OTHER	23	1,259.56	3.6%
COMMERCIAL	167	454.92	1.3%
INDUSTRIAL	9	48.05	0.1%

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

Figure 33. Sharp interface between urban area and wildland.

Figure 34. High density land use pattern.

Figure 35. Land use that could result in house-to-house fire spread in a wildfire.

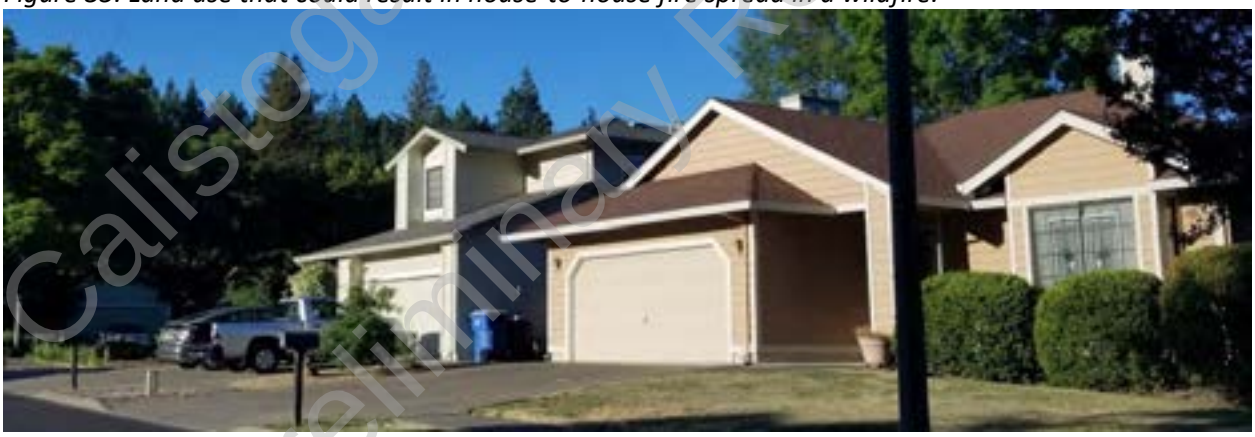
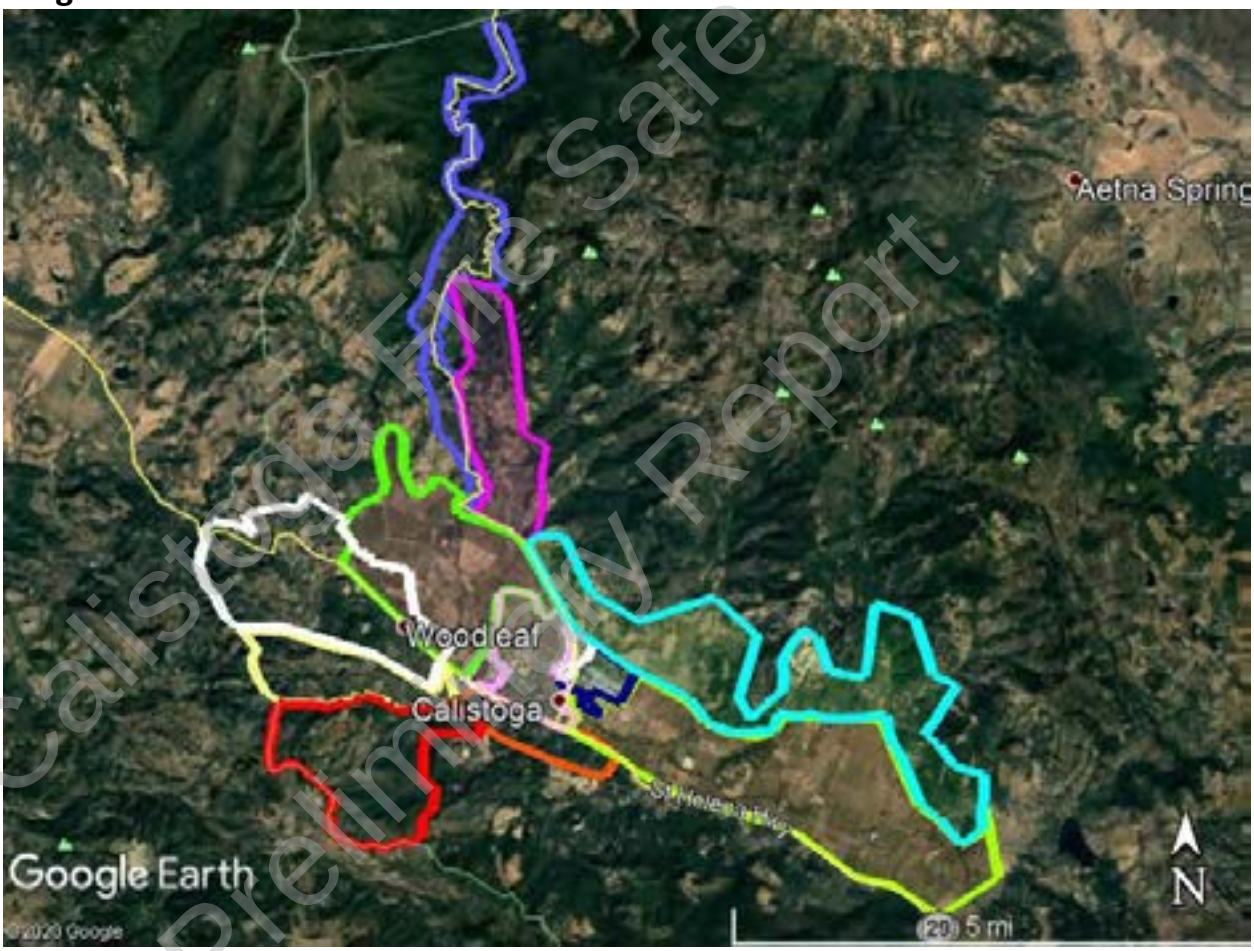


Figure 36. Development using ignition-resistant construction.

Figure 37. Scale of "urban" part of "wildland-urban interface".

K. Neighborhood Assessment



There are eleven neighborhoods identified in this risk assessment. Of these nine were assessed in detail, with one (South Calistoga) to be described later because it has low structure density with relatively low risk from wildfire.

Aerial imagery was reviewed to determine similarities in land use development pattern (density, clustering, land use), terrain, access, vegetation type and density. Borders were roughed in, generally

following roads and canyons as they tend to facilitate communication within the neighborhood. Each area was visited, and where possible, neighbors were visited.

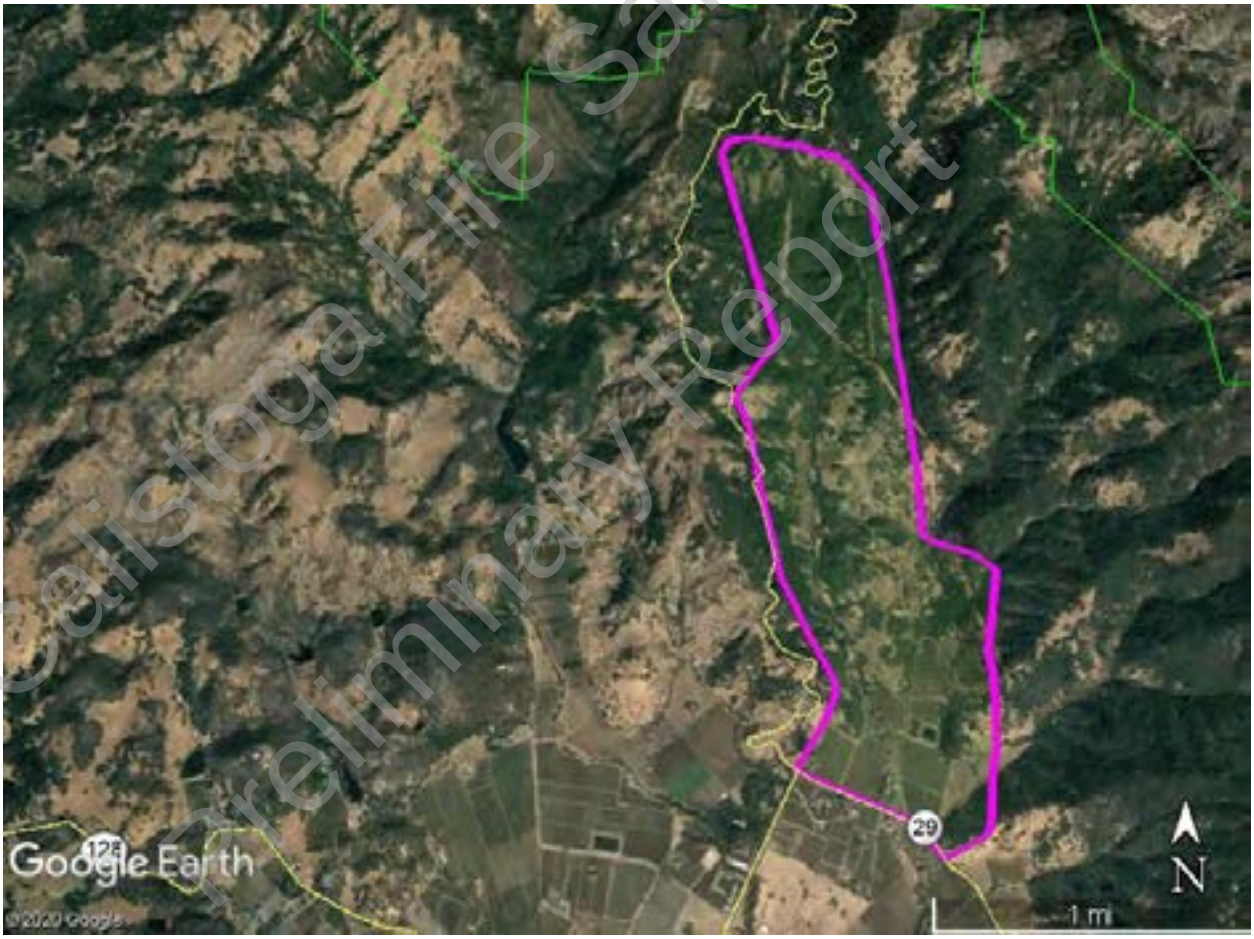
In each neighborhood the following topics are described, all as it relates to fire safety:

- Pattern of Development
- Access
- Terrain
- Defensible space and structure construction
- Adjacent fuels
- Unusual wind conditions
- Likely ignition sources
- Possible projects

Not every possible project is listed for each neighborhood, so all readers should refer to the list of projects that follows, as many projects should be implemented in many neighborhoods.

Old Lawley Toll Rd. (OLTR)

This neighborhood extends from the Highway 29 just south of Palisade Road up to where the OLTR intersects with Highway 29.



<u>Pattern of Development and how it relates to fire safety</u>: Larger parcels, of, are the rule with mostly residential land use. Each parcel is large enough to influence fire behavior around the structure. However, there are two wineries and two vineyards in the neighborhood. Vineyards will serve as a fuelbreak in most cases, unless the area is not tilled due to slope steepness. In that case, fire spread

can be rapid, but fire intensity would be low. Generally, vegetation in large residential parcels are not managed except for areas immediately surrounding the structure. This allows fuels to accumulate and promote fire spread and intensity.

Vineyards at the base of the neighborhood span Old Lawley Toll Rd and Palisades Road, create a break in wildland vegetation between the sides of the canyon and the main access below (Silverado Trail).

Access: Old Lawley Toll Road is a through road, connecting Lake County Highway and Silverado Trail. Few spurs exist.

Driveways are typically moderate in length (shorter than 500 feet); most have gates which could delay fire response. Bridges (some unrated) are present on parcels near the valley floor, which could also limit fire response.

The road along the upper reaches of OLTR narrows to slightly more than one lane, with a rough paved roadbed. The grade is significantly steep and constantly rising, and curves are sharp. All these limit/slow fire response from all but brush rigs.

Palisades Rd is relatively flat and leads to a long driveway.

Residential driveways throughout this neighborhood vary in length, width, steepness. Most are moderately long; almost all have gates, which could delay response slightly.

Because there is only one main through road, this is a concern for evacuation; traffic going up and down the road would compete with emergency response vehicles.

There are multiple exit routes should evacuation be necessary; however, they all feed into two highways, where congestion can be anticipated.

Terrain: Jericho Canyon is a significant canyon. It is oriented north-south and extends for several miles. Other canyons include the unnamed canyon that drains Garnett Creek and Hoisting Works Canyon.

Jericho Canyon and the canyon that drains Garnett Creek have moderately steep slopes, whereas the Hoisting Works Canyon and slopes to the south are extremely steep, as indicated by the name Palisades Rd.

Defensible Space Conditions: Most homes have adequate defensible space, as landowners were likely motivated by the nearby 2017 Tubbs Fire. Approximately half are newer homes, built with construction practices that prevent ignitions, and half are older, building without those protective sidings, vents, and windowpanes.

Adjacent Fuels: Vegetation in the wildland of this neighborhood varies by elevation and aspect. The east-facing slope supports Douglas fir forests, whereas higher up the road and on south and west facing slopes throughout the neighborhood oak forests are the rule. The abundance of understory shrubs and small trees also varies. The east-facing slopes are more commonly filled with small Douglas fir trees. Many of the oak forests are free of understory shrubs, possibly due to historic grazing, whereas some locations are filled with these types of 'ladder fuels' and promote fire spread upward to the tree canopy. In particular, one ranch east of OLTR near the top has a recent growth of abundant French broom.

Unusual Wind Conditions; Cause; Likely Spread: The rise and fall of terrain results in daily wind flows up and down the drainage, due to the heating and cooling of different parts of the slopes. Significantly, wind flows above the neighborhood from the west, through a topographic gap, and then down Jericho Canyon on a routine basis.

Ignitions from vehicles on Lake County Highway caused a fire in 1990; several fires from Highway 29 have spread into the neighborhood. Similarly, when accidents occur on Highway 29, OLTR is used as an alternative route; this is a potential ignition source as travelers unfamiliar with this road could cause an accident themselves that could result in a wildfire.

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 that indicate access and water supply.

Treatment of roadside vegetation should be prioritized. This would include removal of hazardous trees and tree branches that could block emergency access and egress. This is particularly important for OLTR, as it serves a large number of structures and residents.

The installation of neighborhood knox boxes at the base of the roads is recommended. This type of knox box contains information for fire responders about the water sources, access and number of structures present within that one-way-in road.

Contingency containment lines that were created in 2017 further up the road should be cleaned up and maintained in advance of the next wildfire. Cut brush that remains should be removed, and landowners engaged to possibly expand this area into a shaded fuelbreak where feasible.

Lake County Highway (Highway 29)

This neighborhood runs along Highway 29 from the start of Old Lawley Toll Road (OLTR) to the Lake County border. This neighborhood has many characteristics of the OLTR, but is a separate neighborhood because the community is likely to be a separate set of individuals.

Pattern of Development and how it relates to fire safety: A few large parcels dominate the land area in the community: The Robert Louis Stevenson State Park and the Montesol Ranch, now owned by Napa Land Trust. Many landowners have 40+ acres, while others have acreage less than 5 acres. Smaller parcels tend to be located adjacent to the highway. Each parcel is large enough to influence fire behavior around the structure.

The four land uses are recreational (for the State Park and Land Trust), residential, one vineyard, and a CalTrans maintenance yard. Recreational use in itself does not result in ignitions, however, the parking lot is a possible location of fire starts due to possible vehicular malfunction. The one vineyard on a major ridgeline can serve and has served as a fuelbreak. Generally, vegetation in large residential parcels are not managed except for areas immediately surrounding the structure. This allows fuels to accumulate and promote fire spread and intensity. The CalTrans yard offers another type of ignition potential if grinding is done on-site.

Vineyards at the base of the neighborhood span Old Lawley Toll Rd and Palisades Road, create a break in wildland vegetation between the sides of the canyon and the main access below (Silverado Trail).

Access: The Lake County Highway is obviously a through road that can accommodate emergency vehicles. Few spurs exist, and each is fairly narrow, windy, and steep.

Most of the residents are served by short driveways off the highway; all are gated, which could cause momentary delays in fire response. A few parcels have structures with long shared driveways, but that is not the norm. One long road (Livermore Road) connects Aetna Springs with Highway 29, but is not a suitable alternative access route.

Because there is only one main through road, this is a concern for evacuation; the high volume of traffic going up and down the road could result in an accident that would block access and egress for both emergency response vehicles and evacuees.

Terrain: This neighborhood follows the highway route as it climbs up on the east side of a sharp-spined ridgetop that runs north-south. Side slopes are extremely steep, limiting management options, and fostering fast fire growth. There is a topographic gap that funnels winds from the west into this neighborhood and the OLTR neighborhood.

Further north, the terrain becomes more complicated with significant side canyons that can cause erratic winds.

Defensible Space Conditions: Most homes have adequate defensible space, as landowners were likely motivated by the nearby 2017 Tubbs Fire. Most of the homes are older buildings of wood construction, without protective sidings, vents, and windowpanes.

In 2015-2016 CAL FIRE treated the roadside for approximately 30-feet on both sides of the road; this was instrumental in the containment of the 2017 Tubbs fire. Currently, this area has re-grown and supports a thick understory of French broom and other sprouting species.

Adjacent Fuels: Vegetation in the wildland of this neighborhood varies by elevation and aspect. The east-facing slope supports Douglas fir forests, whereas higher up the road and on south and west facing slopes throughout the neighborhood dense oak forests are the rule. The abundance of understory shrubs and small trees also varies. The east-facing slopes are more commonly filled with small Douglas fir trees. Many of the oak forests are free of understory shrubs, possibly due to historic grazing, whereas some locations are filled with these types of 'ladder fuels' and promote fire spread upward to the tree canopy.

The one vineyard is a benign adjacent fuel that can ameliorate fire spread.

Unusual Wind Conditions; Cause; Likely Spread: The rise and fall of terrain results in daily wind flows up and down the drainage, due to the heating and cooling of different parts of the slopes. Significantly, wind flows from the west, through a topographic gap, and then down Jericho Canyon on a routine basis.

Ignitions from vehicles on Lake County Highway caused a fire in 1990; several fires from Highway 29 have spread into adjacent neighborhoods.

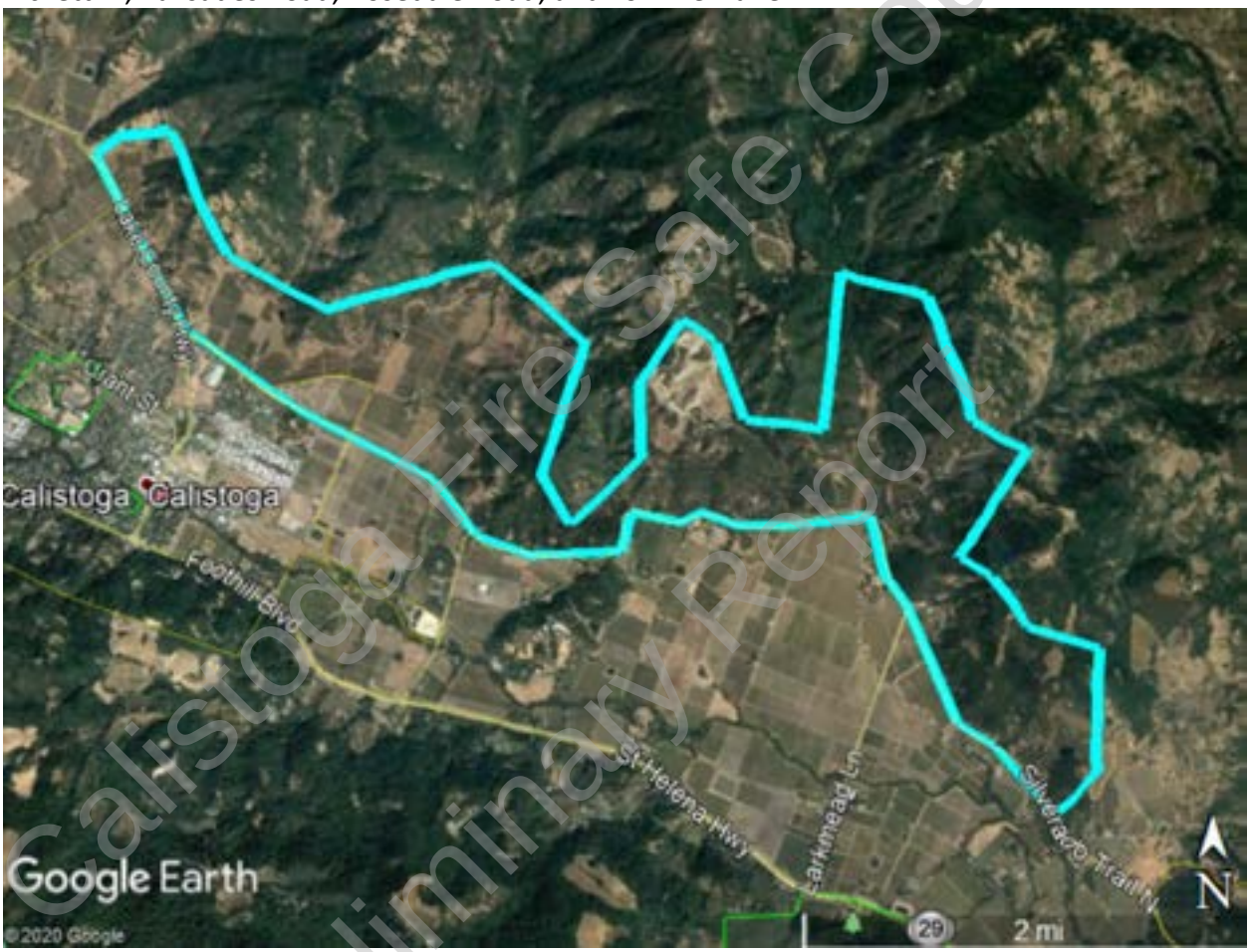
Possible Projects for Napa FireWise: Treatment of roadside vegetation should be prioritized. This would include removal of hazardous trees and tree branches that could block emergency access and egress. This is particularly important for Lake County Highway because it is a major thoroughfare, because there is a history of roadside ignitions, and because this road can serve once again as a containment line for a future wildfire. This roadside treatment could also extend to the perimeter of roadside trailheads at Robert Louse Stevenson State Park.

The installation of a neighborhood knox boxes at the base of the few roads that serve multiple residences is recommended. This type of knox box contains information for fire responders about the water sources, access and number of structures present within that one-way in road.

Contingency containment lines that were created in 2017 further up the road should be cleaned up and maintained in advance of the next wildfire. Cut brush that remains should be removed, and landowners engaged to possibly expand this area into a shaded fuelbreak where feasible. This project would not include the RLS St Park.

East Calistoga

This neighborhood covers the area with a mix of residences, vineyards, wineries and wildlands east of the Silverado Trail, from the eastern end of Lincoln to the Deer Park FSC boundary, and includes Pickett R., Palisades Road, Rosedale Road, and Lommel Lane.



Pattern of Development and how it relates to fire safety: Parcel size is almost uniformly large. Some of the largest parcels in the FSC are located in this neighborhood, and all are associated with vineyards, including Araujo Estates Winery (Pickett Rd), Carver Sutro Winery (Palisades Rd), and Kelly Fleming Wines (Pickett Rd).

Not surprisingly, much of the land is categorized as vineyards, but residences are sometimes associated with those vineyards, generally isolated within a vineyard (and presenting no hazard or risk), but also sometimes on the fringe of the vineyard, at the interface of wildlands. In this case, defensible space is especially important.

The number of structures in this neighborhood is small, with two important clusters: the new development on Rosedale Rd., and the Calistoga Ranch.

A few of the canyons have creeks that limit access if bridges are not rated for emergency vehicle response crossing.

Access: Because most of the length of roads are along the valley floor, roads do not limit fire response, however some roads hug the toe of the canyon slope, and roadsides are heavily vegetated, which could preclude safe passage of emergency vehicles. Similarly, a few roads have overhanging tree branches (or hazard trees) that could block access and egress. While the grade is flat, and straight, the street width is not sufficient for simultaneous entry of emergency response and evacuation.

Residential driveways can be quite long, but often traverse vineyards do pose not hazard.

In the Calistoga Ranch, access within the dense development is limited to a few spine roads. Most of the structures are accessed via golf carts as the road is only one lane wide.

All roads in the East Calistoga Neighborhood are one-way in and one-way out, leading to the Silverado Trail. In times of evacuation, the Silverado Trail can be expected to be congested.

Terrain: The valley floor rises to the high ridges in the east in a series of steep-sided canyons where strong winds are funneled during northeast wind events. Each of these canyons has a delta-like floor that is almost flat. Most of the acreage in this neighborhood is on the valley floor, and thus poses no challenge for fire safety.

Few roads extend up the canyon slopes, with the exception of Dutch Henry Canyon. Similarly, few residences are located on the slopes, except for the end of Pickett Rd, and Dutch Henry Canyon.

Defensible Space Conditions: Residences generally have fine defensible space. Older homes built before ignition-resistant construction was required are more vulnerable to ignition, however homes in this neighborhood are generally located in vineyards, so are less likely to ignite from flames. Single family residences built high on the slopes in this neighborhood tend to be newer and built with ignition resistant construction.

The new structures on Rosedale Rd are built under current codes with ignition-resistant construction, whereas the structures at Calistoga Ranch have wood shake siding and lattice screening, both prone to ignition. The landscaping in the Rosedale Rd development is fire-resistant, and low fuel volume. The landscaping in Calistoga Ranch is managed but has abundant volume.

The canyons that have creeks flowing through them present corridors of high fuel volume because regulations limit fuel management. Luckily, fuel moisture of the actual riparian vegetation is typically high, and therefore it burns with low intensity.

Adjacent Fuels: Adjacent fuels are important to consider in this area as a means of fire contagion and spread, because while most of the values at risk have managed fuels, the west-facing slopes are covered with high volumes of vegetation certain to burn with intensity. These vegetative fuels consist of chaparral, oak forests with shrubby understory, and small pockets of conifers.

During a northeast wind event, these fuels will serve as a contagion to the structures at the edge of the wildlands, and the long flame lengths at these locations would most likely easily ignite structures. Those structures surrounded by vineyards, and those in the middle of valley floor are insulated from the effect of these fuels (except through ember distribution).

Unusual Wind Conditions; Cause; Likely Spread: Because of the steep slopes and high ridges above, winds flow up and down the valleys every day. In addition, winds are funneled down the canyons during a northeast wind event.

Roadside ignitions on the Silverado Trail are a constant possibility; with a westerly wind, fires caused by roadside ignitions could blow to the heavily vegetated slopes nearest the road, which could burn fast and intensely. Wherever vineyards abut the road, spread is minimized.

Possible Projects for Napa FireWise: Treatment of roadside vegetation should be prioritized for those roads that are not in the middle of vineyards. This would include removal of hazardous trees and tree branches that could block emergency access and egress. This is particularly important for Lommel Rd., as it serves a large number of structures and visitors.

The installation of neighborhood knox boxes at the base of the roads is recommended. This type of knox box contains information for fire responders about the water sources, access, and number of structures present within that one-way-in road.

West Calistoga

West Calistoga neighborhood is comprised of lands west of Highway 128 that are within the City limits. It extends from a few hundred feet north of Petrified Forest Road to below the mouth of Kortum Canyon.

Pattern of Development and how it relates to fire safety: This neighborhood is among the most hazardous and is designated as a Very High Fire Hazard Severity Zone by Calistoga Fire Department.

There is a mix of residential and commercial (cottages, B+B) and a cemetery, with other commercial businesses such as a BBQ and small market on the south, and a gas station and small markets to the north. As described below, some of the commercial properties can pose a slightly higher risk of ignition, however these are also typically properties that are well maintained.

Lot size is generally ¼ acre or less, with few exceptions in newer developed parcels, and a large cemetery.

Access: This neighborhood is at the base of long roads such as Kortum Canyon, Lerner Rd., and lead off a main highway. All roads are one-way in and out.

The grade of the road varies, with some steep roadways gaining elevation quickly off Highway 128, and others following a gentle incline in a valley to the west. In some locations the grade of roads is at the limit for fire response.

Roads are narrow, barely two-lanes, and in some cases, such as High Street, lead to more roads not obvious from Highway 128. Most driveways are short, with a few exceptions of parcels with long driveways and gates

During an evacuation event Highway 128 can be expected to be congested.

Terrain: The terrain in West Calistoga can be described as moderately steep, rising consistently to the west.

One small valley (Calistoga Cottages) is located within the neighborhood. The terrain has influenced roadway routes and grade; the steep terrain causes roads to also be steep, and often narrow and curvy.

Defensible Space Conditions: For the most part, there is compliance with defensible space standards, and in some locations (the north side of Lerner Rd.), there is a shaded fuelbreak. Other locations, such as those properties surrounding the City Cemetery require significant treatments to achieve defensible space.

Adjacent Fuels: Vegetation beyond 100 feet from structures to the west is a serious concern. The large parcel to the west is comprised of Douglas fir forests with thick understory of young conifers and shrubs with some vineyards directly abutting the neighborhood.

The current volume of shrubby fuel in the cemetery creates a hazard for surrounding neighbors. The shrubs are generally French broom, likely grown since the previous fuels management treatment conducted by the City.

Unusual Wind Conditions; Cause; Likely Spread: One concern specific to this neighborhood is for fire spreading downhill to cross the highway. Another concern for a roadside ignition (or an ignition associated with commercial enterprise such as the BBQ) could spread uphill. This could be a problem with low wind speeds but could especially be problematic with a northeasterly wind. Fortunately, the fuels to the east of Highway 128 are managed and not of a significant concern. Plus, the east-facing slope shelters site from westerly winds, which reduces the chance of fire spreading downhill.

Visitors are possible causes of ignition, often from unwise use of yards (outdoor fireplaces, smoking and BBQs). A few commercial businesses (BBQs) involve active fire and present a remote chance of ignition.

Possible Projects for Napa FireWise: Work with the City to create a funding source to cut French broom and otherwise remove understory fuels (small trees and shrubs). Goat grazing or hand labor are preferred methods of treatment.

Distribute and otherwise educate residents of importance of and methods for creating defensible space.

Work with commercial land uses (particularly those in hospitality /hosting businesses) to prepare ignition prevention material for guests and visitors. For example, outdoor fireplaces should be removed/decommissioned during fire season, and all BBQs should be gas (no charcoal BBQs, because disposal of hot coals is a common cause of fires in vacation rentals).

Signage is especially important on the western side because of the large number of structures and unusual configuration of roads/shared driveways.

Downtown Calistoga

This neighborhood spans the area between Highway 128 and 29, and from vineyards on the north and south of City limits.

Pattern of Development and how it relates to fire safety: Standard grid pattern with parcel sizes of one eights of an acre, where house-to-house fire propagation is a possibility during a wildfire.

Commercial development near Lincoln Ave., and government-owned civic facilities (ball field, track, fairgrounds, schools) cover a significant portion of the center of the neighborhood. This creates large areas of low fuel.

Access: Three bridges cross Napa River, limiting access. Otherwise there is no constraint to emergency access as the streets are broad, flat, and in a grid pattern.

Residential driveways are at a minimum. However, some driveways serve multiple residents in a confined space; in these circumstances, access is limited.

There are multiple exit routes should evacuation be necessary; however,, they all feed into two highways, where congestion can be anticipated.

Terrain: The terrain is nearly to completely flat.

Defensible Space Conditions: Most yards have defensible space; however, vegetation is used for privacy, creating a continuous fuelbed from house to house. The mature arbor over roads driveways and houses do not cause a risk of canopy fire spread due to the fact they are all pruned of lower branches. The commercial and government parcels in the center of town have defensible space and low fuel conditions created by parks, and parking lots.

Adjacent Fuels: The downtown area is surrounded by vineyards and open fields. The most heavily vegetated area is to the west of Highway 128.

Unusual Wind Conditions; Cause; Likely Spread: There are no unusual wind conditions in the Downtown area. High levels of human activity would present multiple ignition possibilities, most likely being a structure fire that would catch nearby vegetation; a wildfire is not likely to originate in this neighborhood.

Possible Projects for Napa FireWise: This area is well served by Calistoga Fire Department, with few wildland vegetation issues. No projects are currently identified for this neighborhood.

Dense Calistoga

While most of residential parcels in Downtown Calistoga are smaller than one-quarter acre, a large portion of the land base and population live in very high density developments. This neighborhood includes two distinct locations: one in the northern portion of the city just at the intersection of Petrified Forest Road and Highway 128, and the other is on the south side of the City, south of Lincoln near the Silverado Trail. The neighborhood includes mobile home parks and resorts with small cottages.

Pattern of Development and how it relates to fire safety: In the mobile home parks in this neighborhood all residences are on one parcel; every structure is within 20 feet of the next, and in most cases the separation is less. Should a structure ignite, the heat of the fire is likely to ignite the next one; house-to-house fire contagion is a concern.

Additionally, two of the mobile home parks abut creeks, which limit the type and extent of work that can be done to protect the vulnerable structures. Some of these facilities have central parks.

Access: All these facilities have one way in and one way out. Road design (width, grade, curvature, surface), are all adequate for fire response. However, the number of vehicles that will need to evacuate using the single entrance is a concern. Parking is all off street, thereby freeing up lanes for emergency response.

Terrain: Terrain is not a factor in wildfire risk scenarios.

Defensible Space Conditions: All residents are in compliance with defensible space, however, vegetation is used as privacy screening, creating even greater continuity of fuels between structures, and facilitating loss of structures from a possible wildfire.

The road network itself provides a fuel-free location surrounding structures and could serve as a containment location, should house-to-house fire spread occur.

The structures themselves are vulnerable to ignition, and some residents use lattice and other small-diameter material (kindling) for screening. This compounds the ease of ignition.

Adjacent Fuels: Almost all of these facilities are adjacent to an open field, creekbed, or other heavy vegetated environments. All these offer fuels that can be ignited and can spread to the facility.

Unusual Wind Conditions; Cause; Likely Spread: No wind special patterns or topographic concerns are present.

Ignition causes are not different from the rest of the neighborhoods, but they are simply condensed in space. The chance of ignition from construction or grass mowing, for example, are probably lower in these facilities.

Possible Projects for Napa FireWise: The installation of neighborhood knox boxes at entry point is recommended. This type of knox box contains information for fire responders about the water sources, access and number of structures present within that one-way in road.

Because locating a structure within the facilities is sometimes problematic, clear addressing should be made a priority for this neighborhood.

These high-density facilities should work with adjacent landowners to ensure an effective defensible space present at the border. Where there is an open grassy field, a strip of very short grass should be installed every year prior to June 1. The heavy vegetation between Solage and Calistoga Springs should be treated to remove dead material, create separations between the ground surface and top of vegetation by pruning the bottom branches and/or shortening the stand of vegetation.

North West Calistoga

Pattern of development and how it relates to fire safety: This neighborhood comprises more than half of the structures in the Fire Safe Council, with a land use that is a mixture of residential parcels ranging from 1 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 northern 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, 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; it 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.

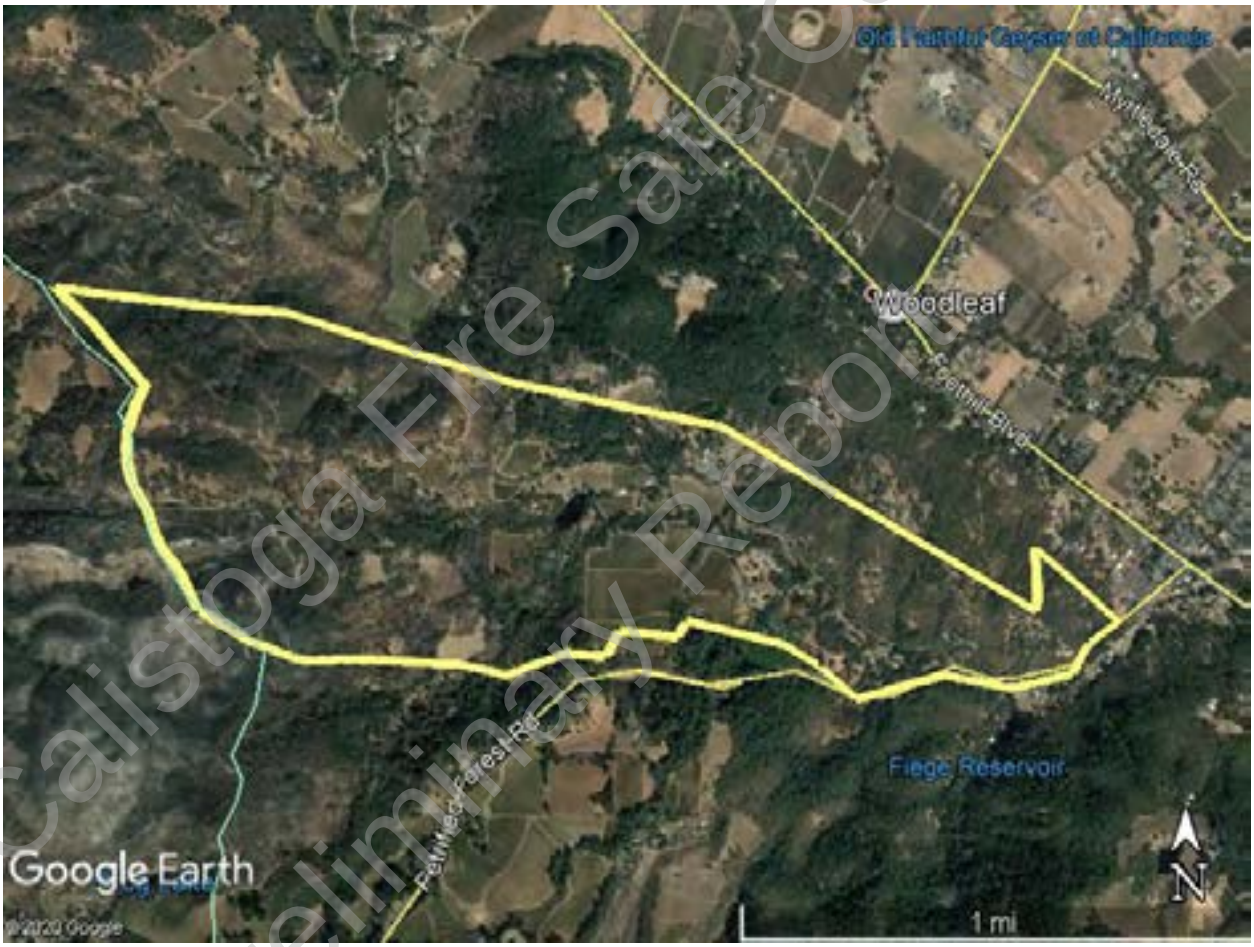
Defensible Space Conditions: Some residential yards are exemplary. Most residents are in compliance with fire safety regulations regarding defensible space.

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 and 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 that roadside vegetation is treated every year, and that signs are installed that aid locating streets and structures and that indicate access and water supply.

Franz Valley School Rd.



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 in 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 residentials 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 and 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 and embers traveling to the west during an east wind event.

Possible Projects for Napa FireWise: This neighborhood would benefit from ensuring that roadside vegetation is treated every year. Trees that are likely to block passage should be pruned or removed. Signs should be installed that aid locating streets and structures and that indicate access and water supply. Access would also be improved by widening areas for turnouts wherever possible.

Petrified Forest Rd.

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 1 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, with 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 also 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 and 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 likely funnel dry winds and 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 and structures and that indicate access and water supply.

North Calistoga

Pattern of Development and how it relates to fire safety: The land use and pattern of development in northern portion of Calistoga is a mixture of vineyards with sparse residential development interspersed, with lot sizes generally ranging from 1-40 acres. There are more residences south of Tubbs Lane. A few, commercial enterprises are located within this neighborhood, including the Old Faithful Geyer of California, and a rehabilitation center. The commercial uses pose no particularly elevated ignition risk.

Access: Access is good in this neighborhood, with Tubbs Lane spanning Highway 128 and 29, connections to downtown Calistoga via Myrtledale/Grant Road to the south and Bennet Lane to the north that leads to Highway 128. These roads are wide, and as with all roads in this neighborhood, nearly flat.

The only concern would be that during an evacuation event Highway 128 can be expected to be congested.

Terrain: The terrain in this neighborhood is uniformly nearly flat, and pose no particular hazard

Defensible Space Conditions: The vineyards are well maintained, and under everything but the worst circumstances can slow fire spread; many residential parcels have exemplary defensible space, however a few residential parcels are either vacant and untended, or in a state of disrepair. Structures are mostly built after 1985, when construction standards are more strict, and result in ignition-resistant buildings, however many residences are made of wood; nearly all have non-combustible roofs.

Adjacent Fuels: Vegetation in the vineyards, which comprise the majority of the land in this neighborhood generally poses low hazard. Wildland vegetation adjacent to the neighborhood to the north and northwest was consumed in the 2017 Tubbs fire and now has a large proportion of dead material, and flashy fuels.

Unusual wind conditions; Cause; Likely spread: While this neighborhood is the location of the ignition of the 2017 Tubbs Fire, there is no inherent elevated cause of ignition in this neighborhood. Winds in the flatter part of the valley will blow with the same intensity as the rest of the valley floor; no topographic feature concentrates winds, or blocks winds. While we know fire can spread in the neighborhood, fire intensity and rate of spread is normally moderated by vineyards and the low fuel volume present in this neighborhood.

Possible Projects for Napa FireWise: Work with commercial land uses (particularly those in hospitality /hosting businesses) to prepare ignition prevention material for guests and visitors. In the vineyards and wineries, fire-safe behavior can be taught to vineyard workers and staff in the wineries.

Signage is important throughout the neighborhood as some buildings are not visible from the street.

Distribute and otherwise educate residents of importance of and methods for creating defensible space.

South Calistoga