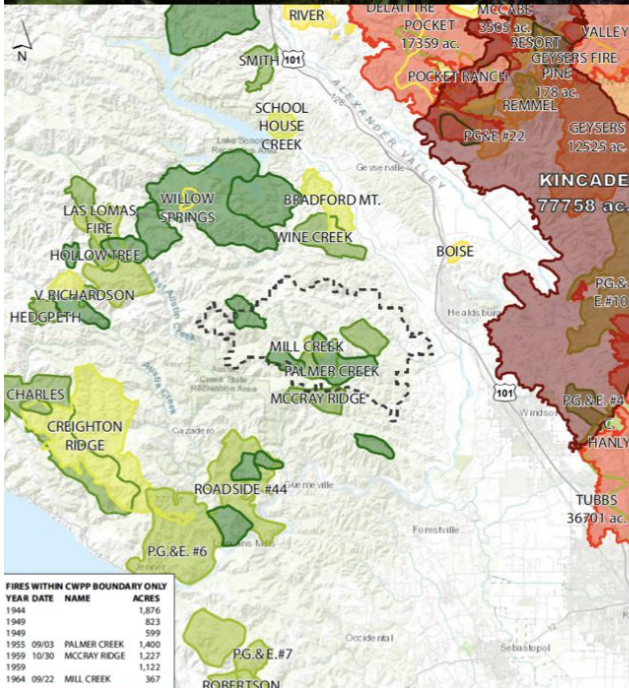


# Mill Creek Community Wildfire Protection Plan



*Final*  
*Sonoma County, California*  
*June 8, 2020*

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## Disclaimer

Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view(s) of any governmental agency, organization, corporation, or individual with which the authors may be affiliated.

This publication is designed to provide accurate and authoritative information in regard to the subject matter covered. This Community Wildfire Protection Plan (referred here as 'CWPP') is a work in progress. Various changes are anticipated throughout this plan over the next several years.

Readers are urged to consult with their own agencies on the topic of having jurisdiction regarding the use or implementation of this plan, as well as their own legal counsel on matters of concern.

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This CWPP is not to be construed as indicative of project "activity" as defined under the "Community Guide to the California Environmental Quality Act (CEQA), Chapter Three; Projects Subject to CEQA." Because this CWPP does not legally commit any public agency to a specific course of action or conduct, it is thus not a project subject to CEQA or National Environmental Policy Act (NEPA).

However, if and once grant funding is received from state or federal agencies and prior to work performed pursuant to the CWPP, or prior to issuance of discretionary permits or other entitlements by any public agencies to which CEQA or NEPA may apply, the lead agency must consider whether the proposed activity is a project under CEQA or NEPA. If the lead agency makes a determination that the proposed activity is a project subject to CEQA or NEPA, the lead agency must perform environmental review pursuant to CEQA or NEPA.



# *Executive Summary*

## **Purpose of the Plan**

The purpose of this Plan is to enhance protection of human life and reduce the wildfire threat to community assets such as homes, critical infrastructure, agriculture, businesses, as well as natural and historic resources within the Mill Creek Community Area.

## **Community Profile**

The *Mill Creek Community Wildfire Protection Plan (CWPP) area*, herein referred to as the “*Mill Creek Area*” is located in northern Sonoma County, approximately 70 miles north of San Francisco and one mile west of Healdsburg, California (**Fig. 1**). The area covers 19,688 acres formed primarily by the Mill Creek watershed (**Fig. 2**) plus a small amount of acreage outside the watershed. Mill Creek Road provides the only access to the Mill Creek Area. Mill Creek Road is a steep, narrow, winding, ten-mile dead end road that effectively functions as the only evacuation route for the entire community. Notifications in case of wildfires are hampered by lack of cell phone service in most of the area.

In contrast to the neighboring wine growing region of the Dry Creek Valley, there are few family-owned wineries and historic small-scale agricultural operations in the Mill Creek Area. Instead, the area comprises a picturesque, forested rural setting and private landholdings and residences, which are almost entirely (99%) privately owned, with more than 85% of them residing on land that is heavily forested with Douglas-fir, Coastal Redwood, Tanoak, Madrone and California Bay Laurel. The vast majority of the area consists of second- and third-growth forest as a result of extensive logging in the 1800s and 1900s.

## **Fire Issues**

A century of fire suppression with little forest management or harvesting has led to the Mill Creek Area exhibiting high density forests with many young, stressed trees and copious dead surface loading fuel. The last major fire in the Mill Creek area occurred over 60 years ago.

The past three years have seen large and damaging wildfires destroy large portions of Sonoma County as the area experiences more frequent drought conditions and a longer warm and dry season due to climate change. Three of the ten most destructive wildfires in California recorded history (Tubbs, Valley, Nuns) have occurred in Sonoma County in the past five years. These large, destructive fires are associated with an abundance of dry or cured vegetation, coupled with strong, dry winds. 86% of the Mill Creek CWPP area has been modeled as either a *High* or *Very High* Fire Hazard Severity Zone (see *Fire Hazard Severity Zones Map* in [Appendix C](#)).

## **Assets at Risk**

The Mill Creek Area encompasses 305 parcels with approximately 200 homes, a total of 780 structures and a population estimated between 460 and 510. A majority of the homes were built prior to the enactment of the 2007 wildland-urban interface (WUI) building codes, increasing their vulnerability to wildfire ignition. Other structures include the restored 137-year-old, one-room, historic Daniels Schoolhouse, the Venado Post Office (in operation from 1921 through 1941), as well as several small-scale vineyards and historic orchards.

The Mill Creek Area environmental assets include over 30 miles of high priority blue-line streams with some of the best breeding habitat for endangered coho and steelhead salmon in the Russian River watershed. The Mill Creek area has several stands of redwood and Douglas-fir forest, with old-growth redwood elements that support northern spotted owls. Several parcels have Sonoma Land Trust conservation easements to preserve and enhance this rare habitat type. The Mill Creek Area is immediately adjacent to the 6,000-acre Austin Creek

State Recreation Area and to the Armstrong Redwoods State Reserve, which preserves some of the oldest and best old-growth redwood forests in Sonoma County. Additional environmental assets include the unique floristic endemics of The Cedars serpentine area, which occur on parcels administered by the Bureau of Land Management that are arguably the most extraordinary natural resource occurrence in Sonoma County.

## **Risk Reduction Priorities**

A Wildfire Risk Assessment was completed for the Mill Creek Area and can be found in [Appendix A](#). Proposed projects to mitigate the identified wildfire risks can be broadly categorized as addressing:

- Emergency access and evacuation
- Fuels reduction
- Ignitions reduction
- Emergency notification and communication, and
- Acquiring funding

A list of proposed projects in each of these categories is provided in [Appendix B](#), including projects such as:

- Hardening of existing structures
- Preventing and controlling ignitions through early detection
- Improving early warning and evacuation systems
- Developing water sources
- Creating more defensible space around houses, and
- Creating strategic fuel breaks to act as access routes and staging areas for firefighters

## **Conclusion**

Recent large and damaging wildfires have increased awareness of the vulnerability of the Mill Creek Area. The goal of this CWPP is to guide mitigation projects to protect the area, save lives, homes, businesses, sensitive wildlife species and ecological processes, and to help create a more fire-resilient forest environment. Fuel reduction efforts in some areas may not only reduce wildfire risks, but may also improve or maintain water quality, reduce erosion, and restore some fire-resilient old-growth redwood forest characteristics.

The Mill Creek Citizens Organized to Prepare for Emergencies (COPE) organization has achieved considerable success in organizing members of the Mill Creek Community to promote fire preparedness. The CWPP provides the COPE organization a collaborative framework based upon community consensus that has identified the risks, and discussed and proposed projects to assist in mitigating those risks.

This CWPP also supports the three major goals of the National Cohesive Wildland Fire Management Strategy, by attempting to create:

1. Resilient Landscapes
2. Fire Adapted Communities
3. Safe and Effective Wildfire Response

# *Mill Creek CWPP Planning Group Members*

## **Dan Grout**

Principal author of this CWPP manuscript and a Wildlife Biologist with over 40 years of experience. Former Senior Ecologist for California State Parks, Endangered Species Recovery Biologist with the U.S. Fish & Wildlife Service, Associate Faculty with California State University Monterey Bay and Cal Poly, teaching Wildlife Biology and Sustainable Forestry. Dan lives among the old-growth redwoods on a historic family ranch and homestead on Mill Creek with his wife and daughter above the Daniels School.

## **Mark Menne & Mark Farmer**

Contributed to the preparation and writing of this CWPP manuscript. Mark Menne and Mark Farmer co-founded the Mill Creek Community Citizens Organized to Prepare for Emergencies (COPE) organization in 2017 and have since grown membership to over 300 residents. They are also involved in efforts to implement COPE on a county-wide basis to improve community preparedness across northern Sonoma County.

## **Monica Munoz-Torres, PhD**

Copy editor, contributed to the preparation and writing of this CWPP manuscript. Dr. Munoz-Torres, is currently an Assistant Professor in the Department of Environmental and Molecular Toxicology at Oregon State University (OSU). At OSU, she serves as Director of Operations for NIH's Center for Cancer Data Harmonization, and as Program Manager for the Translational and Integrative Sciences Laboratory. As well, she is an Affiliate Professor in the Division of Environmental Genomics and Systems Biology at Lawrence Berkeley National Laboratory. She is a Mill Creek resident, and an active member of the Mill Creek COPE.

## **Marshall Turbeville**

Contributed to the preparation and writing of this CWPP manuscript. Marshall Turbeville is a CAL FIRE Sonoma-Lake-Napa Unit Battalion Chief and Fire Chief for the Northern Sonoma County Fire Protection District. Marshall is a graduate of Cal Poly, San Luis Obispo and teaches at the Santa Rosa Junior College.

## **Paul Fleckenstein**

Paul Fleckenstein is a CAL FIRE Battalion Chief in the Sonoma-Lake-Napa Unit assigned to the Healdsburg Battalion which includes the Mill Creek Area. Paul grew up in the Healdsburg area and also has been a member of the Healdsburg City Fire Department for over 25 years. Paul attended the University of California at Davis and served on the Mill Creek CWPP Steering Committee.

## **Caerleon Safford**

Caerleon safford has worked with Fire Safe Sonoma, Sonoma County's nonprofit fire council for more than a decade to serve as a resource for those who want to assess and mitigate wildfire risks. In addition to leading development of the Sonoma County Community Wildfire Protection Plan (CWPP), she has led the efforts to develop CWPPs in local communities throughout Sonoma County. She served as the main advisor to the Mill Creek CWPP effort.

## **Mill Creek CWPP Steering Committee (2020)**

*Bob Alpern*

*David Baeli*

*Lynn Bond*

*Ray Degischer*

*Marcia Farber-Wescott*

*Mark Farmer*

*Paul Fleckenstein*

*Doug Fisher*

*Bob Fouts*

*Dan Grout*

*Mark Menne*

*Monica Munoz-Torres*

*Christina Nelson*

*Gregor Nelson*

*Charmaine Osborne*

*Martha Perry*

*Matt Perry*

*Marshall Turbeville*

*Rob Urmini*

*Celeste Yparraguirre*



# *Agency and Community Stakeholders*

The members of the Mill Creek CWPP Steering Committee wish to express their thanks and gratitude for the expertise, input and guidance provided by the following agency and community stakeholders, who attended a presentation of the CWPP at the Daniels Schoolhouse on March 11, 2020.

- **Jason Boaz**, Healdsburg Fire Department
- **Andy Cash**, Sonoma County Sheriff's Department
- **Linda Collister**, Healdsburg Fire Department
- **Desiree Dela Vega**, California Department of Fish & Wildlife
- **Lisa Hulette**, Permit Sonoma
- **Mariska Obedzinski**, California Sea Grant
- **Katie Robbins**, Sonoma County Resource Conservation District
- **Shepley Schroth-Cary**, North Bay Fire
- **Robyn Swann**, California Department of Fish & Wildlife
- **Stuart Tiffen**, Office of Sonoma County Supervisor James Gore
- **Jeff Tunnell**, Bureau of Land Management
- **James Williams**, Permit Sonoma



*Presenting Draft Mill Creek CWPP findings to agency stakeholders at Daniels Schoolhouse. March 11, 2020.*

# Mutual Agreement

## Mill Creek Community Wildfire Protection Plan

The Mill Creek Community Wildfire Protection Plan (CWPP) was developed in accordance with the guidelines set forth by the Healthy Forests Restoration Act. This Plan:

1. Was collaboratively developed. Interested parties in the region of this CWPP have been consulted.
2. Identifies and prioritizes areas for hazardous fuels reduction treatments and recommends the types and methods of treatment to reduce the wildfire threat to values at risk in the area.
3. Recommends measures to reduce the ignitability of structures throughout the area addressed by the plan.

The following representatives of the entities required for CWPP approval mutually agree with and approve the contents of this Mill Creek CWPP:

James Gore

James Gore (Jun 23, 2020 14:12 PDT)

Mr. James Gore

Supervisor, Sonoma County Board of Supervisors

Jun 23, 2020

Date

Shana Jones

Chief Shana Jones

Unit Chief, CAL FIRE

Jun 23, 2020

Date

Jason Boaz

Jason Boaz (Jun 23, 2020 10:13 PDT)

Chief Jason Boaz

Fire Chief, Healdsburg Fire Department

Jun 23, 2020

Date

ROBERTA MACINTYRE

Ms. Roberta MacIntyre

Chair, FireSafe Sonoma

Jun 23, 2020

Date

Shepley Schroth-Cary

Shepley Schroth-Cary (Jun 23, 2020 11:14 PDT)

Chief Shepley Schroth-Cary

Fire Chief, North Bay Fire

Jun 23, 2020

Date

# *Mill Creek Community Wildfire Protection Plan*

## **1. Introduction**

Seven of the ten most destructive wildfires in California history have occurred in the last five years. The **Tubbs**, **Nuns**, and **Pocket** Fires of 2017 burned more than 108,000 acres in Sonoma and Napa Counties, destroyed approximately 7,000 structures, and killed 25 people. The 2018 **Camp Fire** burned over 100,000 acres in the first 48 hours, and eventually resulted in 85 lives lost, many during a frenetic evacuation from the Paradise area of Butte County. The 2019 **Kincadee Fire**, the largest wildfire in Sonoma County history, burned nearly 78,000 acres, destroyed over 375 buildings, and forced the evacuation of roughly 200,000 residents of Sonoma County. If it had jumped Highway 101, as feared, it could have burned unimpeded all the way to the coast, possibly destroying the Mill Creek Area and much of the central portion of Sonoma County.

Fire has been an essential part of a natural cycle that has kept forests healthy for thousands of years. Nearly one hundred years of fire suppression strategies have created unhealthy forests with dangerously dense trees and heavy fuel loads. The situation has been made worse by droughts and changes in temperature and precipitation patterns brought on by climate change. These factors have created longer fire seasons in California and an exponential increase in the size, frequency, severity, and destructiveness of wildfires. In the past forty years, the total acreage burned by wildfires in the western U.S. has increased by over 1000% (National Interagency Fire Center 2019).

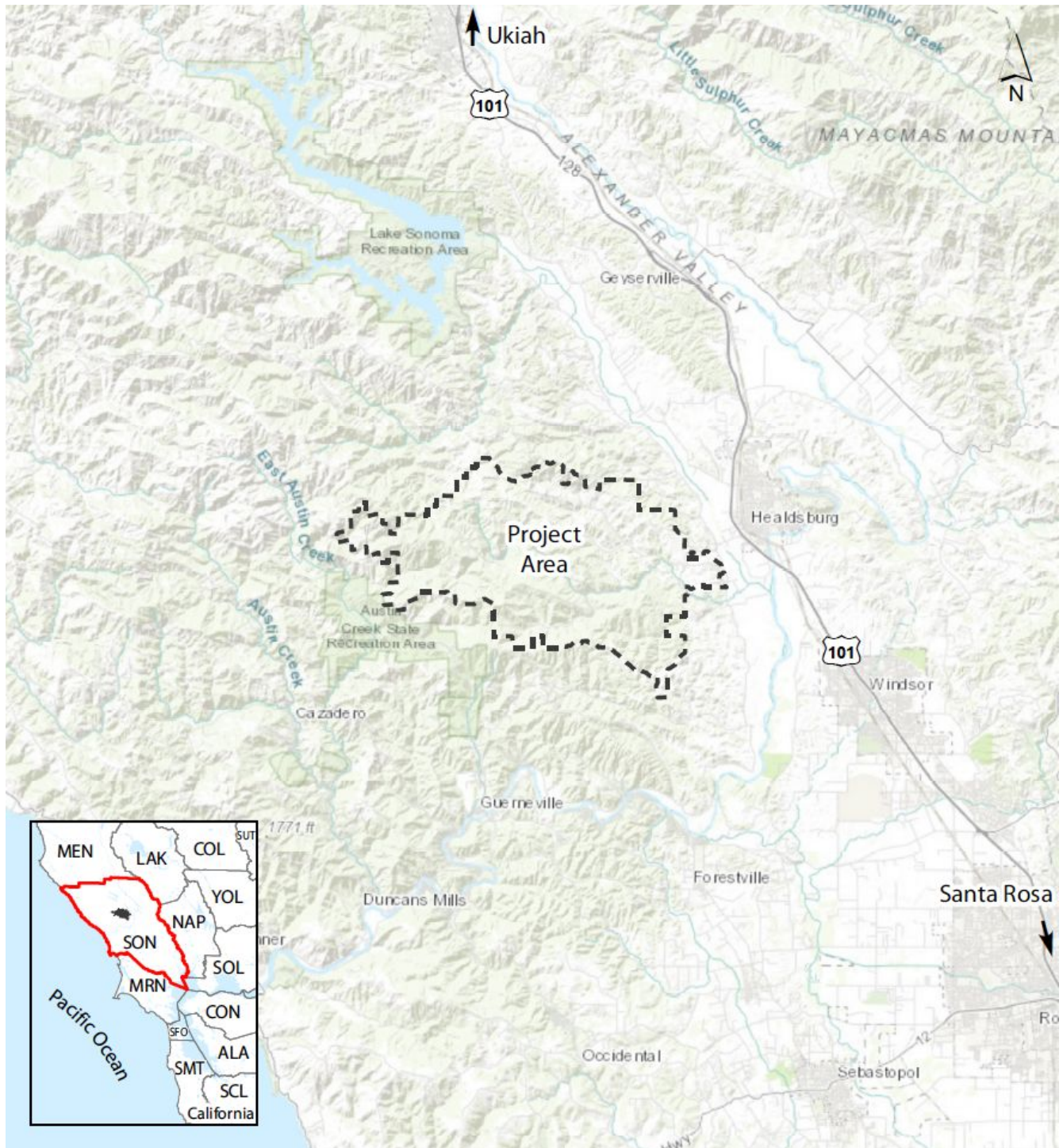
Most of the residents of the Mill Creek Area live along Mill Creek Road, a steep, narrow, winding, dead-end road that effectively functions as the only evacuation route for the entire community. Mill Creek area residents recognize the inevitability of fire in the region, but they also recognize the role they can play to help reduce the risks of devastating wildfires, and to respond to them more effectively when they do occur.

### **1.1 Purpose of the Plan**

The purpose of this Plan is to enhance protection of human life and to reduce the wildfire threat to community assets such as homes, critical infrastructure, agriculture and businesses, as well as natural and historic resources within the Mill Creek Community Area.

The Mill Creek Area, under the leadership of the existing Citizens Organized to Prepare for Emergencies (COPE) organization, mobilized and joined forces with FireSafe Sonoma, CAL FIRE, and the Healdsburg Fire Department in January of 2020 to prepare the Mill Creek Community Wildfire Protection Plan (CWPP). Residents self-organized with the goal of providing a framework for guiding the efforts to protect our community, lives, and homes, and to help create a more fire-resilient forest environment. The CWPP describes the unique resources and risks of the Mill Creek Area, and clearly states the immediate priorities of the area with respect to wildfire risk planning, which will assist with community cooperation necessary and subsequent funding to implement these potential projects as quickly and effectively as possible.





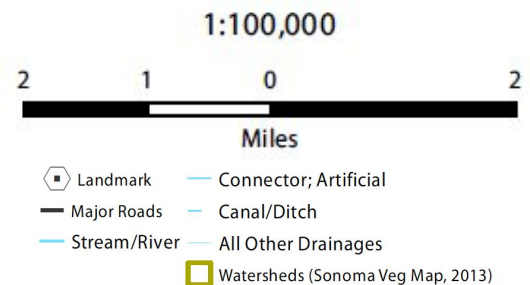
**Figure 1. Vicinity Map.** Dotted line marks the Mill Creek CWPP Boundary (19,688 acres). See [Appendix C](#) for details.

Topographic basemap from ESRI data service. CWPP boundary provided by Marshall Turbeville (2020). Map created by digitalmappingsolutions.com on 3/9/2020.





**Figure 2. Watershed Map.** Dotted line marks the Mill Creek CWPP Boundary (19,688 acres). See [Appendix C](#) for details.  
Hillshade basemap from ESRI data service. CWPP boundary, landmarks, and roads provided by Marshall Turbeville (2020). Watershed boundaries and streams were digitized using vectors and rasters derived from LiDAR data acquired for Sonoma Veg Map and NASA in 2013. Map created by digitalmappingsolutions.com on 3/9/2020.



## **2. Location and Boundaries of the Mill Creek Area**

The Mill Creek Area is located in northern Sonoma County, approximately 70 miles north of San Francisco and one mile west of Healdsburg, California (**Fig. 1**). Healdsburg has a population of approximately 11,656 (U.S. Census Bureau, 2014). The CWPP area covers 19,688 acres, formed primarily by the Mill Creek watershed (**Fig. 2**) plus a small amount of acreage outside the watershed. The area is accessed by Mill Creek Road from Westside Road, approximately one mile west of Highway 101. The area boundaries generally match the Mill Creek COPE Community, generally described as those parcels which are:

- West of Westside Road
- North of the southern boundary of the Mill Creek watershed
- East of “The Cedars,” including four Bureau of Land Management (BLM) parcels
- South of the northern boundary of the Mill Creek watershed

## **3. Fire Department Service Area**

The Mill Creek Area is located within Sonoma County Service Area 40 (CSA 40). The County of Sonoma has contracted with North Bay Fire to manage all CSA 40 areas. The County of Sonoma has also contracted with the Healdsburg Fire Department to respond to all emergencies in the Mill Creek Area. Surrounding fire agencies including the Northern Sonoma County Fire Protection District, Sonoma County Fire District, Cloverdale Fire Protection District and Forestville Fire Protection District also respond, depending upon the nature and complexity of the emergency. These above listed fire agencies have combined paid and volunteer staffing.

CAL FIRE has jurisdiction for all wildfires as the area is entirely a State Responsibility Area, except for Bureau of Land Management (BLM) parcels, which are designated as CAL FIRE Direct Protection Area (i.e., CAL FIRE responds in place of the Bureau of Land Management due to closer proximity of response resources). CAL FIRE also responds to other emergencies as part of existing mutual aid agreements.



## 4. Parcel Data

The Mill Creek Area consists of 305 parcels. According to Sonoma County-maintained geospatial data, there are a total of 780 structures inside the area. These structures vary from residences to storage sheds, and also contain agricultural buildings and accessory dwellings. Please refer to **Table 1** for additional parcel information.

<b>Mill Creek CWPP Parcel Data</b>	
<b>Total acreage</b>	19,688 acres
<b>Total number of parcels</b>	305
<b>Parcels with structures* ('Improved')</b>	
Total number of improved parcels	199
Average size of improved parcels	53 acres
Number of improved parcels more than 30 acres in size	89
Average size of improved parcels more than 30 acres in size	107 acres
Average size of improved parcels less than 30 acres in size	10 acres
Total number of structures	780
<b>Vacant parcels (without structures, 'Unimproved')</b>	
Total number	106
Average size of vacant parcels	85 acres
<b>Approximate Population**</b>	460 - 510

**Table 1. Mill Creek Area Parcel Information.**

\* Based on Sonoma County geospatial data.

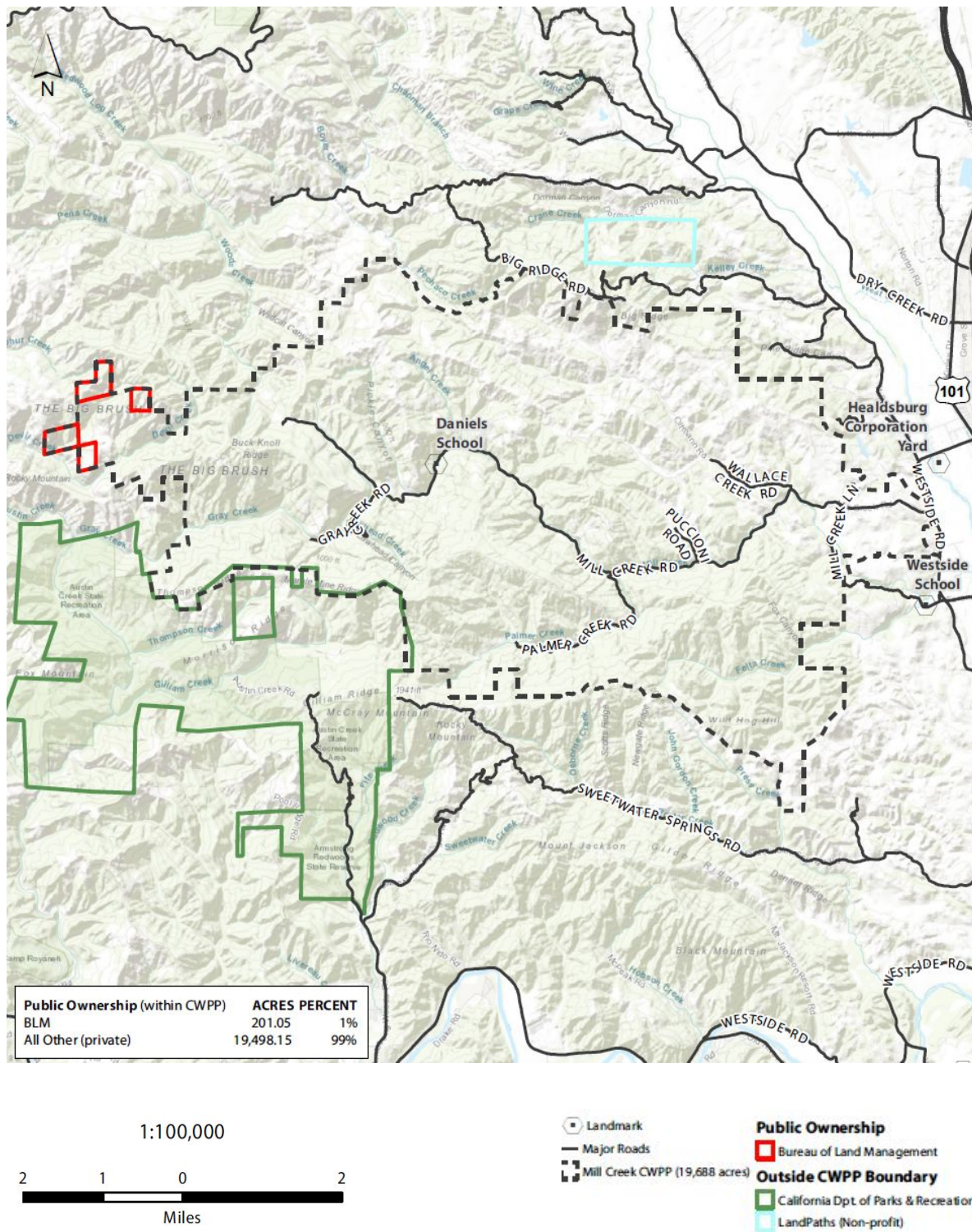
\*\*Based on 2.57 people per improved parcel.

## 5. Land Ownership

The entire Mill Creek Area is privately owned, except for four parcels owned by the BLM, totalling 201 acres of the total 19,688 acres (**Fig. 3**). The area is adjacent to the northeastern boundary of the 6,000-acre Austin Creek State Recreation Area. Approved uses for the land consist of timber, grasslands, vineyards, orchards and rural residential areas. (**Fig. 4**).

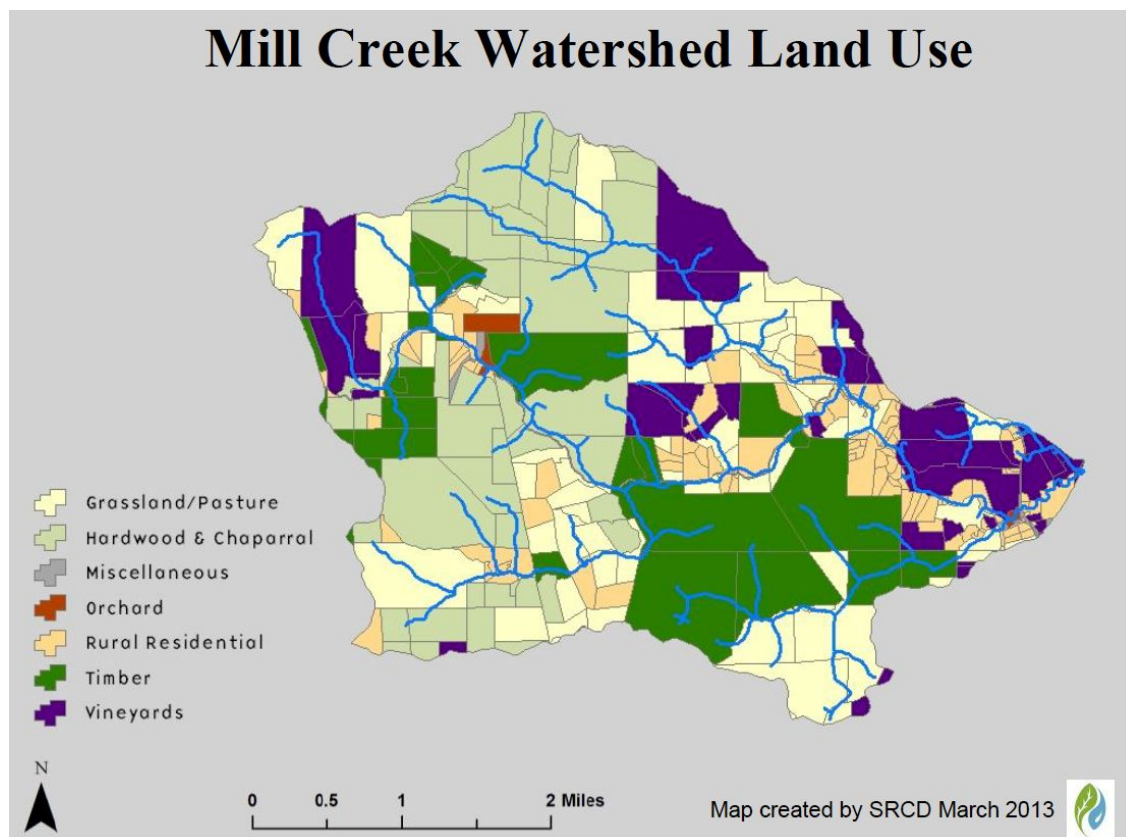
## 6. Demographics

Approximately 200 of the 305 parcels that comprise the Mill Creek Area have homes and other buildings, with a total of 780 structures on all parcels (**Table 1**). Demographic information was calculated using both the Mill Creek Community COPE database and Sonoma County's average household size of 2.57 to estimate the Mill Creek Area population to be as high as 510. Approximately 10% of the residences are "second homes" and/or utilized as short-term vacation rentals, however, which reduces the estimate to 460; hence, the approximate population is estimated to be between 460 and 510 residents, with a population generally older than the Sonoma County average age of 41. More accurate full-time resident population estimates will be available in the future as more residents become engaged in the COPE and CWPP programs. There are few visitors to the area due to the lack of public land trailheads, businesses and other attractions, although there is recreational bicycle riding along Mill Creek Road, and occasional tours of the historic Daniels Schoolhouse.



**Figure 3. Public Ownership Map.**

Topographic basemap from ESRI data service. CWPP boundary and landmarks provided by Marshall Turbeville (2020). Fire District boundaries from Sonoma County GIS. Public ownership data from FRAP (2018). Map created by digitalmappingsolutions.com on 3/9/2020.



**Figure 4. Land Use in the Mill Creek Watershed.** The areas shown here are based on information from 2013, provided by the Sonoma County Permit and Resource Management Division<sup>1</sup>.

## 7. Community Organizations

A number of community and neighborhood organizations operate within the Mill Creek Area:

- Mill Creek Community Citizens Organized to Prepare for Emergencies (COPE)
- Palmer Creek Association
- Puccioni Road Homeowners Association
- Westside Community Association
- Venado Historical Society

## 8. Wildland-Urban Interface Condition

All of the Mill Creek Area is considered a Wildland-Urban Interface (WUI). The 'WUI' term may have different definitions and subcategories based upon its application to building codes, CWPPs, insurance rates, etc. The Mill Creek Area is a WUI Intermix Community according to FireSafe Sonoma WUI categories, which are from the Federal Register<sup>2</sup> and are defined as follows:

- The **Interface Community** exists where structures directly abut wildland fuels. There is a clear line of demarcation between residential, business, and public structures and wildland fuels. Wildland fuels do not generally continue into the developed area. The development density for an interface community is usually three or more structures per acre, with shared municipal services. Fire protection is generally provided by a local government fire department with the responsibility to protect the structure from both



an interior fire and an advancing wildland fire. An alternative definition of the interface community emphasizes a population density of 250 or more people per square mile.

- The **Intermix Community** exists where structures are scattered throughout a wildland area. There is no clear line of demarcation; wildland fuels are continuous, outside of and within the developed area. The development density in the intermix ranges from structures very close together to one structure per 40 acres. Fire protection districts funded by various taxing authorities normally provide life and property fire protection and may also have wildland fire protection responsibilities. An alternative definition of intermix community emphasizes a population density of between 28-250 people per square mile.
- The **Occluded Community** generally exists in a situation, often within a city, where structures abut an island of wildland fuels (e.g., park or open space). There is a clear line of demarcation between structures and wildland fuels. The development density for an occluded community is usually similar to those found in the interface community, but the occluded area is usually less than 1,000 acres in size. Fire protection is normally provided by local government fire departments.

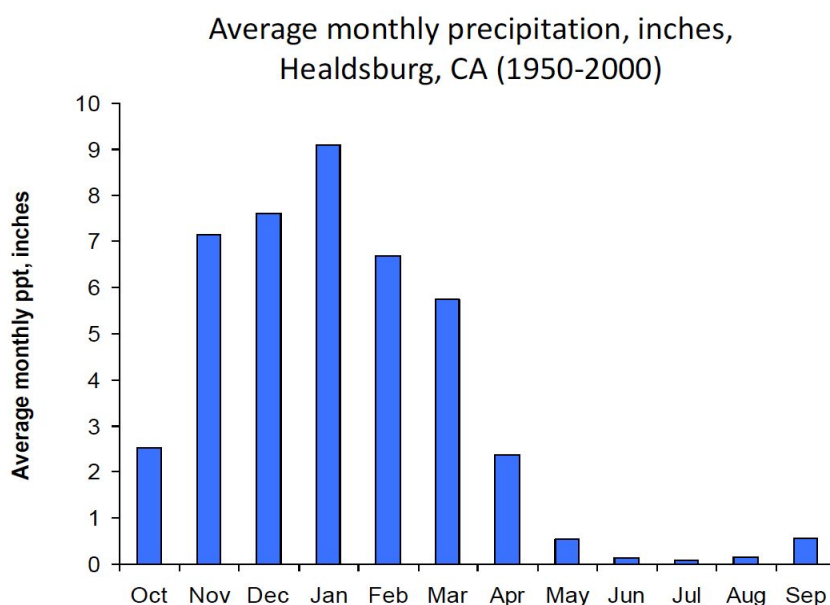
## 9. Climate

The climate patterns of the Mill Creek Area are characteristically Mediterranean, like most of coastal California. Summers are warm and dry, while winters are wet and cool. Strong northeasterly winds are common in the late summer and fall months. Average temperatures in the Mill Creek Area range between 36°F in January and 89°F from July through August.<sup>3</sup> Rainfall data recorded over a 50-year period in Healdsburg report an average total yearly precipitation of 41 inches, with 90 percent of the average annual rainfall occurring between November and April.

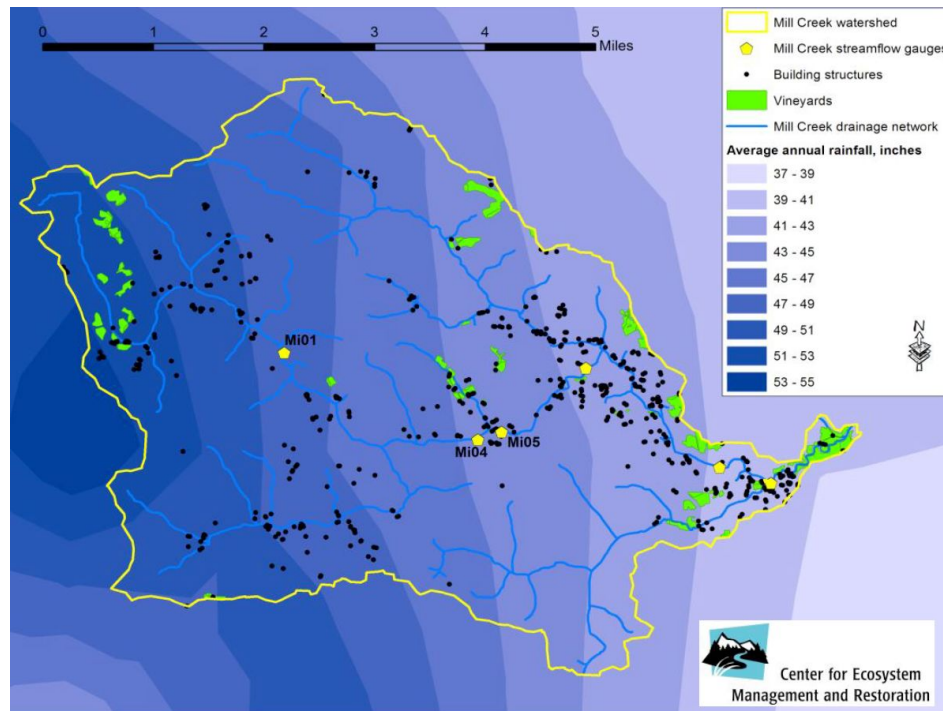
The National Weather Service, the Sonoma County Water Agency, and the State Department of Water Resources maintain a weather station in the western portion of the Mill Creek Area (an area known as Venado), which has averaged over 60 inches of rain over the past forty years. The Venado weather station consistently records the highest rainfall in the County, which is among the highest in California. During the 2016-17 water year, Venado recorded 154 inches (almost 13 feet) of rain. **Fig. 5** shows monthly temperature and rain taken at the Venado weather station, located at 1210 feet elevation<sup>4</sup>.

Localized climate change projections predict shorter and increasingly arid winters, as well as longer, hotter, drier summers. Rainfall is predicted to come in more intense rain events, rather than spread out over the wet season, increasing drought stress on soil, and as a result, predicting a higher fire risk due to more flammable vegetation during the late summer months.<sup>5</sup>

**Figure 5.** Average monthly precipitation, Healdsburg, CA<sup>1</sup>.



**Fig. 6** illustrates the average annual precipitation distributed across the watershed and shows a recorded high of 63 inches in the higher elevations to the west, as well as a low of 42 inches in the lower elevations to the east, near where Felta Creek joins Dry Creek, an area similar in elevation and climate to that of Healdsburg. The PRISM spatial data set of rainfall (developed by Oregon State University, widely considered a standard for rainfall analysis in the Western United States) indicates that the Mill Creek watershed receives on average 49 inches of rainfall, with more occurring at higher elevations in the watershed and less at lower elevations. Over the 24 square mile watershed, this amounts to approximately 62,000 acre-feet of water falling on the Mill Creek watershed in an average year.



**Figure 6.** *Precipitation / Isohyetal Map of the Mill Creek watershed<sup>1</sup>*

## 9.1 Climate Change and Healthy Resilient Forests

Climate change poses increasing challenges to natural forest systems. In particular, extreme events such as flooding, fire, and plant diseases are expected to occur more frequently. Regional climate predictions vary in terms of trends in overall precipitation. However, most models predict that weather patterns will be more extreme, with drought and floods becoming more common and more intense. If, as predicted, rain comes in shorter and more intense events, drought stress on soils and plants is expected to increase even in years of heavier rainfall. Drought stress on soils in late summer is estimated to increase 11-22% in the North Bay by the end of the century (North Bay Climate Adaptation Initiative, NBCAI<sup>6</sup>). This will likely result in a continued lengthening of the fire season, more frequent large wildfires, and an increase in the severity of the fires when they do occur<sup>5</sup>. The number of acres burnt each year by wildfires in the western United States is now over ten times larger than it was forty years ago. This is the high risk fire environment that the Mill Creek Area finds itself in now and for the foreseeable future.

Wildfires also result in large releases of carbon into the atmosphere, which can have additional impacts on climate change. Yet Redwood forests also grow and store large quantities of carbon dioxide, a greenhouse gas and the primary driver of global climate change. Young, rapidly growing forests can sequester a remarkable amount of carbon dioxide, while older forests store carbon over many generations.

## 10. The Built Environment

The built environment of the Mill Creek Area consists almost entirely of private homes and related structures. A small number of commercial structures in support of agricultural operations exist within the Mill Creek Area.

### 10.1 Homes

Most homes in the Mill Creek Area were built before WUI building codes and standards associated with the construction of buildings took effect in 2007 with the publication of the Updated California Building Code (Chapter 7A of the California Building Code<sup>7</sup>). Most homes have vulnerable elements that increase the potential for ignition, such as old or non-Class A rated roofs, attic or foundation vents that allow for ember intrusion, wooden decks and attachments, and siding. Refer to [Appendix C](#) for Fire Hazard Severity Zone Map.

Many residents have not created adequate defensible space around their buildings for a variety of reasons including cost, physical ability, age, and lack of awareness. Fortunately, sufficient space exists to create the required 100 feet of defensible space, given the large average size of parcels. Moreover, large parcels reduce the likelihood of house-to-house ignitions, a characteristic of many recent wildfires.

Refer to [Appendix D](#), *Creating Wildfire Adapted Homes and Landscapes*, for specific guidelines about home hardening and defensible space.

### 10.2 Homeowners Insurance

The Mill Creek Area has experienced homeowner insurance cancellations and rate increases since the fall of 2017 and a recent increase following the 2019 **Kincade** Fire. Rate increases have been as much as five times the premium from previous years. Many of these residents had longstanding relationships with their insurance companies that spanned decades. These trends reflect patterns reported in local, regional and national media through the county and state.

Notably, the California State Insurance Commissioner announced on December 5, 2019 a one-year moratorium on insurance cancellations for people residing in or near areas where the state's 16 wildfires burned that year which includes the 2019 **Kincade Fire**. This decision does not prevent insurance companies from increasing premiums, deductibles, or making other changes to policies that pass on costs to policyholders.

## 11. Access: Ingress and Egress, Evacuation, and Security Gates

The primary and only access to the Mill Creek Area is provided by Mill Creek Road, a narrow and winding, county-maintained road. Mill Creek Road extends on roughly an east-west axis for approximately 9.8 miles from Westside Road to its termination point at a locked privately owned gate ("Dodge Gate"). It takes about 26 minutes to travel the length of Mill Creek Road by vehicle. Four secondary residential roads, which are mostly unpaved, feed into Mill Creek Road: Mill Creek Lane, Wallace Creek Road, Puccioni Road, and Palmer Creek Road. Many private roads, shared driveways, and driveways (paved and unpaved) feed into Mill Creek Road and the four secondary roads.

Mill Creek Road follows the Mill Creek waterway through much of its course. The majority of the road travels in a deep river valley with significant riparian and Redwood vegetation present throughout.

**Mill Creek Road** presents many significant hazards that both affect access and may represent delays for emergency responders, including:

- **One way in/out.** Mill Creek Road dead ends after 9.8 miles, thus creating a significant evacuation challenge in the event of an emergency. Mill Creek Road is the primary evacuation route for the entire



Mill Creek community. An alternate emergency evacuation route was established through private property in 2019 to provide access from Palmer Creek Road to Sweetwater Springs Road. The alternate evacuation route is unpaved, and contains directional signage throughout its length. This evacuation route is also one lane and requires periodic inspection and maintenance to remove blockages and manage vegetation growth.

- **Narrowness.** Roadway narrowness is an issue along Mill Creek Road due to the pavement width and vegetation, including large trees. but it is particularly hazardous west of Puccioni Road where the roadway narrows and yellow divider striping ends. The roadway narrows to 14.5 feet at its perceived narrowest point, about 100 feet west of Palmer Creek Road. The narrowness of the roadway forces cars to slow down when confronting oncoming traffic, especially during non-daylight hours. The entire length of Mill Creek Road lacks a road shoulder or bicycle lane. The road contains several unpaved turn-offs to let vehicles pass.
- **Vegetation.** Significant overgrown vegetation is present throughout the entire length of Mill Creek Road, including many overhanging trees and limbs. Fallen trees or broken limbs routinely block Mill Creek Road, especially during winter months.
- **Windiness.** Mill Creek Road follows the serpentine Mill Creek waterway through much of its length. As a result, Mill Creek Road is extremely windy in sections with many narrow blind curves, which creates traffic hazards.
- **Cell phone and GPS coverage.** The majority of the road lacks cell phone coverage. The topography and vegetation limits reliable cell phone coverage to the first mile on the eastern end of Mill Creek Road. Because of the steep canyons and thick forest canopy, there is also a lack of GPS navigational assistance.
- **Sound limitations.** The geographic nature of the Mill Creek Area limits the distance and quality of sound transmissions. During a county-sponsored evacuation drill in the fall of 2019, the use of a “Hi-Lo” siren by the Sheriff’s Department was only partly successful as a means to notify residents.
- **Non-hardened power and telephone lines.** The current power and telephone infrastructure consists of wooden poles and power lines that do not reflect the latest fire safety technology. PG&E announced plans for 2019 and 2020 to harden several miles of power lines and poles along the first several miles of Mill Creek Road. While the vegetation clearing associated with this improvement is occurring during the spring of 2020, the line and pole hardening improvements have not yet taken place.
- **Flooding.** Several sections of Mill Creek Road are susceptible to flooding given their proximity to the Mill Creek waterway, including some sections that have become impassable in recent years.
- **Address signage.** Address signs lack uniformity throughout the Mill Creek Area, thus presenting challenges to emergency responders when looking for a specific address.
- **Roadway bridges.** The Sonoma County Department of Transportation and Public Works (TPW) maintains eight bridges that cross over the Mill Creek waterway. While rated to support heavy equipment, including emergency vehicles, and seemingly in good condition, these bridges present hazards during the rainy season due to potential flooding.
- **Roadway quality.** Road quality of Mill Creek Road is adequate but not great. The roadway shows signs of wear from erosion and mudslides, with many potholes. The first mile of Mill Creek Road was repaved in 2019. The remaining 8.8 miles have not been repaved for many years, and there are numerous large potholes and uneven areas that make for hazardous driving conditions. Many of the potholes that have been patched have created an uneven driving surface.
- **Unrepaired slides.** Heavy rains and erosional landslides have often resulted in rockstrewn roadblocks and hazardous one-lane constrictions, often along blind curves. In addition to several recurring landslides, there are also at least three locations where the Mill Creek Road pavement surface has structurally failed or been significantly undercut by flood waters of Mill Creek and its tributaries near 5920,

6600 and 7230 Mill Creek Road. In recent years. None of these road failures have yet been permanently repaired.

- **Gates.** Numerous gates leading to private residences are present throughout the length of Mill Creek Road. Gates are typically locked when not in use. Many gates have “Knox boxes” for access by emergency personnel. Electrical outages may affect the operation of gates.
- **Driveways.** Many residences are located a significant distance from the roadway and are accessible only by steep driveways that are often unpaved. An additional hazard is sometimes presented by the need to cross over private maintained wooden bridges that do not have posted weight ratings and are of unknown condition.
- **Bicycling.** Mill Creek Road is a popular route for recreational bicyclists due to its natural beauty and shaded course. The lack of a dedicated bike path and other features of the roadway create hazards for both cyclists and drivers.

Many of these same hazards are also present along the four secondary roadways that feed into Mill Creek Road. Of these secondary feeder roads, only a portion of Wallace Creek Road is maintained by TPW. The remaining three (Mill Creek Lane, Puccioni Road, and Palmer Creek Road), are privately owned and maintained by resident groups.

In addition, unpaved Gray Creek Road extends from a turnoff near the end of Mill Creek Road through a locked gate to Austin Creek Fire Road, a distance of approximately three miles. The roadway is gravel or dirt, narrow, and involves several stream crossings. Another locked gate blocks the entrance to the Austin Creek Fire Road, which connects to Manning Flats Campground and eventually Armstrong Woods Road. Gray Creek Road is a candidate for a second alternate evacuation route from Mill Creek Road though likely suited only for high clearance vehicles.

## 12. Emergency Notification and Alerts

### 12.1 Internet, Landline and Cellular Phone Communications

Landline telephone service by AT&T provides the most reliable form of voice communication in the Mill Creek Area. Cellular phone communications are unreliable due to the lack of a nearby cellular tower and geographic challenges of the area. Many residents deploy commercially available cellular phone boosters in their homes that provide coverage by routing cell signals through internet connections. Cellular phone service is expected to improve following completion of a proposed cell tower at 6699 Mill Creek Road, though the project is still in the early planning stages. Internet service is provided through satellite providers or line-of-sight networks. DSL service by AT&T is not available.

### 12.2 Sonoma County Alert and Warning Program

The Sonoma County Department of Emergency Management (DEM) maintains an alerting and warning program for unincorporated Sonoma County. There is no one single alert and/or warning system capable of alerting the total affected population at any given time. All systems are limited by a combination of factors including geography (topography), technology, and infrastructure. Each system, by itself, is only expected to reach a fraction of the affected population. Therefore, DEM sends alerts and warnings using redundant and overlapping systems to ensure the greatest amount of the affected population is contacted. The “last resort” is door-to-door alerting/notification. The DEM alerting and warning program includes the following systems:

- **SoCo Alert.** SoCo Alert is a system that allows officials to alert specific or defined areas. Messages are sent primarily by landline phone, unless a person registers their cellular telephone (with text and/or voice options) and email at [www.socoalert.com](http://www.socoalert.com). SoCo Alert is only used for emergencies.

- **Wireless Emergency Alert (WEA).** The WEA system is operated by the Federal Government. The WEA is part of IPAWS (Integrated Public Alert and Warning System) and alerts are only sent through cellular telephone. Cellular coverage is needed. Registration is not required, and a cellular telephone will receive a warning tone if they are in the area designated to receive an alert. The warning tone will be accompanied by a text message. The WEA system has a limited text capacity, and alerts are short and may not give detailed information.
- **Emergency Alert System (EAS).** EAS is part of the IPAWS system. An EAS message is sent using radio and television systems.
- **NOAA Weather Radio (NWR).** DEM has partnered with the National Weather Service to send alerts through the NWR. More information can be found at <https://www.weather.gov/nwr>. The messages associated with the NWR alert are limited.
- **Nixle.** Nixle sends cellular telephone texts (without an alarm) and emails. Nixle is provided at no cost to consumers but requires registration. DEM does not have a Nixle account. The Sonoma County Sheriff uses Nixle (<https://local.nixle.com/sonoma-county-sheriffs-office/>). Nixle is used during emergencies to support other alerting and warning systems, and is also used by the Sonoma County Sheriff for non-emergency public information.
- **Hi-Lo Sirens.** Sonoma County Sheriff vehicles and various other public safety agency vehicles are outfitted with a special “Hi-Lo” siren, similar to the sound used by emergency vehicles in Europe. These sirens are used when driving through evacuating neighborhoods to help provide alerts to those who may not have received the alert through the above systems.

### 13. Fire Environment

Each year nationally, firefighters combine efforts to successfully contain approximately ninety-seven percent of wildfires at less than ten acres. This success is a direct result of favorable weather and fuels conditions, early fire reporting, and a rapid and aggressive fire suppression response. However, when an ignition occurs during unfavorable weather and fuel conditions, or when firefighting assets are committed to fighting simultaneous wildfires, a new fire has potential to escape the efforts of initial attack firefighters.

The probability of a catastrophic wildfire occurring at any particular location within or adjacent to the Mill Creek Area is dependent on a chain of events that includes fire ignition, fire weather, wildland fuel, heat transfer, topography, fire behavior, suppression actions taken, and the interaction of these factors. To understand the wildfire problem in the Mill Creek Area requires an understanding of wildland fire risk factors, wildfire history, vegetation and wildland fuels, the expansion of human residences into the wildland interface, and the influence of a changing climate on the wildland fire environment.

#### 13.1 Wildland Fire Risk Factors

Wildfire behavior is based on three primary factors: **topography**, **weather**, and **fuel**. The three elements are called the “Fire Behavior Triangle.” Ultimately, fire behavior is directly related to the severity of conditions of each of these three factors. A worst-case scenario is when all three elements of the Fire Behavior Triangle are heightened. These are the conditions in which there is the potential for extreme fire behavior<sup>8</sup>.

The Mill Creek Area is vulnerable to all three of these elements: Steep topography, warm dry windy weather, and heavy vegetative “fuel” loading. With over 85% of the Mill Creek CWPP area consisting of steeply forested slopes of mixed conifer-hardwoods, the risk of a rapidly moving wildfire is high.

Fire intensity, size, rate of spread, and loss of structures and life have increased dramatically in California in recent years. If a fire starts on a day with low fuel moisture, high winds, low relative humidity, and high temperatures, fire behavior will be much more intense with much higher potential for significant loss of lives, structures, and natural resources. While low-intensity fires are a necessity to maintain healthy ecosystems, a

large uncontrolled wildfire can have significant negative environmental consequences to natural vegetation and wildlife. Sedimentation after a major fire can cause damage to water quality and riparian habitat and species.

Daily temperatures during fire season are high, often over 100°F with low relative humidity. The highest elevation in the area is Queen's Peak at 1,948 feet, and the lowest is ~90 feet where Mill Creek crosses Westside Road. With an average elevation of 912 feet, much of the Mill Creek Area is within or even above coastal and valley fog, and does not experience the nighttime cooling common at lower elevations. While temperatures along the coast are typically well below 80°F during most of the summer months, the Mill Creek temperatures often run much warmer. Seasonal northeastern wind events (also known as Diablo Winds) are common during summer and fall, and represent the greatest increased risk of uncontrollable wildfire.

## 13.2 Fire History

While the role of wildfire has changed through the years, fire will always be with us. In order to learn how to better live with wildfire in the future, it helps to better understand its role in the past, and how it has shaped the current fire environment.

Prior to wildland fire suppression efforts that began in the early 20th century, most of California's forest lands were subject to frequent low-intensity fires, often brought on by Native Americans for a variety of purposes, including food production and ease of harvest. These anthropogenic fires were typically low- to moderate-intensity. Many of these wildfires did not burn during warm, dry, and windy conditions. These wildfires removed excess fuel, thinned vegetation, and reduced competition between residual trees. A wildfire history study performed within the Jackson Demonstration State Forest found that the pre-20th century mean fire return interval for the Redwood and Redwood-Douglas-fir forest types ranged from approximately 6-20 years<sup>9</sup>. Fire use in oak-grasslands is estimated to have been even more frequent, with most areas burning every 5 years. Fire was used so often and for so long that it has become a necessary component of many of California's ecosystems and essential to their health and regeneration.

Wildfire created a mosaic of different vegetation types and structures, and created large gaps between vegetation that reduced the movement of fire across the landscape. Frequent wildfire had an evolutionary impact on forested stands by naturally retaining the trees that were more resilient to fire. Fire reduced competition among vegetation for water, sunlight, and nutrients, which reduced stress on individual trees and created forests that were more resilient to forest pathogens.

Early European explorers were often rhapsodic in their praise of the open and abundant landscapes they saw, but did not realize the role of conscious use of fire in creating and maintaining these landscapes. With the arrival of European settlers, disruption in Native American lifeways and prohibition of burning greatly decreased beneficial fires in the landscape. Initial logging in the Mill Creek Area began in the mid-19th century, resulting in the majority of the old-growth conifers being cut by the early 1900s. Slash-and-burn techniques were often used, whereby fires were intentionally set after timber was felled to clear debris before logs were transported (yarded) by oxen. After depleting the Mill Creek Area of first- and much second-growth redwoods, loggers turned to Douglas-fir harvesting by 1960. By this time much of the watershed was harvested and clear-cut, although logging of second- and third-growth continued after 1975. As a result of this logging, the size and spacing of trees within the watershed is now relatively small and less fire-resilient than had been the case during the time of original old-growth forests, which were generally characterized by large and widely spaced trees with little understory fuels.

The policy of wildfire suppression in the western U.S. began in earnest in the 1930s and 1940s. Seven to ten decades of fire suppression efforts since then have generally left forest vegetation in California and the western states with fuel loads that are unnaturally dense. Fire suppression, coupled with large-scale logging of larger trees, increased the number of small-diameter, shade-tolerant trees and reduced canopy height. This has led to high fuel loadings that may easily carry fire up into the forest canopy and across the landscape. The

biomass buildup within the area's forests has the potential to result in high fire intensity when a wildfire event does occur.

The effects of climate change and other human disturbances to the forest ecosystem means that using past fire behaviors and frequencies as a tool to predict fire behavior may actually underestimate how wildfires will burn here in the future<sup>3</sup>. The recorded historic forest fires of the Mill Creek Area and surrounding lands are nevertheless worthy of review and discussion, even if the area has a vastly different fire environment than as recently as ten years ago.

Large fires in the Mill Creek Area since 1945 are shown in **Fig. 7** (below). The map reveals that there have not been large fires in the Mill Creek area for over 60 years. The last major fires in the area were the **Mill Creek Fire** in September 1964 (360 acres), and the **Palmer Creek Fire** in September 1955 (1,400 acres). With each year that the area does not burn, the risk of a severe wildfire here only grows more likely.

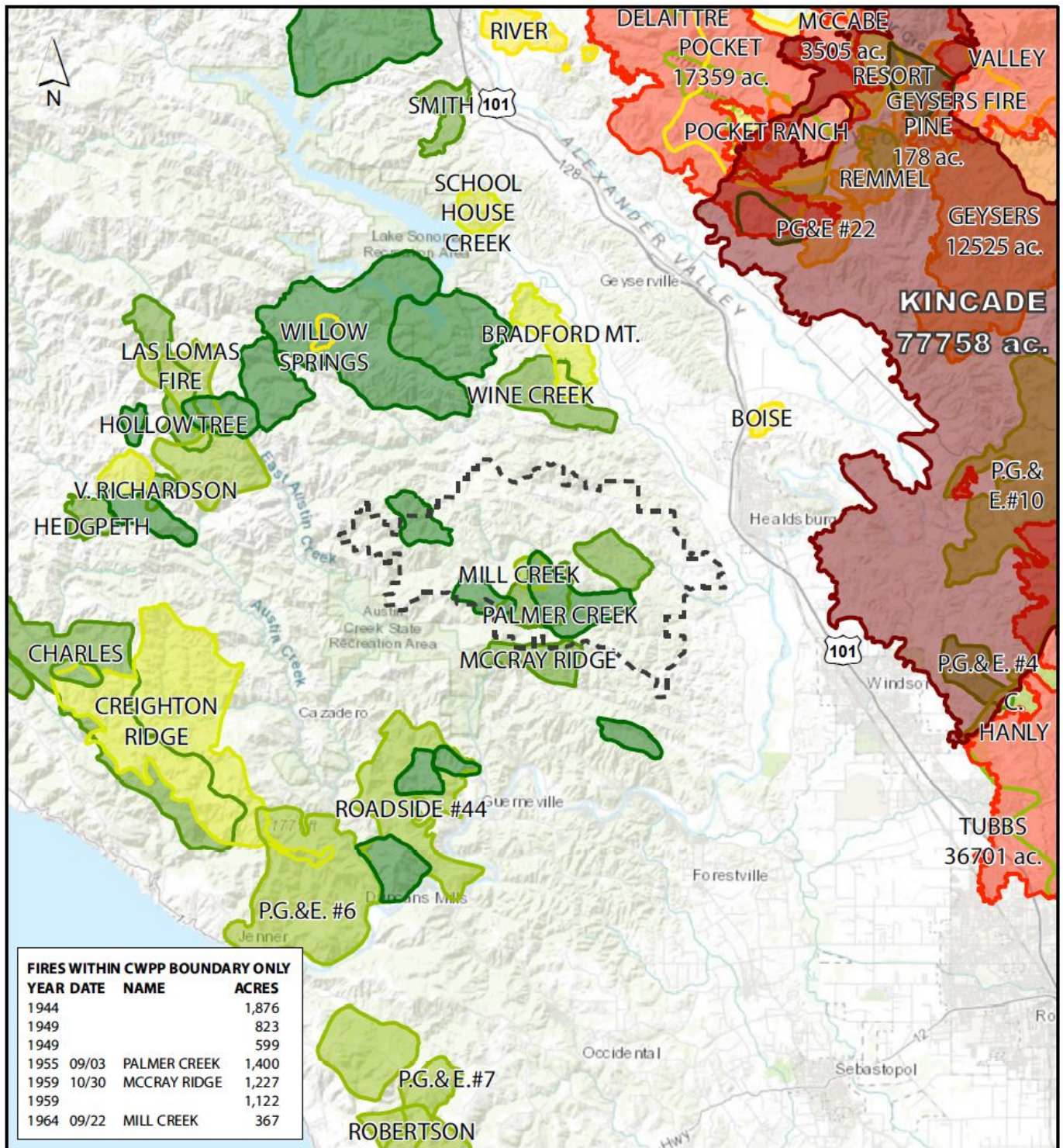
Notably, within the past several years, some of the most destructive fires in state history have struck Sonoma County, including forested areas. The **Tubbs, Nuns, and Pocket Fires**, and several smaller fires, together known as the **Sonoma Complex Fire of 2017**, burned 108,000 acres in Sonoma County, destroyed nearly 5,300 homes (7,000 structures) and claimed 25 lives. During the **Sonoma Complex Fire** more than 100,000 residents were evacuated and 350 fire departments aided in response. Several people now living in the Mill Creek Area relocated from homes that burned then. The largest fire in recorded Sonoma County history, the **2019 Kincade Fire**, started in the evening of October 23 in an area known as *The Geysers*, and spread east. The Kincade fire burned 77,758 acres (121 square miles, 7% of the County), and over 175 homes and 11 other structures. No lives were lost, largely due to the early evacuation of nearly 200,000 Sonoma County residents.

These major fires all took place during high wind conditions, with hot dry northeast and easterly winds whipping the fires and embers. Power lines were associated with the cause of the wildfires.

In addition to these large regional fires, the Mill Creek area also has experienced many small fires, which were quickly extinguished. On November 3 and 14, 2019, two fires occurred in the 8000 block of Mill Creek Road. The November 3 fire was a wildfire along the shoulder of the road that was contained at less than an acre. The November 14 fire was a vehicle fire inside a garage.

The two broad categories of wildfire causes are natural and unnatural. Natural wildfires would be caused primarily by lightning with little to no rain during the dry months of the year. There have been very few natural caused wildfires within the Mill Creek Area. A majority of the wildfires are related to human activity and are generally accidental, negligent, or intentional (arson). Human activity includes power lines, mowing, equipment, vehicles, smoking, campfires, target shooting, and other routine tasks such as the dumping of hot ashes.





**Figure 7. Fire History Map.**

Topographic basemap from ESRI data service. CWPP boundary, landmarks, and roads provided by Marshall Turbeville (2020). Fire history data from CAL FIRE FRAP fire perimeter layer (18.1). Map created by digitalmappingsolutions.com on 3/9/2020.



### 13.3 Fire Hazard Severity Zones (FHSZ)

CAL FIRE's Fire Resource Assessment Program (FRAP) has classified all State Responsibility Area (SRA) into three categories of FHSZ; Moderate, High, and Very High. The last modeling and classification of this area was completed in 2008. FHSZ are utilized primarily for WUI building code requirements, with the modeling and classification based upon a wildfire's potential to ignite a structure. Inputs into the FHSZ classification include several variables including vegetation, fire history, and housing density. Refer to [Appendix C](#) for the FHSZ map. The Mill Creek Area is entirely SRA, except for the BLM parcels, with the following FHSZ classifications:

FHSZ	Acreage	% of Total Area
Very High	499	3
High	16,381	83
Moderate	2,638	13
Not classified (BLM)	182	1

FRAP also maintains a "Fire Threat" map for the California Public Utilities Commission (CPUC) for primarily SRA using three categories; Tier 1 (non classified), Tier 2, and Tier 3. Please refer to [Appendix C](#) for the Fire Threat map. The Mill Creek Area has the following Fire Threat classifications.

Fire Threat	Acreage	% of Total Area
Tier 3	12,913	65
Tier 2	6,241	32
Tier 1 (Non classified)	546	3

## 14. Vegetation and Wildlife

### 14.1 Vegetation Types

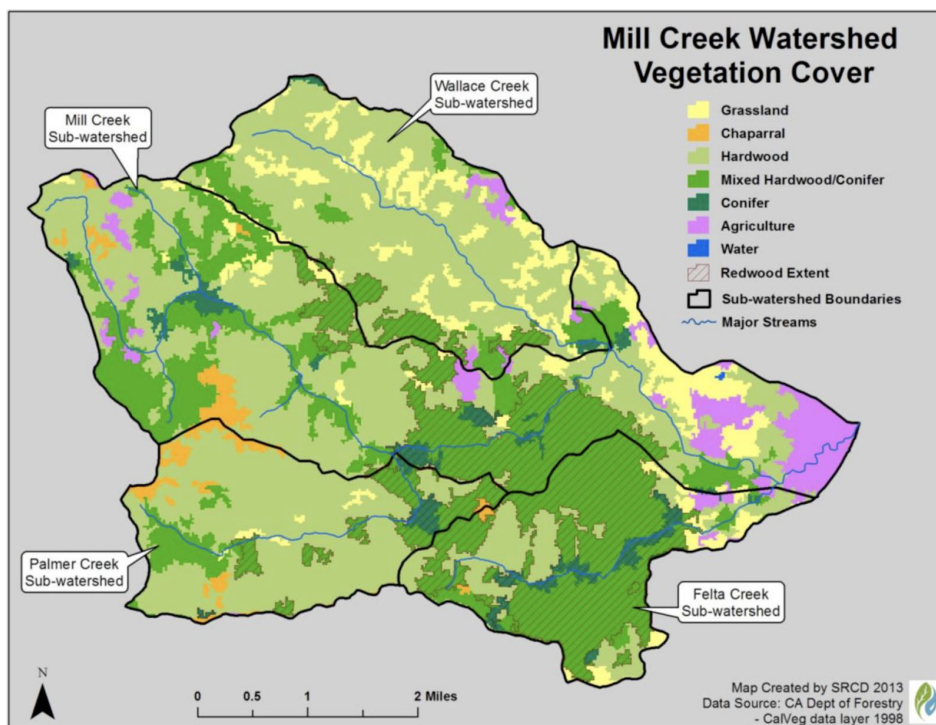
The Mill Creek area is located within the California Floristic Province Inner North Coast Ranges and Outer North Coast Ranges subregions<sup>10</sup>. Vegetation in the Mill Creek area is diverse but composed primarily of typical North Coast Mediterranean vegetation types (**Fig. 8, 9**), particularly coniferous and hardwood forests and a scattering of chaparral and grassland openings. Native forests comprise over 85% (17,024 acres) of the Mill Creek area (**Table 2**). Grasslands (8.7%, 1723 acres), shrublands (2.7%, 544 acres), and vineyards (2.0%, 408 acres) comprise the majority of the remainder of the watershed.

#### Vineyard

Most of the 408 acres of vineyards in the area are situated along the lower elevations of the Mill Creek area in the eastern lowlands. A few vineyards and orchards also are found among the upper south-facing slopes of the hills in the center of the area as well. A few dozen acres of small historic fruit orchards can be found among the older residential dwellings throughout the Mill Creek Area.

#### Chaparral/Shrubland

Approximately 544 acres of chaparral plant communities can be found on hot dry ridges and south-facing slopes, including Woodland manzanita (*Arctostaphylos menziesii*), Chamise (*Adenostoma fasciculatum*), and Coyote-brush (*Baccharis pilularis*). California lilac (*Ceanothus*) can often also be found growing along the sunny edges of grassland openings. Chaparral often integrates with oak woodland, coniferous forest, and grassland vegetation.



**Figure 8.** Vegetation Types in the Mill Creek Watershed<sup>1</sup>.

Vegetation Type	Acreage	% of Total Area
Herbaceous/Grassland	1,723	8.7
Chaparral/Shrubland	544	2.7
Native Forest	17,024	85.6
Vineyard	408	2.1
Orchard	32	0.2
Water	21	0.1
All Other/Misc/Developed	88	0.5
Total	17,688	100

**Table 2.** Vegetation Types in the Mill Creek CWPP area (from Sonoma Vegetation, 2015).

## Grassland

Grassland is a widespread association of annual and perennial herbs, usually without shrub or tree cover. In the relatively small openings in the forest cover in the Mill Creek area, a mixture of annual and perennial grasslands occur, with an herbaceous species composition characteristic of formerly grazed pastures and orchards.

Species often encountered in the area include slender oats (*Avena barbata*), broad-leaf filaree (*Erodium botrys*), birds foot trefoil (*Acmispon americanus*), smooth brome (*Bromus racemosus*), bristly dogs tail (*Cynosurus echinatus*), meadow barley (*Hordeum murinum*), fescue (*Festuca sp.*), coyote brush (*Baccharis pilularis*), blue wildrye (*Elymus glaucus*), and common plantain (*Plantago major*). Common grass species also include: Italian rye (*Festuca perennis*), Pacific bentgrass (*Agrostis avenacea*), California wild oatgrass (*Danthonia californica*), rattlesnake grass (*Briza maxima*), softchess (*Bromus hordeaceus*), wild oat (*Avena*

sp.), horehound (*Marrubium vulgare*), velvet grass (*Holcus lanatus*), ripgut brome (*Bromus diandrus*), and soft chess (*Bromus hordeaceus*). Other species sometimes found in such grasslands include Western blue eyed grass (*Sisyrinchium californicum*), white clover (*Trifolium repens*), rose clover (*Trifolium hirtum*), woodland manzanita (*Arctostaphylos manzanita*), Himalayan blackberry (*Rubus armeniacus*), wedge-tailed Ceanothus (*Ceanothus cuneatus*), and sometimes the invasive and highly flammable French broom (*Genista monspessulana*), and Scotch broom (*Cytisus scoparius*).

### **Native Forest**

Approximately 85% of the Mill Creek area is heavily forested with Douglas-fir, Coastal Redwood, Tanoak, Madrone and California Bay Laurel. Forests types within the Mill Creek area include Valley oak woodland, conifer forest, mixed conifer-hardwood forest, and old-growth Redwood forest.

### **Mixed Conifer-Hardwood Forest**

Sonoma County is home to ten species of oaks and 19 different conifer species (CalFlora Database 2011). Plant species characteristic of mixed oak-conifer woodlands include: Black oak (*Quercus kelloggii*), Coast live oak (*Quercus agrifolia*), Coast redwood (*Sequoia sempervirens*), California bay (*Umbellularia californica*), Douglas-fir (*Pseudotsuga menziesii*), and madrone (*Arbutus menziesii*). Many of the oak woodlands, grasslands and manzanitas being shaded out by quick-growing Douglas-firs, Tan oak, Madrone and California Bay laurel. These woodland forest types integrate with riparian habitat along the creeks that are composed primarily of coniferous species like Coast redwood, as well as hardwoods such as Valley oak, Red alder and Big-leaf maple.

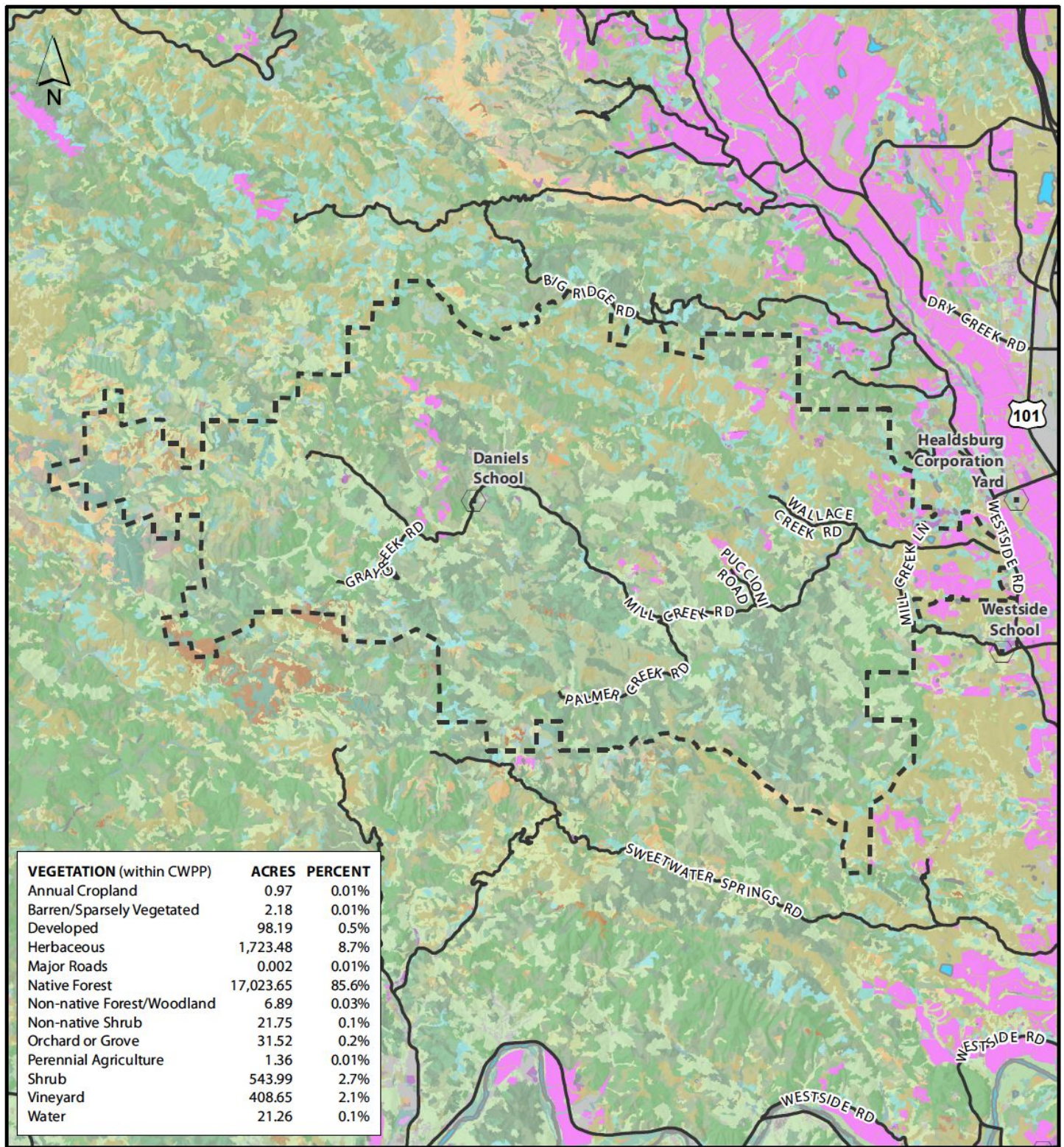
Other groundcover species in the closed-canopy portion include sword fern (*Polystichum californicum*), torrent sedge (*Carex nudata*), goldback fern (*Pentagramma triangularis*), baby blue eyes (*Nemophila menziesii*), poison oak (*Toxicodendron diversilobum*), hazelnut (*Corylus cornuta*), Baltic rush (*Juncus balticus*), Douglas' iris (*Iris douglasiana*), pricklyfruit buttercup (*Ranunculus muricatus*), soap plant (*Chlorogalum pomeridianum*), common yarrow (*Achillea millefolium*), notch leaf clover (*Trifolium bifidum*), round-leaved miner's lettuce (*Claytonia perfoliata*), pennyroyal (*Mentha pulegium*), California strawberry (*Fragaria vesca*), common bedstraw (*Galium aparine*), California bedstraw (*Galium californicum*), slender rush (*Juncus tenuis*), and bracken fern (*Pteridium aquilinum*).

### **Coniferous Forest**

The two dominant species in the Mill Creek Area are Douglas-fir and Coast Redwood. Douglas-firs are capable of growing over 300 feet, and are among the most massive trees in the world<sup>11</sup>. Douglas-firs are arguably the most important commercial conifer species in North America. As a pioneer species, it grows best in full sun, but as seedlings and saplings it is moderately shade tolerant, and prefers cool moist slopes with northern exposures. Known as the "bully of the forest", Douglas-firs often become established in the understory of another forest or vegetation type, with young trees growing slowly in the shade, but rocketing upward to 150-200 feet tall once a tree-fall opens up the canopy. While they reach maturity in 100-150 years, they can live 800-1200 years. California Bay and madrone can grow below these evergreens, growing faster when an opening appears.

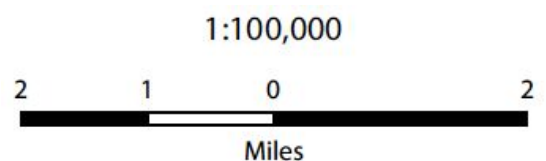
California's Coast Redwood (*Sequoia sempervirens*) is the world's tallest known tree, and one of the oldest, with some being over 2,000 years old. The coast redwood ranges from Big Sur in the south to the Oregon state border, and can obtain up to 45% of their water from fog. The largest known Redwood had a 23-foot diameter and reached 368 feet, but 95% of these old-growth trees are now gone; they were logged starting in the 1800s, when it might have taken two men a week to fell one tree. After the 1906 earthquake, second-growth forests of the Mill Creek area were cut to rebuild San Francisco. Another wave of logging, mostly in second-growth redwood and Douglas-fir stands, ran from the 1950s into the '70s. After that, commercially viable timber grew much more limited, with only third-growth logging, and mills shut as demand and prices for wood declined.





**Figure 9. Mill Creek CWPP Vegetation Map.** See legend with description for each color on the following page.

CWPP boundary, landmarks, and roads provided by Marshall Turbeville (2020). Vegetation data downloaded from the Sonoma Veg Map website (funded by Sonoma County Agriculture and Open Space District), 2015 (version 5.1). Map created by digitalmappingsolutions.com on 3/9/2020.





## Legend

### Vegetation and Habitat Map Classes

#### Herbaceous

Allium falcifolium - Eriogonum spp. - Streptanthus spp.  
Annual and Perennial Grassland

#### Shrub

Eriodictyon californicum - Lupinus albifrons  
Ceanothus thyrsiflorus  
Adenostoma fasciculatum  
Ceanothus oliganthus  
Arctostaphylos (bakeri, montana)  
Rubus armeniacus  
Arctostaphylos viscidula  
Californian Mesic Chaparral Group  
Ceanothus cuneatus  
Arctostaphylos (mixed) A. glandulosa  
Quercus durata  
Toxicodendron diversilobum  
Baccharis pilularis

#### Non-native Forest and Shrub

Non-native Forest & Woodland  
Eucalyptus  
Non-native Shrub

#### Riparian Forest and Shrub

Vancouverian Riparian Deciduous Forest Group  
Riparian/Wash Scrub Group  
Populus fremontii Alliance  
Riparian Evergreen and Deciduous

#### Hardwood Forest

Acer macrophyllum  
Quercus wislizeni (tree)  
Aesculus californica  
Quercus agrifolia  
Quercus chrysolepis

Quercus garryana Alliance

Quercus kelloggii Alliance

Umbellularia californica

Quercus douglasii

Notholithocarpus densiflorus

Arbutus menziesii

Quercus lobata

Quercus (mixed)

#### Conifer Forest

Hesperocyparis sargentii

Pseudotsuga menziesii - Notholithocarpus densiflorus

Pinus ponderosa - Pseudotsuga menziesii

Pseudotsuga menziesii

Sequoia sempervirens

#### Herbaceous Wetland

Freshwater Aquatic Vegetation

Dry Stock Pond

American Freshwater Marsh

#### Agriculture

Annual Cropland

Irrigated Pasture

Orchard or Grove

Perennial Agriculture

Vineyard; Vineyard Replant

#### Other Map Classes

Forest Sliver

Water

Barren & Sparsely Vegetated

#### Developed

Urban Window

Major Roads

Developed

Today's regenerated Mill Creek Area forests are different from the ones that were cut in the 1800s. Clear-cut logging and settlement of the area led to subsequent forests being dominated by dense faster growing tree species. Douglas-firs and bays and tan oaks have become more common and widespread, expanding into areas that had been oak woodland, grassland and chaparral for hundreds or thousands of years. Fire suppression has left the forests full of stressed young trees, ground fuel (duff, buried logs, roots, etc) and dead material. Without recent harvesting and regular burning or wildfire occurrence, trees have grown quite dense. Areas that formerly had well spaced older trees with tree densities of less than 100 trees per acre are now packed with dense young "fire-ladder fuel" forests with hundreds or even thousands of trees per acre.

Average old-growth redwood trees stand about 200-240 feet, and have

diameters of 10-15 feet. In the Mill Creek Area, however, only a few stands of these larger old-growth trees remain, mostly in Mill Creek valley and along the more inaccessible ridges and north-facing slopes. Second- and third-growth growth stands occur throughout the area in the valleys along the slopes, where they occur with tan oaks, madrones, California bay laurels and Douglas-firs.

Moderate disturbances, particularly low-intensity burns that once helped maintain the redwood forest, no longer occur with any frequency. Such fires, which recycled soil nutrients and kept the forest floor open, are far different from the high-intensity wildfires of today. Selective cutting for firewood and timber, when carefully done, is a moderate disturbance that results in healthier, more biodiverse forests. The benefits of regular burning, a technique used by indigenous people for millennia, are increasingly recognized as a means to both promote ecological health and to reduce fuel loads, which helps protect homes from much more catastrophic wildfires.

## 14.2 Wildlife

Forest and woodland habitats that dominate the Mill Creek Area support a variety of birds, mammals, amphibians, reptiles, invertebrates, and fish species. Here we provide a brief summary of some of the commonly occurring species in the area. Descriptions of some of the rare, threatened or endangered animal species that often occur in the area can be found in the following section, 14.3.

### Mammals

Commonly occurring mammals in the Mill Creek Area include: bobcats, grey foxes, striped skunks, racoons, deer, brush rabbits, jack rabbits, western grey squirrels, feral pigs, mountain lions, and coyotes. Less common but also present in the region in very low numbers are ring-tailed cats, porcupines, and the occasional black bear. Small mammals also occur, such as dusky-footed woodrats, white-footed deer mice, California voles,

and pocket gophers. There are also over a dozen bat species with known occurrences in northern California, and a number of these species have a high probability of occurring in the area (see [Appendix E](#)).

## **Birds**

Birds represent the most numerous and prominent wildlife species within the Mill Creek Area. Year-round resident birds include chestnut-backed chickadee, western scrub-jay, Steller's jay, American robin, common bushtit, plain titmouse, Bewick's wren, California quail, dark-eyed junco, black phoebe, spotted towhee, and Anna's hummingbird. Larger birds commonly present throughout the area include the turkey vulture and wild turkeys.

Migratory species observed and potentially breeding within the area include a number of species like the solitary vireo, flycatchers, orange-crowned warbler, Wilson's warbler, Allen's and Rufous hummingbirds, and black-headed grosbeaks. This area is part of the Pacific Flyway for migratory birds. Foraging and breeding habitat exists in the area for Sonoma County's most common raptors: red-tailed and red-shouldered hawks, as well as Cooper's and sharp-shinned hawks. A variety of owls are present including: great horned owl, barn owl, saw-whet owl, northern pygmy owl, western screech owl, and more rarely, the northern spotted owl (See *Section 14.3.2 for further discussion of this species*).

Tree-climbing birds common in the area are nuthatches, chestnut-backed chickadees and brown creepers, as well as acorn, Nuttall's, hairy, and downy woodpeckers. The dense fir and redwood patches are also key habitat for North America's largest woodpecker, the pileated woodpecker. Casual winter residents include ruby-crowned kinglet, varied thrush, Townsend's, and yellow-rumped warblers.

## **Amphibians & Reptiles**

Locally common amphibians include the Pacific tree frog, *Ensatina*, California slender salamander, arboreal salamander, California giant salamander, rough-skinned newt, and red-bellied newt. Common reptiles found in this community include western pond turtle, Skilton's skink, western fence lizard, alligator lizard, common kingsnake, gopher snake, ring-necked snake, sharp-tailed snake, California red-sided garter snake, and the Pacific rattlesnake.

## **Fish**

Three species of anadromous fish are present within Mill Creek watershed: the endangered coho salmon (*Oncorhynchus kisutch*), and the threatened steelhead (*Oncorhynchus mykiss*) and Chinook (*Oncorhynchus tshawytscha*). For more information on these salmonids, see section 14.3.2 (Sensitive Animal Species).

Use of the streams in the Mill Creek watershed for spawning, rearing, and migration by these three species of salmonids has been observed throughout the watershed and its tributaries<sup>1</sup>. In addition to coho, steelhead, and Chinook, other fish found within the watershed include: sculpin (*Cottidae*), California roach (*Lavinia symmetricus*), threespine stickleback (*Gasterosteus aculeatus*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), fathead minnow (*Pimephales promelas*), Pacific lamprey (*Lampetra tridentate*), Sacramento sucker (*Catostomidae*), and Sacramento pikeminnow (*Ptychocheilus grandis*).

## **14.3 Sensitive Plant and Animal Species**

Vegetation classification manuals<sup>12,13</sup> were consulted to help describe the structure and composition of existing communities. The potential occurrence of special-status species (listed in [Appendix E](#)) within the area was determined based on occurrences reported in the California Department of Fish and Wildlife California Natural Diversity Database,<sup>14</sup> the primary source for special-status plant and animal sighting information in the state.

In California, special-status plants and animals include those species that are afforded legal protection under the Federal and California Endangered Species Acts (ESA and CESA, respectively) and other regulations. Consideration of these species must be included during project evaluation in order to comply with the California Environmental Quality Act (CEQA), in consultation with state and federal resources agencies, and in



the development of specific management guidelines for resource protection. For the purposes of this Plan, special-status species are defined as the following:

- Species listed or proposed for listing as threatened or endangered under the federal ESA,
- Species listed or proposed for listing as threatened or endangered under the California ESA,
- Species that are recognized as candidates for future listing by agencies with resource management responsibilities, such as U.S. Fish and Wildlife Service, NOAA's National Marine Fisheries Service, and California Department of Fish and Wildlife,
- Species defined by California Department of Fish and Wildlife as Species of Special Concern,
- Species classified as Fully Protected by California Department of Fish and Wildlife,
- Plant species, subspecies, and varieties defined as rare or threatened by the California Native Plant Protection Act (California Fish and Wildlife Code Section 1900, et seq.),
- Plant species listed by the California Native Plant Society as List 1 and 2 and some List 3 plants under CEQA (CEQA Guidelines Section 15380); some list 4 plants based on CNPS guidelines (CNPS 2013); see [Appendix E](#) for explanation of CNPS rankings, and,
- Species that otherwise meet the definition of rare, threatened, or endangered pursuant to Section 15380 of the CEQA Guidelines.

Projects undertaken, funded, or requiring a permit by a public agency must comply with the California Environmental Quality Act (CEQA). The primary purpose of CEQA is to inform decision-makers and the public about the potential environmental impacts of the proposed activities.

#### 14.3.1 Sensitive Plant Habitats

A brief overview of a few of the more commonly occurring sensitive plant habitats in the area is provided below. For a complete list of plant species potentially present in the area that are considered sensitive by CDFW, USFWS or the California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California<sup>15</sup>, see [Appendix E](#).

There are three major sensitive plant habitat types in the Mill Creek area: **Valley Oak Woodland**, **Riparian Corridor** along Mill Creek, and the **Serpentine "Cedars"** area in the western portion of the area. Several sensitive plant species occur in these areas and potentially throughout the Mill Creek Area. Several animal species that are listed or considered rare or sensitive are known to occur in the area as well. Below is a brief discussion of some of the sensitive plant and animal species known to occur in the Mill Creek Area. For a complete list of all sensitive species of plants and animals that may occur in the Mill Creek CWPP, see [Appendix E](#).

##### *Valley Oak Woodland*

Valley oak woodland is among the rarest of habitats in California (Holing 1988). Once covering much of the Central Valley, they were cut for fence posts, firewood and flooring when the land was cleared after 1850. The Valley oak (*Quercus lobata*) is one of the largest oaks anywhere in the world, reaching up to 12 feet in diameter and growing over 150 feet tall. Growing slightly upslope from the riparian zone of Mill Creek, these park-like woodlands are increasingly rare. The majority of the Valley oak woodlands in the Mill Creek CWPP occur on the level and more gently sloping lands above Mill Creek in the eastern and central portions of the area, above the riparian corridor.

##### *Riparian Corridor/Old-Growth Redwoods*

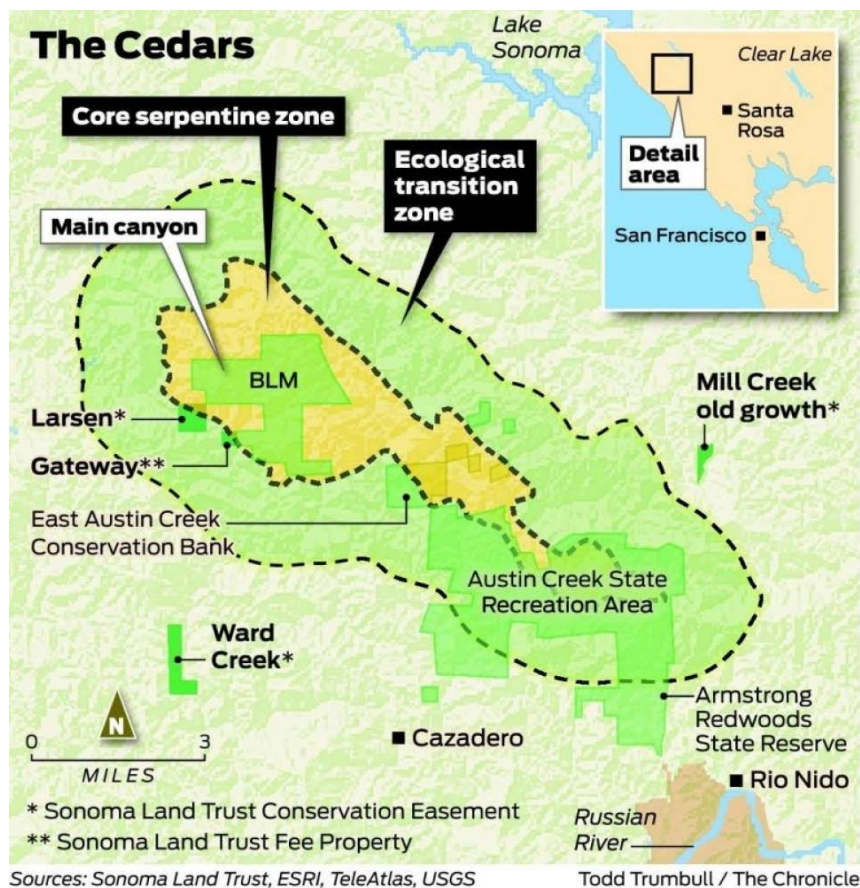
Sonoma County has designated areas within 50 horizontal feet of streams to be a special management zone where vegetation is protected from removal in order to stabilize the stream banks and to provide benefits to the riparian ecosystem, such as water quality and adequate shading for listed salmonids. These zones follow the length of Mill Creek, as well as Palmer Creek, Wallace Creek, Felts Creek and Austin Creek.

The dominant tree species throughout much of this riparian corridor along Mill Creek are Coast redwoods (*Sequoia sempervirens*). While redwoods are not listed as an endangered species, the few old-growth stands that remain in the Mill Creek area are considered quite rare, as only about 5 percent of the former ancient virgin redwood stands remain nationwide. These massive trees can be as old as 2,200 years, although few that old still remain. A second-growth stand of even-aged redwoods has little in common with the twilight world of the old-growth forests, where trees are so large that only about 30 trees grow in a single acre, supporting rare deep-forest species such as coho salmon, marbled murrelets, and northern spotted owls.

Redwoods are nearly a California endemic, stretching from just north of the California-Oregon border south to Big Sur. They occur only within a narrow band along the coast within the fog belt, usually within approx. 20 miles of the coast. About 2 million acres of second- and third-growth redwood forest still exist, but about one-third of that total are located in residential areas in Santa Cruz and Sonoma Counties. The remaining 1.3 million acres is commercial or "working" forestland — most of it in the northern coastal counties, and much of it too degraded and eroded to support the fish and wildlife species endemic to the primordial groves. The Mill Creek Area has several stands of old-growth trees that have been surveyed and preserved as part of conservation easements with the Sonoma Land Trust, as well as many more individual trees and several stands on private lands that have not yet been officially surveyed.

### *The Serpentine Cedars*

*The Cedars* (Fig. 10) makes reference to a remote and hard-to-access area in the East Austin Creek drainage. The area is located in the vicinity of the BLM parcels, towards the western portion of the CWPP area that is also known locally as the "Red Slide," a reference to the largest of its red-hued talus barrens<sup>16</sup>. *The Cedars* have been called arguably the most extraordinary natural resource occurrence in Sonoma County, and no other serpentine site can match *The Cedars* for its importance to the study and conservation of California's serpentine flora.<sup>17</sup> *The Cedars* has dozens of rare, sensitive, disjunct, and unique plant species, with at least six endemic taxa.



**Figure 10. The Cedars.** A serpentine canyon system in northwestern Sonoma County, The Cedars constitute a most extraordinary natural resource, important for conservation efforts both for Sonoma Co. and the entire state of California.

*The Cedars Conservation Plan* was recently written (2009) by the Sonoma Land Trust<sup>17</sup> for this area, encompassing 35,000 acres of core and transitional serpentine ecosystems. While centered on several BLM landholdings, approximately 80% of the Cedars conservation area is privately owned. In 2006, the BLM designated their 1,500 land-locked acres in the center that they own as an Area of Critical Environmental Concern (ACEC), the strongest protection that the BLM can offer its lands.

A variety of plants are endemic to *The Cedars* area, as its underlying geology is serpentine, an usual mineral that weathers to produce a thin gravelly soil peppered with rocks and small boulders and talus<sup>16</sup>. Serpentine is low in essential nutrients but is high in magnesium and other heavy metals, which make it difficult for most plant species to survive there. The plants that do survive in these isolated geological pockets often become quite specialized and can no longer survive in other habitats.

*The Cedars* is a classic example of what is called a “floristic island”, with at least eight endemic plant taxa (plants that occur nowhere else in the world). Some of the unique species found in this area include the *Cedars* manzanita, purple-leaf stream orchid, *Cedars* fairy lantern, *Cedars* buckwheat, *Cedars* creambush, serpentine fleabane, and at least two jewelflowers (*Streptanthus spp*). A Recovery Plan for the federally endangered plants of serpentine species in the Bay area has been written by the U.S. Fish and Wildlife Service.<sup>18</sup>

The “*Cedars*” is actually a botanical misnomer, as it refers to *cypress* trees, the Sargent cypress (*Hesperocyparis sargentii*). While not restricted to *The Cedars*, the Sargent cypress is a dominant woodland feature in the area. Sargent cypress are generally restricted to soils of serpentine origin. These rare Sargent cypress woodlands occur in *The Cedars* area in the far northwestern portion of the Mill Creek area within and near the BLM landholdings, as well a small population in the Palmer Creek watershed. Wildfire is the predominant event that triggers its regeneration, as its resinous wood often explodes in a crown fire. The fire melts its resin bonds and its tightly closed serotinous cones are opened by the heat of the fire, and the seeds are liberated onto the ashes below, where they germinate. Seeds dropped at other times rarely germinate and survive. The close connection between fire and Sargent’s cypress results in a correlation between the stand age and the number of years since the stand last burned. While most Sargent cypress exist as stunted dwarfs in the *Cedars*, they can sometimes reach huge diameters and heights if the stands evade fire.

### 14.3.2 Sensitive Animal Species

Habitat for fish and wildlife in the Mill Creek watershed has been impacted by the history of timber harvest and other land use practices, but habitat remains in some areas that still supports many sensitive species. Many upland wildlife species suffer from fractured habitat continuity, or degraded habitat from land use practices. The redwood region suffers from a lack of mature, or old-growth, forest characteristics to which many terrestrial species have adapted their habits. Characteristics of these mature stands include large trees within a stack multi-layered canopy with large numbers of snags and downed logs present that contribute to an increased level of stand decadence. Snags, den trees, nest trees of the area are required habitat elements for more than 160 wildlife species.

The Mill Creek Area still contains some old-growth redwood, however, and there are also larger second- and third-growth conifer trees with recovering old-growth characteristics. While only a small portion of the forested area remains as old-growth habitat, the stream habitats for fish have been slowly recovering thanks to recent restoration efforts. While a complete list of all of the potential occurring sensitive animals of the Mill Creek Area can be found in [Appendix E](#), the following is a discussion of some of the more commonly occurring listed and sensitive species known to occur throughout the Mill Creek area.

#### *Birds*

The dominant habitat type in the Mill Creek Area is second- and third-growth redwood and Douglas-fir forest, which is a mix of conifer species as well as tanoak and madrone. Like many other areas in the region, the Mill Creek Area suffers from a lack of mature old-growth forest characteristics to which Federally Threatened bird species, such as the northern spotted owl (*Strix occidentalis caurina*) and marbled murrelet (*Brachyrhampus marmoratus*), have adapted. Mature stands that do occur have some large trees within a multilayered canopy with large snags. While no marbled murrelets have been documented nesting in the Mill Creek area, they are known to currently breed west of the Mill Creek area, in the Austin Creek State Recreation Area and Armstrong Reserve. Northern spotted owls are known to occur and breed in selected portions of the Mill Creek area. For a

complete list of bird species of special concern that could be present in the Mill Creek area, see [Appendix E](#), and other references below<sup>19</sup>.

### **Northern Spotted Owl**

Northern spotted owls (*Strix occidentalis caurina*) were listed as Federally Threatened by the United States Fish and Wildlife Service (USFWS) in 1990, and occur from Marin County to British Columbia. They are usually restricted to nesting in cavities or crowns of old-growth redwood and Douglas-fir stands that are at least 200 years old. The snags and woody debris in these old-growth forests provide cover for the flying squirrels and dusky-footed woodrats that form the owl's major prey. Over 95% of the former old-growth forest that once occurred in California and the western states is now gone, and it is estimated that fewer than 6,000 northern spotted owls remain<sup>20</sup>. The remaining population of northern spotted owls has been declining throughout their range at unsustainable rates of 1.2% to 8.4% per year<sup>21</sup>.

The habitat that remains is very fragmented, and when harvesting creates too large an opening, predators and competitors like the great horned owl and barred owl can move in, driving spotted owls from the remaining areas. Northern spotted owls have been observed in the southern portions of the watershed. Late-successional forest habitat is located throughout the watershed, providing an opportunity to decrease habitat fragmentation caused by past forest management activities in the watershed and increase the total amount of habitat for at-risk species. A few USFWS protocol-level surveys have been conducted for spotted owls in the Mill Creek watershed area recently for Timber Harvest Plans that confirm their presence in the area (D. Grout. *pers. comm*).

Northern spotted owls generally inhabit older forested habitats because they contain the structural characteristics required for nesting, roosting, and foraging. Specifically, northern spotted owls require a multilayered, multispecies canopy with moderate to high canopy closure. The stands typically contain a high incidence of trees with large cavities and other types of deformities; large snags (standing dead trees); an abundance of large, dead wood on the ground; and open space within and below the upper canopy for spotted owls to fly. Recent landscape-level analyses suggest that in some parts of the subspecies' range a mosaic of older forest habitat interspersed with other vegetation types may benefit northern spotted owls more than large, homogeneous expanses of older forests. In redwood (*Sequoia sempervirens*) forests along the Coast Range of California, northern spotted owls may be found in younger forest stands that contain structural characteristics of older forests. Habitat for the northern spotted owl continues to decline by at least 2% per year range-wide, due mainly to timber harvesting and catastrophic wildfires<sup>20</sup>.

Forest management on private lands can be conducted so as to avoid impacts to spotted owls by following the *Northern Spotted Owl "No-Take" Guidance for Private lands in California*<sup>22</sup>. No Critical Habitat for the northern spotted owl occurs within or near the Mill Creek CWPP area.

### **Marbled Murrelet**

This rarely seen bird species is also listed as Threatened by the USFWS, and as Endangered by the California Department of Fish and Wildlife (CDFW). Critical Habitat for the marbled murrelet occurs in the Austin Creek State Recreation Area to the west of the Mill Creek CWPP. The marbled murrelet is listed in the USFWS Critical Habitat Database as occurring in the southwestern corner of the Mill Creek watershed. No suitable nesting habitat is known to occur in the planning area and no recent surveys for marbled murrelets have been conducted within the Mill Creek watershed, and so no recent documentation of their presence within the Mill Creek CWPP area is currently available.



## Mammals

While several sensitive mammal species are known to occur within the Mill Creek area, none are listed as threatened or endangered by the USFWS or CDFW, but a few are designated as Species of Special Concern (SSC). Among those mammals that are rarely encountered but still confirmed as present in the planning area are: the North American porcupine (*Erethizon dorsatum*); Sonoma red tree vole (*Arobroimus pomo*) CDFW SSC; American badger (*Taxidea taxus*) CDFW SSC; Pallid bat (*Antrozous pallidus*) CDFW SSC; Townsend's big-eared bat (*Corynorhinus townsendii*) CDFW SSC; and western red bat (*Lasiurus blossevillei*) CDFW SSC.

While not listed, the wide-ranging mountain lion (*Felis concolor*) is also a regular visitor to the Mill Creek Area, subsisting primarily on deer and feral pigs, but also sometimes taking some stock animals as well. Several individual lions in the County have recently been outfitted with GPS collars to help study their movements and hunting behaviors.

## Amphibians and Reptiles

A variety of amphibian species, including the state and federally listed and CDFW Species of Special concern California red-legged frog (*Rana draytonii*), depend upon small-pond depressional wetlands and riparian areas in the watershed for breeding and rearing habitat. Additional species present include the foothill yellow-legged frog (*Rana boylei*) - CDFW SSC; candidate for CDFW; red-bellied newt (*Taricha rivularis*) - CDFW SSC; western pond turtle (*Emys marmorata*) - CDFWS SSC; and the California giant salamander (*Dicamptodon ensatus*) CDFW-SSC. Habitat for the federally Endangered California tiger salamander (*Ambystoma californiense*) does not occur within the Mill Creek Area, and the closest extant population for the species occurs over 6 miles to the southeast, east of the Russian River in the Santa Rosa area<sup>23</sup>.

## Invertebrates

Among others, two sensitive invertebrates that occur in the area are the obscure bumble bee (*Bombus caliginosus*) - International Union for Conservation of Nature (IUCN) vulnerable, and the western bumble bee (*Bombus occidentalis*) - USFS Sensitive Species. For a complete list of listed or sensitive invertebrate species that may occur in the area, see [Appendix E](#).

## Fish

Mill Creek itself is a Class I stream, meaning that it provides habitat for fish, which flows directly into Dry Creek near its convergence with the Russian River. Mill Creek winds past redwood forests, vineyards and private homes west of Healdsburg, California. A major tributary to the Russian River, it harbors some of the best habitat for federally endangered **coho salmon** (*Oncorhynchus kisutch*) and threatened **steelhead trout** (*Oncorhynchus mykiss*) in the watershed.

The National Oceanic & Atmospheric Administration's National Marine Fisheries Service (NMFS) is the federal agency responsible for planning the recovery of threatened and endangered salmon in the United States. The Mill Creek watershed falls within the critical habitat designated for federally endangered Central California Coast (CCC) coho salmon, federally threatened California Coast Chinook and for federally threatened CCC steelhead trout. NMFS has been active participants in the planning and identification of restoration priorities for the recovery of endangered salmonids in the Mill Creek watershed and the greater Russian River.

Forest management decisions upslope of Mill Creek have the potential to impact water quality throughout the fish-bearing stream and thus the habitat of these listed species. Agency consultation and best management practices should be employed during any projects conducted on both road and vegetation treatments to reduce the risk of sedimentation to the anadromous fish ecosystem.

Fish habitat in the Mill Creek watershed has been impacted by historical timber harvests and other land use practices in the watershed. Only a small part of the watershed remains old-growth habitat, and stream habitat for fish has been degraded. Several other species of anadromous fish also live in the watershed including Chinook salmon (*Oncorhynchus tshawytscha*). Due to a lack of historic survey records, it is unknown whether Chinook salmon were present in the Russian River prior to the first release of hatchery fish in 1881, however, a self-sustaining population of Chinook currently exists today.

### **Coho Salmon**

A recovery plan by the NOAA National Marine Fisheries Service identified Mill Creek as the highest priority area for coho conservation and habitat enhancement in the Russian River watershed. Early documentation of salmonid presence in the Mill Creek watershed is limited, but historic coho salmon presence was confirmed in Mill Creek, Felta Creek and Wallace Creek, and steelhead trout were likely present in all of the major tributaries within the system.

The Russian River watershed once supported native runs of anadromous coho (*Oncorhynchus kisutch*) and pink salmon (*O. gorbuscha*), as well as steelhead trout (*Oncorhynchus mykiss*). Russian River coho salmon were historically prevalent enough to support a commercial fishery once numbering 100,000. Pink salmon are now extirpated from the system.

The Central California Coast Evolutionarily Significant Unit (CCC ESU) of coho salmon (including those found in the Russian River), which are estimated to have numbered in the tens of thousands as recently as the early 20th century, are on the brink of extinction. The decline of CCC coho has been especially rapid in recent decades, resulting in their listing as endangered under both the State of California and federal Endangered Species Acts. Critical Habitat has been designated for the coho within the Riparian Corridor of Mill Creek, Palmer Creek, Felta Creek and Pena Creek.

Unfortunately, less than one percent of all the salmon that hatch or are stocked in the watershed ever complete the round trip back home to breed. During the late 1900s the salmon began to disappear, stream by stream, throughout the watershed. In 2001 naturalists, fishermen and the community discovered that the population had crashed, with only 5 Coho counted returning to breed in 2001. By 2004, only 3 of 39 tributaries and creeks in the entire Russian River watershed held any coho at all.

The NMFS *Recovery Plan for Central California Coast Coho Salmon Evolutionarily Significant Unit* (Coho Recovery Plan) identifies water conservation strategies for the Russian River. The Coho Recovery Plan designates 11 tributaries as core, high priority areas for coho protection and restoration work in the Russian River basin. The Mill Creek watershed is one of these core priority areas, and was a focused watershed for a proposed flow recovery program beginning in 2013. Experts consider the upper reaches of Mill Creek to have the perfect mix of what coho salmon require to survive: steady flowing water, woody cover, cool pools and clean gravel beds for salmon eggs. Water flow is especially critical: after hatching, juvenile coho spend an entire year or more in the stream before heading to the sea. Mill Creek is considered a high priority for restoration. In response to declining salmonid populations, more than 10 years of study and planning, captive breeding and painstaking stream rehabilitation then ensued, conducted by a group of local, state, and federal agencies, private groups, academic institutions, community coalitions, concerned individuals, private landowners and NGOs. They began to conserve and restore critical salmonid habitat within the Russian River watershed. In 2001, with Russian River coho salmon populations on the brink of extinction, a collaborative effort was formed to restore self-sustaining runs of native coho salmon to streams within the watershed that historically supported them.

The Russian River Coho Salmon Captive Broodstock Program (Broodstock Program) represents a broad partnership involving the CDWF, NMFS, U.S. Army Corps of Engineers (USACE), SCWA, UC-Sea Grant, and hundreds of private landowners. This multi-year program was built on the use of native coho juveniles as

broodstock for the production of juvenile salmon for release into historic coho streams. Broodstock program partners carefully capture wild juvenile coho, rear them to adulthood at the Don Claussen Warm Springs Hatchery, spawn them, release the juvenile offspring into selected tributary streams and monitor their growth and survival until the fish move downstream to the ocean. This cycle is repeated annually, along with monitoring of adult coho that return to spawn in those same streams two to three years after their release as juveniles.

As a major tributary to Dry Creek, Mill Creek was found to be an important coho stream where “most of the qualifying summer rearing habitat” is located within the Russian River watershed. Two restoration projects were identified as priorities for SCWA to implement in the Mill Creek watershed:

1. Wallace Creek Fish Passage Enhancement - at the Wallace Creek Road/Mill Creek Road crossing was ranked as a high priority for removal.
2. Mill Creek Fish Passage Improvement - a recently undermined flashboard dam on private property exists midway in the watershed which is a partial barrier to migration for adult and juvenile coho and steelhead.

A dam removal project was proposed and funded on lower Mill Creek to help the coho and steelhead move upstream. The private landowners whose property surrounds that area of Mill Creek agreed to assist in the project, and the project was completed in October 2016. By February 2017, more than eight Coho redds had been counted upstream of the former dam site. Red-flushed mature coho salmon are now once again found spawning in the tree-shaded upper reaches of Mill Creek, up to Angel Creek, where they had been virtually absent for decades (**Fig. 11**).



**Figure 11. Coho salmon returns to Mill Creek.** Coho salmon observed spawning upstream of the newly-remediated passage barrier of Mill Creek. “The Mill Creek Dam Fish Passage Project is one of the most important actions we can take to help bring [coho] back in the Russian River. Its completion is a major step forward for coho salmon and steelhead.” Joe Percharich, NOAA Fisheries. (Photograph by Sea Gant<sup>24</sup>).

There were over 2,294 Coho smolt estimated in Mill Creek in 2019. Over the past 15 years, millions of dollars have been invested in restoring the coho to Mill Creek through the Broodstock Program and Mill Creek Salmonid Monitoring Projects<sup>1</sup>.

Additionally, in association with Sea Grant California, The University of California's Russian River Coho Salmon Captive Broodstock Program conducts ongoing monitoring of salmonid populations in tributaries to the lower Russian River in order to evaluate the efficacy of the Broodstock Program, and to apply advances in scientific knowledge to its management.<sup>25</sup> Working in this capacity, they are documenting the abundance, survival, and distribution of wild and program-raised coho salmon throughout the southern portion of the Russian River basin over time. Both wild and hatchery stocks of Mill Creek coho have been the subject of year-round monitoring since the first Broodstock Program planting in 2004, with additional documentation of steelhead and Chinook. Through this program, Passive Integrated Transponder (PIT) tag recording stations were placed along Mill Creek. Information about the PIT tag program can be found on the California Sea Grant website<sup>26</sup>.

Additional information about these programs, and the data that they have collected, can be found in the 2015 Mill Creek Watershed Management Plan<sup>1</sup> prepared by the Sonoma Resource Conservation District.

### **Steelhead Trout**

Russian River steelhead formed the basis of a highly prized game fishery that attracted anglers from around the world until the 1950s. Steelhead are now listed as threatened under the Federal Endangered Species Act.

Steelhead and coho salmon fry over-summer in their natal streams before migrating out to sea the following winter/spring. Steelhead may stay in their natal streams for up to four years before out-migrating. Water temperature and quantity during the summer and fall low-flow periods are two of the most important limiting factors for survival of juvenile steelhead trout and coho salmon in stream habitats. When water temperatures exceed 68°F (20°C), salmonid fry become stressed and their ability to grow is reduced. In addition, as water temperature increases, the concentration of dissolved oxygen decreases, which adds stress to juvenile salmonids.

When adult salmonids return to freshwater stream habitats to spawn, suitable conditions must be present for them to reproduce successfully. Adequate water depth for migration and complex scour sites for refugia are needed to reach the spawning sites. Typical spawning habitats occur at the transition between a pool and riffle, termed "riffle crest." Substrate size and the lack of excessive fine sediment are required for a female to dig the redd (nest) prior to depositing the eggs. Thresholds for fine sediment in spawning habitats are measured using embeddedness ratings, and when embeddedness exceeds 50% the site is considered unsuitable for spawning purposes.

Salmonid recovery, habitat restoration and monitoring projects have resulted in a marked increase in the number of steelhead in Mill Creek and the greater Russian River system, with almost 80,000 steelhead spawning in the Russian River watershed in 2019, twice as many as in 2018.

## **14.4 Sudden Oak Death and Tree Mortality**

Sonoma County has been heavily devastated by the tree disease **Sudden Oak Death (SOD)**, caused by the plant pathogen *Phytophthora ramorum*. The infection was first detected in the tanoak trees in Marin County in 1995. *P. ramorum* was introduced to California by infected nursery stock. Since its discovery, it has steadily moved north along the coastal regions of California, into Oregon and Washington. It has since been identified in the Southeast US, and around the world.



In 2007, Sonoma County had the highest rate of new infection in the state. County-wide there are hundreds of thousands of SOD-killed trees on more than 75,000 acres. The disease is especially deadly to tanoak, live oak, and black oak trees. These dead trees greatly increase fire fuels and pose falling risks year round (*Sonoma County Sudden Oak Death Strategic Response Plan*. University of California Cooperative Extension, Sonoma County, and the Sonoma County Department of Emergency Services, January, 2008).

SOD has heavily impacted the Mill Creek Area of Central Sonoma County due to three primary conditions: 1. *P. ramorum* thrives in the cool, wet climates which typify our winters; 2. California bay laurel, which grows throughout our forested areas, acts as breeding grounds for inoculum, which may then be spread through wind-driven rain, flowing water, plant material, or human activity; and 3. Tanoak, which is especially vulnerable to SOD, is a dominant species. All three conditions exist in the Mill Creek Area.

The death rate of tanoak, coast live oak and black oak trees has accelerated alarmingly in the affected areas. Tanoak trees are extremely resilient to most pathogens, which makes their susceptibility even more unusual. An inconsistent symptom of the pathogen is an oozing of liquid, usually on the trunk of the tree. The *Phytophthora* species enters through the bark and limbs, and thrives in wet conditions. Signals to watch for are sudden decline and death of tanoak, usually in isolated individual trees, and a brown or black resinous exudation on the lower trunk.

Crowded forests are less healthy than more open ones, as trees compete for limited sunlight, water and nutrients. Just as human sickness spreads quickly under crowded conditions, so do plant diseases. Bay trees carry the Sudden Oak Death pathogen but rarely succumb to it. In dense conditions, the disease spreads easily to coast live oaks and tanoaks, which are now dying off in large numbers in the Mill Creek Area.

Stands of tanoak which are extremely crowded from repetitive resprouting after logging, clearing, or fire are already stressed and may be more susceptible than more open, less dense or more mature stands. Large numbers of dead trees will cause operational complications for firefighters, severely impact egress and evacuation, increase fire behavior, and cause life safety risks. Therefore, removal of dead trees is a high priority.

SOD kills the above-ground growth of trees, leaving the roots alive. Unfortunately, this means that even if a dead tree is removed, it will sprout a significant amount of brushy growth from the stump, creating a low brushy fuel. Herbicides have been used to kill the tree, but there is significant opposition to herbicide use in the area. Stump grinding or removal of the root ball can help, but adds significantly to the cost.

Tanoak mortality varies from patchy to nearly total in heavily impacted areas. SOD has continued to kill trees in the Mill Creek Area since first identified over two decades ago. Unfortunately, little can be done to reduce the spread of SOD. More information about SOD can be found at [www.suddenoakdeath.org](http://www.suddenoakdeath.org).

At least two insects and two additional fungus diseases are associated with oak decline in the area: -the western oak bark beetle and the oak ambrosia beetle, and *Armillaria* root disease and *Hypoxylon thourarsiarum*. These may be contributing stress factors leading to mortality or they may also be causative. The area is also experiencing an increase in conifer mortality from various beetles, and pathogens like pine pitch canker. Lack of fire in the area has resulted in stands that are uniformly old, and are currently dying in large numbers. The proportion of dead fuels in the landscape is increasing annually at a significant rate. Tree mortality in the Mill Creek Area is expected to continue to worsen in the foreseeable future.

Removal of dead and dying trees is a critical need, especially near roads and homes. Removal can be very expensive. Grant funds can help, but challenges remain, such as the difficulty of obtaining contractors to do the

work, and maintenance of treated areas post-treatment. Outreach to affected property owners and collaboratively seeking solutions is a continuing need.

## **14.5 Wildland Fuels**

Decades of fire suppression, in combination with conversion of managed forest and grazing lands to residential use, along with climate change, have had dramatic effects on virtually all of Sonoma County's ecosystems, leaving a legacy of dense vegetation with a high proportion of dead materials and brushy fuels that will increase fire behavior and fire spread. This is certainly true in this project area, where vegetative fuels have been increasing for decades. Projects that will help increase forest health while reducing available fuel are critically important. Wildland fuels need to be thinned and maintained to create healthier forests and landscapes that are better adapted to our fire-prone environment. Sonoma County is the most highly parcelized county in California, and there is very little public ownership of forested timberlands in the county. Forest health therefore depends in large part on the private landowner. The relatively small size of land ownership in Mill Creek has created parcels that are mostly uneconomical for timber harvest. The general use at this time is "no-action," when active forest management is actually needed<sup>27</sup>.

Logging practices and the suppression of fires across California have altered the structure and composition of our forests, woodlands, chaparral, grasslands, and other communities. The understories of many forest, oak woodland and chaparral communities are often thick with Douglas-fir saplings. Douglas-fir trees rapidly overtop the canopy layer of oak woodlands, grasslands and chaparral, eventually shading out and killing the species beneath. Encroachment by Douglas-fir trees also increases the amount of woody debris and fuel in the understory, which can exacerbate the effects of forest fires.

While projects that increase forest health on a landscape scale are important, highest priority fuels treatments should be those which will help save lives and property. Reducing flammable vegetation within 100 feet of homes and on roadsides is critically important. It is also essential to educate residents about how to create "wildfire-adapted" homes and defensible space, and provide assistance that will help them reduce risks of economic and life loss.

## **15. Vegetation Treatment Options**

There are a wide variety of methods and programs available to help reduce the fuel load in the Mill Creek Area, and several vegetation treatment options to better manage our forests for fire resilience and other natural characteristics. Several of the most common techniques are described below, and many may be used simultaneously, or in succession, on a given piece of land, to achieve the desired effect. Consultation with a Registered Professional Forester and the pertinent natural resource agencies should obviously be done prior to planning or conducting any action that might have an impact on protected resources, as permits may be necessary in many cases.

### **15.1 Fuel Reduction**

Fuel reduction treatments improve forest resiliency by reducing wildfire severity and related mortality, improving tree growth, and stabilizing carbon retained in trees. Thinning activities implemented could change stand structure to concentrate carbon storage in more widely-spaced trees that are more resistant to wildfire, drought, and insect attack, and reduce the likelihood of wildfire transitioning into the forest canopy.

Treatments should focus on treating understory trees or brush to reduce surface and ladder fuels, disrupt both vertical and horizontal continuity of vegetative fuels, with forest management practices intended to stabilize sequestered carbon by changing forest stand structure to increase carbon storage in more widely spaced trees

in a more fire-resilient stand. Selection of practices must be done on a site-specific basis, and an assortment of practices to suit the circumstance should be selected.

Fuel reduction in some areas may also serve to improve or maintain the quality of in-stream aquatic habitat for the endangered coho and the Mill Creek Salmon Brood Stocking Program (see section 14.3). Researchers and foresters are beginning to manage redwood properties in a way designed to bring back old-growth characteristics, and can begin to see evidence of classic old-growth characteristics emerging in carefully managed second-growth redwood stands.

An increasingly popular management philosophy for the second-growth working forests favors streambed rehabilitation, conservation easements, slope stabilization and sustainable harvesting practices. After 150 years of focusing simply on extracting timber, forest specialists and landowners are now focusing on trying to recreate the fire-resilient ancient redwood ecologies that existed before Europeans settled California. A significant number of Mill Creek landowners are concerned with controlling erosion, thinning groves as a means of achieving old-growth configurations, improving coho habitat and controlling the role of fire in maintaining primeval forest characteristics.

Available management options for thinning the forested areas of the Mill Creek Area include:

- Mechanical (using large machines such as masticators),
- Manual Labor,
- Grazing of domestic livestock,
- Pile Burning,
- Herbicide,
- Shaded Fuel Breaks, and
- Broadcast Burn/Prescribed Fire

**Mechanical:** Employing large machines like masticators, grinders, and chippers, trees are taken down and chipped on-site. Chips can be disposed of by broadcasting, or removed off-site for disposal or reuse (firewood, chips for cogeneration, finished wood products, etc.). Mechanical treatment can only be used when roads allow access to the site. Costs for mechanical means of treatment per acre vary considerably, and the cost of treatment will increase along with fuel loading, steepness, and difficulty of access to terrain. Disruption to sensitive natural resources must be considered when using mechanical means.

**Manual Labor:** Chainsaws and other tools are used to cut trees and brush, either lopping and scattering, chipping debris in place, or burning in piles. Per-acre cost for hand work varies considerably, and the cost of treatment will increase along with fuel density, difficulty of access, and steepness of terrain.

**Grazing:** Properly managed, grazing of domestic livestock such as sheep, goats, and cattle can be an efficient and cost-effective means to control grasses and brush, and can greatly benefit soil health and the ecosystem. Grazing animals can browse noxious plants such as poison oak that are difficult to manage, and greatly reduce fuels on slopes too steep for maintenance.

**Pile Burning:** Pile burning is a method of eliminating vegetative material by incineration. Material is cut down and piled in relatively open areas with decent access by vehicles. The piles are fully or partially covered with waterproof material to cure, typically for one year, until they are dry. The piles are burned on cool moist days, and typically on days where rain is expected. Pile burning requires permits from Northern Sonoma County Air Pollution Control District.

**Herbicide:** Licensed and permitted herbicide application can be a useful tool for removing invasive and undesirable vegetation in selected areas, especially for maintaining safe clear roadsides and along shaded fuel breaks, where emerging and flammable plants can be quickly eradicated before they create a fire hazard.

**Shaded Fuel Breaks:** Fuel breaks are helpful features on the landscape because they provide relatively safe areas for firefighters to fight wildfire, and they provide areas of relatively light fuels from which to begin prescribed fire treatments. They also can be utilized to reduce fuels near roads and utility lines, which are the largest sources of ignitions. The exact location of where to strategically create shaded fuel breaks should be done in consultation with a registered professional forester and relevant regulatory land agencies.

**Broadcast Burn/Prescribed Fire:** Prescribed fire is one of the best and most cost-efficient means of fuel reduction<sup>28</sup>. Prescribed fire is the intentional use of fire to help control and reduce vegetation by removing small trees and brush. Broadcast burning, often called prescribed burning, is conducted during times of the year when fuel moisture tends to be higher, such as the spring or winter.

Not all fuels are the same. Fine fuels start, and carry fire, while large fuels sustain fire. Large-diameter logs and snags often provide habitat for various animals, and their retention should be considered despite concerns of fire. Snags (dead standing trees) over 24" diameter are often prioritized for retention, unless they pose a hazard to people, property, or access routes. Snags and downed logs of this size are too large to start a fire, although in the event of a fire they will potentially increase the intensity of fire due to their low moisture content. This issue will be negligible if the forest is maintained in a condition as described above.

By reintroducing fire into the fire-adapted Mill Creek environment, one can improve the health of the local ecosystem. However, needless to say, it does come with inherent risks and complications. Anyone planning a prescribed burn must have all necessary permits and permissions, and ensure that there are sufficient qualified individuals on hand to support burn activities. In areas where there is significant fuels build up, prescribed burns cannot be attempted until mechanical treatment has reduced available fuel. "Prescribed Burn Associations" are forming across the county to help property owners use prescribed fire. Community and fire agency acceptance and buy-in for any burn operation is critical. Increasing capacity for prescribed burning across the project area is a high priority.

There are many benefits to restoring a regular fire return interval to forested landscapes. Frequent fire consumes fuels while they are at a moderate level, which results in flame length and fire line intensities that are moderate; allowing larger trees to survive unscathed. This reduction in fuel loading lowers the risk of catastrophic wildfire over the long term, and it has the added benefit of creating park-like conditions that are preferred for hiking and recreation. Fire creates habitat elements, especially in redwood ecosystems, in the form of basal cavities (often called goose pens). Fire also is known to stimulate responses in forest foods, as acorns flush from oaks and tanoaks in response to fire.

In order to realize the benefits of moderate-intensity, low-severity, fire, broadcast burning must be conducted in a safe and controlled manner. Prior to any burns, fuels reduction treatments are often necessary. Usually treatments involve cutting down vegetation and laying it closer to the ground, so when prescribed fire is applied there are no fuel ladders to carry the fire into the forest canopy. Treatments may also include creating fuel breaks that are completely cleared of fine fuels and readily combustible material, so that prescribed burns can be directed into areas where the fire will burn itself out in a predictable way.

## 15.2 Forest Management Plans (FMPs)

The plan clearly describes the current and desired conditions of the forest resources, what short- and/or long-term goals the landowner has for the land, what management actions can be taken to achieve those goals, and what resources are needed for implementation. Forest Management Plans are individual plans



created for a parcel which outline goals and objectives for a forested property, identify cultural and biological resources on site, identify constraints to management, and provide recommendations or prescriptions for silvicultural treatments, vegetation management, road maintenance, etc. These documents are required in order to utilize government incentives programs, such as the California Forest Improvement Program under CALFIRE and the Environmental Quality Incentives Program under the Natural Resource Conservation Service (NRCS). A completed plan can also help the landowner meet grant requirements when collaborating with state and federal agencies for project funding. Workshops could be conducted in the Mill Creek Area to help landowners develop Forest Management Plans (FMPs) to increase the forest resilience and help them meet their ecological, economic and fire-management goals.

The FMP workshops could address landowner management objectives and planning, forest restoration, fuels reduction, project development, permitting, and cost-share opportunities. Participants could connect with other landowners and learn how to collect information to develop their own management plans. Participants who complete their plans could be eligible for a visit by a Registered Professional Forester to assess its content and discuss next steps.

### **15.3 Post-Fire Treatments**

The strategies discussed above all have as their goal fuel reduction to help mitigate the risk and damage from a wildfire. A wildfire will inevitably come, and substantial effort will be required to promote and restore forest health in a post-fire scenario. Potential projects in a post-fire scenario might include: debris removal, salvage logging, slash/fuel removal, road work for erosion control, water quality, stream sediment reduction replanting, reforestation and habitat recovery. Given the recent fire history in Sonoma County, there is much local expertise to draw from on this topic.

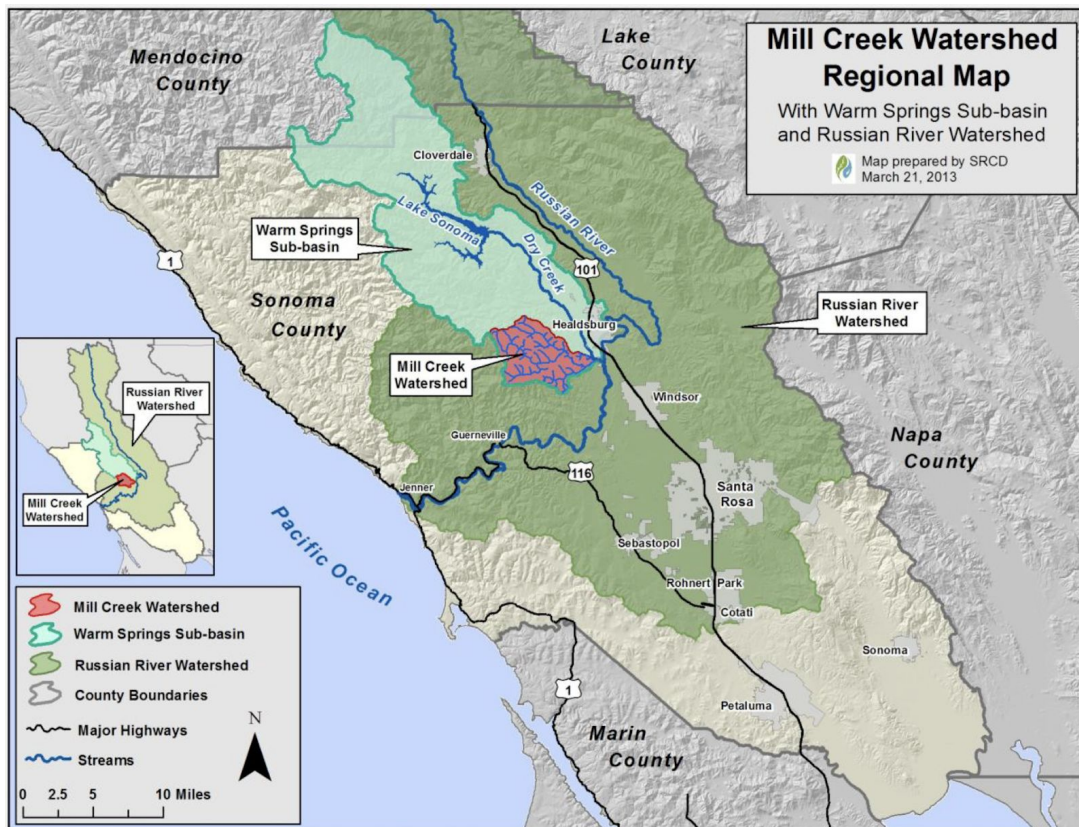
## **16. Water Supply**

The Mill Creek Area does not have a water distribution system. The nearest water system is in Healdsburg. Each house has its own water source, with wells being the most common source. Several houses and structures may utilize the same water source. Newer houses have been required to have a water supply accessible at the house. Firefighters are able to access private water sources including standpipes and water tanks, as well as accessing water from the rivers, streams, ponds, pools, etc. Water sources may be affected by droughts, long summers, lack of maintenance, and fittings not compatible with fire apparatus.

### **16.1 Watersheds and Hydrology**

The Mill Creek Area is formed nearly entirely by the Mill Creek watershed (**Fig. 2**, in the *Introduction* Section), with smaller portions of the Lower Dry Creek, Pena Creek, Lower East Gray Creek, Upper East Gray Creek, East Austin Creek, and Porter Creek watersheds. See **Fig. 12** for a geographical context of the watershed.

Mill Creek joins Dry Creek just above its confluence with the Russian River, where it forms the second largest tributary to that watershed. Major tributaries to Mill Creek include Felta, Wallace, Palmer, and Angel Creeks, along with a smaller tributary, Boyd Creek. These creeks combined drain a basin of approximately 24 square miles. The Mill Creek area system has a total of 30 miles of blue line stream and includes both 2nd and 3rd order streams. Streamflow patterns follow the rainfall in Mill Creek, and U.S. Geological Survey data from the 1980s<sup>1</sup> indicates that almost all of the streamflow occurs in the November-April timeframe, with high flows from January to March, and little surface water from June to November.



**Figure 12. Regional Context of the Mill Creek Watershed<sup>1</sup>.**

## 17. Assets at Risk

There is considerable risk of loss of life, property, and environmental values in the event of a wildland fire in the Mill Creek Area. A summary description of the assets at risk in the Mill Creek Area has been broken into the following topics: lives, houses and structures, businesses, utility infrastructure, and ecological values.

### 17.1 Lives

The demographic information was estimated from data obtained for the Mill Creek Community COPE, which contains 199 houses, and using Sonoma County's average size household factor of 2.57. Multiplying these numbers provides a population estimate of approximately 511 people. However, approximately 10% of the residences are utilized as "second homes" and/or short-term vacation rentals. This reduces the population estimate to approximately 460. The limited evacuation routes, as well as the potential for insufficient time to reliably alert and warn area residents, places them at a significant disadvantage during the early stages of a rapidly evolving wildfire that starts in or near the Mill Creek Area.

### 17.2 Residences and Structures

Sonoma County maintained geospatial data contains 780 structures inside the Mill Creek area. These structures vary from residences to storage sheds and also contain agricultural buildings and accessory dwellings. Please refer to **Table 1** for additional parcel information.

### 17.3 Other Assets of Importance to the Wider Community

In addition to the residences in the Mill Creek Area, there are also a number of historic structures and locations that are of high value to the wider community including the following structures:

- **Daniels Schoolhouse (Fig. 13):** Built in 1883, the Daniels School was designated a Sonoma County Historic Landmark in 2001; the land on which it stands was donated by Bonnie and Richard Pitkin to the Venado Historical Society; historical and structural renovations were completed in 2018. This landmark is used many times per year for community meetings as well for historical tours, and is currently administered by the Venado Historical Society<sup>29</sup>.
- **Venado Post Office (Fig. 14):** Venado was once a thriving timber and mining community near the end of Mill Creek Road. The Venado Post Office was opened in 1921 and closed in 1941. The historic building where a US Post Office once functioned, is located about 12 miles west of Healdsburg, along Mill Creek Road.
- **Venado Weather Station:** located at the end of Mill Creek Road, at an elevation of 1,260 feet above sea level, the station has been an official reporting station for the US National Weather Service since 1939, and it regularly documents record-setting precipitation levels for the County and the State.
- **Rosenberg Boy Scout Camp:** this outdoor youth facility was dedicated in 1924. The main camp area is located north of Mill Creek Road west of Palmer Creek Road, and has sleeping, cooking, and bathroom facilities frequently hosting 10-40 Boy Scouts. The property averages 6-10 uses per year during fair weather conditions.



**Figure 13. Historic Daniels School.** A one-room schoolhouse built in the 1800s.





**Figure 14. Venado Post Office.** *A functioning post office between 1921 and 1941.*

## **17.4 Businesses**

The Mill Creek Area contains:

- Eighteen parcels with wine grape vineyards representing 14 different vineyard businesses (estimated from MLS data)
- Several historic and active agricultural farms and orchards
- One small ranch
- An unknown number of small businesses that function in residences. Many local residents have home-based businesses: carpenters, woodworkers and other trades, solar technicians, high tech, “telecommuters,” artists, vegetable farmers, etc.

## **17.5 Utility Infrastructure**

The utility infrastructure of the Mill Creek Area consists of:

- Electricity supplied primarily by Pacific Gas and Electric (PG&E) through above-ground electrical lines running the length of Mill Creek Road (and from Mill Creek Road to individual residences)
- Electricity supplied by private solar systems installed by an unknown number of residents
- Backup electricity supplied by propane generators
- Water supplied by individual well water systems and tanks
- AT&T landline phone service: above-ground telephone lines that share poles with PG&E electrical lines



- Satellite telephone service used by an unknown number of residents
- Internet service supplied by satellite dish or line-of-sight transmission
- Propane tank storage on most residences
- AT&T cell tower proposed for 6699 Mill Creek Road

## 17.6 Ecological Values

Ecological values of the Mill Creek Area's forests include timber, biodiversity and watershed protection, among others. The trees, forests, creeks and natural habitats of the Mill Creek Area benefit the physical and emotional wellbeing of residents and visitors alike, and they are a large part of the reason most residents love to live in this area. Plant, flower and wildlife species are valued for their aesthetic as well as more utilitarian purposes such as agriculture, as birds and bees are essential pollinators. Rare species that occur include the northern spotted owl, coho salmon and steelhead trout are indicators of forest and stream health. Healthy mature forests ecosystems also help maintain water quality, and a variety of trees in the forest ecosystem are prized for firewood and lumber.

### 17.6.1 Climate Change and Carbon Sequestration

Climate change is likely to increase the frequency and intensity of local wildland fires<sup>30</sup>. Regional projections of the likelihood of very large wildland fires under a changing climate in the contiguous Western United States (Climatic Change 126(3-4): 455-468). Non-timber monetary value is now also being placed on forests, as they are being recognized for their ability to buffer climate change through capturing carbon. The carbon sequestration credits that might be harbored in a forest the size of the Mill Creek Area could be worth several million dollars in a Carbon Cap and Trade market. Redwood trees are over 50% carbon by weight, and recent studies indicate that old-growth redwood forests sequester more atmospheric carbon dioxide than any other tree on the planet, and they do so while maintaining wildfire resilience and water quality, and providing habitat for many threatened and endangered species of concern.

The California Forest Carbon Plan (CFCP Draft, 2017) identifies forestland as the largest land-based carbon sink in the state, but recent trends and long-term evidence suggest that certain forests may become a source of overall net greenhouse gas (GHG) emissions if actions are not taken to manage forests in a way to enhance their potential to sequester carbon. Climate change impacts California's forests with more frequent and severe wildfires, pests, disease, increased temperatures, and changes in water availability. These effects may decrease forest growth, and thus decrease rates of carbon sequestration, as well as result in forests lost to widespread tree mortality, increasing rates of GHG emissions.

In the face of climate change, as temperatures increase and extended droughts are likely to be more common, researchers found that forests actively managed for resilience were better able to sustain their current carbon sequestration rates under significantly hotter and drier conditions than unmanaged stands (CFCP Draft 2017). As a result, how forests are managed has a significant effect on the atmosphere. Forest stand treatments should be aimed at reducing current stocks of small-diameter, fire-sensitive trees in favor of fewer, larger diameter trees, creating a more resilient carbon storage pool.

It is noted that forest carbon pools always decrease immediately after vegetation treatment activities (e.g., thinning, prescribed burning, and harvesting) and modeling suggests they remain lower decades beyond treatment date<sup>31,32</sup>. This is due to the reduction in total biomass present on the landscape when stocks are reduced. If the vegetation removed during thinning and fuel reduction treatments could be utilized, either as lumber or for biomass energy production, the emissions associated with these activities could be reduced.

All vegetation treatment activities create carbon emissions, but emissions can be reduced and future carbon stocks increased by reducing surface fuels, small and intermediate-sized trees, and fire-sensitive species on the landscape<sup>32</sup>. The goal of vegetation treatments in terms of greenhouse gas benefit would be to move carbon stocks from many small, fire-vulnerable trees into large, disturbance-resilient trees. By leaving crowded stands unmanaged, the existing carbon stocks are highly vulnerable to catastrophic loss from large-scale disturbances, such as high-intensity fire and outbreaks of insects or disease.

### **17.6.2 Forest management and climate change strategies**

Ecological values of the Mill Creek Area's forests include biodiversity, watershed protection and carbon sequestration. Non-timber monetary value is now also being placed on forests, as they are being recognized for their ability to buffer climate change through capturing carbon.

#### ***Buckeye Forest Example***

The 19,500-acre Buckeye Forest in northwest Sonoma County, one of the largest nonprofit-owned working forests in the West, is an example of a forest managed for carbon sequestration, as well as a number of conservation co-benefits. It protects 30 miles of fish-bearing rivers and streams for coho and steelhead, habitat for spotted owls and rare plants, and allows wildlife movement and migration through the region. Roughly the same size as the 19,688-acre Mill Creek CWPP Area, it is estimated to harbor nearly 4 million tons of carbon dioxide, or roughly what would be emitted in 6,400 airliner trips around the world. Mostly second-growth redwoods, tanoaks and Douglas-firs, its purchase by the Conservation Fund in 2013 was supported by funding from the Sonoma County Agricultural and Open Space District, the Sonoma Land Trust, the Coastal Conservancy and other partners.

What made the Buckeye Forest purchase possible were credits for the 40,000 tons of carbon Buckeye Forest captures annually (equivalent to 2,500 fossil-fueled automobiles), with an estimated worth about \$2 million in 2015. As a source of income, these credits are sold to industries needing emissions offsets under California's Cap and Trade program. Use of Buckeye Forest is restricted to sustainable forestry, restoration, grazing and public recreation under a perpetual easement. A managed forest can capture and store more carbon than an unmanaged forest. When a parcel is logged, a practice called "selection cutting" can be used that essentially considers each tree's harvest and standing value, ultimately creating mixed-age forests and helping preserve soil nutrients and soil carbon. Carbon credit sales provide significant support for forest management and selective harvesting, and can help in accelerating restoration activities for fish and wildlife. As a working forest, it can provide jobs as well as restoring and sustainably managing the land, while raising funds through carbon offsets and timber harvests.

Carbon credits are also beginning to benefit smaller landowners. Most Sonoma County forest land is in parcels of 40 acres or less. California's Greenhouse Gas Reduction Fund provides resources for small landowner groups to both improve forest health and sequester carbon.

The reestablishment of forests after large-scale disturbances, such as high-intensity wildfire, will offer important ecosystem services for a variety of important natural and social reasons. Best management practices suggest reforestation activities establish a diverse, native forest, which will result in stable carbon sequestration rates and storage, restore watershed functions, and result in a resilient forest. Replanting a disturbed site with trees to create a future forested stand sequesters much more carbon than a brush field, which is often the result of leaving the site to natural succession.

## **18. Existing Plans**

Existing plans with relevance to the Mill Creek Area, have informed this CWPP, or contain helpful information for potential project planning include:

### **18.1 The Cedars Conservation Plan (Sonoma Land Trust, 2009)**

With funding from the California State Coastal Conservancy, the Sonoma Land Trust prepared this plan for the 35,000-acre area of 80% private landholdings and 20% BLM ownership that encompasses dozens of rare, sensitive, disjunct or endemic plant species (see [www.sonomalandtrust.org](http://www.sonomalandtrust.org)). The federally listed serpentine plant species' distribution and recovery needs are outlined in the **Recovery Plan for the Serpentine Soil of the San Francisco Area**<sup>18</sup>.

### **18.2 Mill Creek Watershed Management Plan, and Streamflow Improvement Plan (2015)**

The Mill Creek Area has an existing Mill Creek Watershed Management Plan,<sup>1</sup> written by the Sonoma Resource Conservation District,<sup>33</sup> and funded by the Sonoma County Water Agency, Cooperative Agreement for the Russian River Watershed Program (Agreement #TW12/13-138), and the California Department of Fish and Wildlife, Fisheries Restoration Grant Program (Agreement # P0830401). Mill Creek has been designated as the highest priority for conservation for the listed coho salmon in the Russian River watershed. The **Mill Creek Streamflow Improvement Plan**<sup>25</sup> was prepared by the Russian River Coho Water Resources Partnership, with support from The National Fish and Wildlife Foundation and the Sonoma County Water Agency. The Mill Creek streamflow improvement plan consisted of implementing a project in 2017 to improve the flow for salmonids as one of the first restoration and monitoring plan action items as a result of the original Mill Creek Watershed Management Plan. Active salmonid monitoring is being conducted, documenting the success of this plan by the University of California Cooperative Extension, California Sea Grant<sup>24</sup>.

### **18.3 Steelhead Restoration and Management Plan for California (CDFW, 1996)**

This document describes the major drainages in the state where steelhead populations occur. The Russian River watershed is described in terms of the current threats to steelhead populations and their long-term survival. General basin-level recommendations are given, including an assessment of instream flow requirements, the need for a habitat restoration plan, and a caution against using hatchery fish to repopulate streams containing healthy wild populations.

### **18.4 Draft Russian River Basin Fisheries Restoration Plan (CDFW, 2002)**

The focus of this report is to identify and prioritize recommended management actions to benefit coho salmon populations and their habitat in the Russian River watershed. A description of the watershed is broken down by hydrologic sub-units along with a summary of the limiting factors to salmonid survival. The findings and recommendations are based on the results of CDFW stream inventories conducted between 1994-2001, updated in 2006 (see summary above).

### **18.5 Recovery Plan for the Evolutionarily Significant Unit of Central California Coast Coho Salmon (NMFS, 2008)**

The Central California Coast ESU population of coho salmon was classified as endangered in 2005. NMFS, as the agency responsible for listing CCC Coho Salmon as federally endangered, is responsible for developing and implementing a plan for species recovery. The authors designated three categories for implementing restoration activities: the first and highest priority areas are termed "core areas" and include Felts, Wallace and Palmer Creeks within the Mill Creek watershed, and an implementation timeline is suggested for 2009-2014. The highest priority threats to coho salmon recovery as stated by the plan are: 1) agricultural practices; 2) droughts; 3) roads and railroads; 4) water diversions and impoundments. Priority recovery actions are: 1) to reduce and prevent water diversions to improve summer baseflow; 2) improve agricultural practices to reduce sediment delivery and improve riparian vegetation; 3) increase large wood debris to improve pool frequencies and shelter ratings; 4) increase shade canopy to reduce stream temperature; and 5) reduce road densities within riparian areas and across the watershed.

## **18.6 Resource Conservation District (RCD) Programs in Mill Creek**

### **18.6.1 Planning**

The Sonoma County RCD worked on a design for a Large Woody Material (LWM) project along Mill Creek with funding from the Sonoma County Water Agency and the National Fish and Wildlife Foundation. The design has over 51 sites for a one-mile stretch of the Mill Creek waterway.

The RCD has started developing an in-stream habitat enhancement project in Mill Creek with the goal to enhance habitat complexity, cover, and scour. Additional funding and landowner interest is sought to design a larger project.

### **18.6.2 Mill Creek Watershed Management Plan**

The Mill Creek Watershed Management Plan<sup>1</sup> is available for download from the Sonoma RCD website. The goal of the plan is to work with watershed landowners and stakeholders to investigate and evaluate current and historic conditions as well as recommend a prioritized set of actions to improve water quality, sustain agricultural operations, and improve riparian and aquatic habitat conditions.

### **18.6.3 Water Resource Management**

Sonoma RCD is one of six partners in the Russian River Coho Water Resources Partnership, a National Fish and Wildlife Foundation Coho Keystone Initiative. The Partnership was formed in 2009 to develop a systematic approach to improve streamflow and water supply reliability in Mill Creek and four other sub-watersheds critical to coho recovery in the Russian River Watershed. The Partnership's goal is to further the recovery of coho salmon through habitat and streamflow enhancements and improve water security.

### **18.6.4 Others: Sonoma Resource Conservation District (RCD)**

The RCD is currently reaching out to landowners to develop and implement rainwater storage projects along key stream reaches with the goal of improving water reliability for landowners and to keep more water in the stream during the dry season for salmonids. For more information, see [cohopartnership.org](http://cohopartnership.org)

The Water Quality Monitoring Program is ongoing in several of the watersheds surrounding Mill Creek. The Sonoma RCD is working toward establishing a monitoring program in Mill Creek as well.

## **18.7 Timber Harvest Plans and Forest Management Plans**

A few residents of Mill Creek Area have worked with the Sonoma RCD to prepare Forest Management Plans for their properties (For a discussion of FMPs, see Section 15.2 on page 40). At this writing there are at least three active Timber Harvest Plans for parcels in the Mill Creek CWPP area. A Timber Harvest Plan (THP) serves as a functional equivalent to an Environmental Impact Report under the California Environmental Quality Act (CEQA), an operational guide for Licensed Timber Operators during forest operations, and a permit to harvest and sell timber. A THP is required for the sale of logs in California. Log sales can be an effective way to help pay for beneficial activities in the Mill Creek CWPP that otherwise have no direct funding source.

## **18.8 California Vegetation Treatment Program (VTP) & Vegetation Management Program**

The state is currently in the process of finalizing a document, the *California Vegetation Treatment Program* (VTP), which augments the 1980s document *Vegetation Management Program* (VMP - formerly called the Chaparral Management Program). The VTP program addresses fuels management that includes mechanical fuels treatments not covered by the VMP. Practices such as mechanical treatments (e.g., mowing, mastication), manual (e.g., weed-whacking, weed-pulling), herbicide application, and prescribed fire are included in the VTP, as is the inclusion of grazing as an approved fuels management treatment. At this time VMP is still a valid cost-share program offered by CALFIRE that landowners can use to introduce broadcast fire to the landscape. VTP has been recently approved by the Board of Forestry and Fire Protection, but the program has not yet been utilized in the State.



## 18.9 Other Relevant Plans:

- **California Forest Improvement Program (CFIP) Plans**
- **CAL FIRE Sonoma-Lake-Napa Unit Fire Plan**
- **Sonoma County CWPP** (currently under revision)
- **Sonoma County Multi-jurisdiction Local Hazard Mitigation Plan** (currently under revision)

## 19. Conclusions

The Mill Creek Community Citizens Organized to Prepare for Emergencies (COPE) organization has achieved considerable success in organizing members of the Mill Creek community to promote fire preparedness, most notably development of an alternate evacuation route through privately owned property and extensive mapping of individual properties in the community, including potential resources they can offer to firefighters and other first-responders. Plans for 2020 include a community sign to alert residents of fire danger and communicating other important information. Even with these successes, organizers of the Mill Creek COPE also recognized the need for a more formal framework, and community consensus, to identify and prioritize efforts to improve fire preparedness for the community, which led to the development of the Mill Creek Community Wildfire Protection Plan.

As described in this document, many of the tremendous appeals of the Mill Creek Area — the expansive and steep Mill Creek valley, the fertile and diverse forest, the thick and varied vegetation, and the great unbroken spaces between neighbors — also contribute to the considerable fire risk of the region. A history of logging, farming, and a lack of forest management, coupled with wildfire suppression in the region, have added to this underlying risk by decreasing the natural fire resiliency of the forest. The natural beauty of the region masks conditions that could make a wildfire extremely destructive and potentially deadly. The lack of a major wildfire in the Mill Creek Area in more than sixty years is also a major cause for concern. And the wildfire experiences of the recent years in Sonoma County only heightens the uneasiness of our community.

Sonoma County is the most highly parcelized county in California, and there is very little public ownership of forested timberlands here. Forest health therefore depends in large part on the private landowner. The relatively small size of land ownership in Mill Creek has created parcels that are mostly uneconomical for timber harvest. The general use at this time is “no-action,” when active forest management is needed<sup>27</sup>.

In addition to the current wildfire risk, there is the possibility that an evacuation along Mill Creek Road could quickly turn chaotic, even perilous, due to the current road conditions: it is narrow, winding, and is one way out. The adjacent Mill Creek and steep topography increase the chances of fallen trees and slides impeding the passage of vehicles in an emergency situation. Insufficient cell phone coverage throughout much of the Mill Creek area creates additional complications due to limited communications and a lack of GPS navigational assistance. A complete version of the Wildfire Risk Assessment of the Mill Creek Area can be found in [Appendix A](#).

In consideration of these risk factors, the Mill Creek community decided to proactively work on improving preparedness and reducing the risks associated with potential wildfires. These efforts have generated a targeted list of potential priority projects to address wildfire risks. The projects can be broadly categorized as addressing issues of:

- Emergency access and evacuation
- Fuels reduction
- Ignitions reduction
- Emergency notification and communication

- Acquiring Funding

A detailed list of proposed projects in each of these categories is provided in [Appendix B](#).

This planning work could not have been possible without the continued partnership for collaboration with local and state fire experts and officials. The Mill Creek community is grateful for the support and guidance that representatives from CAL FIRE, FireSafe Sonoma, the Healdsburg Fire Department, and all the other government and agency experts that have provided over the course of this effort.

## 20. References

1. Mill Creek Watershed Management Plan. *Sonoma Resource Conservation District*  
<https://sonomarc.org/district-watersheds/mill-creek/>.
2. Forest Service, Indian Affairs Bureau, Land Management Bureau, Fish and Wildlife Service, National Park Service. Urban Wildland Interface Communities Within the Vicinity of Federal Lands That Are at High Risk From Wildfire. *Federal Register* vol. 66 751–777 (2001).
3. Micheli, E. *et al.* Downscaling Future Climate Projections to the Watershed Scale: A North San Francisco Bay Case Study. *San Francisco Estuary and Watershed Science* vol. 10 (2012).
4. State of California. VENADO (VEN). <https://cdec.water.ca.gov/dynamicapp/QueryF?s=VEN>.
5. Krawchuk, M. & Moritz, M. *Fire and climate change in California: changes in the distribution and frequency of fire in climates of the future and recent past (1911-2099)*. (California Energy Commission, 2012).
6. NorthBayClimate.org. <http://www.northbayclimate.org/>.
7. Chapter 7A [SFM] Materials and Construction Methods for Exterior Wildfire Exposure. *UpCodes*  
<https://up.codes/viewer/california/ca-building-code-2016-v1/chapter/7A/sfm-materials-and-construction-methods-for-exterior-wildfire-exposure>.
8. Carle, D. *Introduction to Fire in California*. (Univ of California Press, 2008).
9. Brown, P. M. & Baxter, W. T. Fire history in coast redwood forest of the Mendocino Coast, California. *Northwest Sci.* **77**, 147–158 (2003).
10. Baldwin, B. G., Goldman, D., Keil, D. J., Patterson, R. & Rosatti, T. J. *The Digital Jepson Manual: Vascular Plants of California*. (University of California Press, 2012).
11. Lanner, R. M. & Others. *Conifers of California*. (Cachuma Press, 1999).
12. Sawyer, J. O., Keeler-Wolf, T. & Evens, J. M. A manual of california vegetation, California Native Plant Society Press. *Sacramento, CA. [Google Scholar]* (2009).
13. Holland, R. F. Preliminary descriptions of the terrestrial natural communities of California. California Department of Fish and Game. *Unpublished report. Sacramento, CA* (1986).
14. California Department of Fish and Wildlife. California Natural Diversity Database. *Biogeographic Data Branch* (2018).
15. California Native Plant Society, Rare Plant Program. Inventory of Rare and Endangered Plants of California. *California Native Plant Society* <http://www.rareplants.cnps.org> (2019).
16. Raiche, R. The Cedars: Sonoma County’s hidden treasure. *Fremontia J. California Native Plant Soc* **37**, 3–15 (2009).
17. The Cedars Gateway - Sonoma Land Trust. *Sonoma Land Trust*  
<https://sonomalandtrust.org/our-preserve-system/ecological-preserves/the-cedars-gateway/>.

18. US Fish and Wildlife Service. Recovery Plan for the Serpentine Soil Species of the San Francisco Bay Area. (1998).
19. David Shuford, W., Gardali, T., Ornithologists, W. F. & California. Dept. of Fish and Game. *California bird species of special concern: a ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California*. (Western Field Ornithologists, 2008).
20. Fish, U. S., Service, W. & Others. Revised recovery plan for the northern spotted owl (*Strix occidentalis caurina*). *US Department of Interior, Portland, Oregon, USA* (2011).
21. Dugger, K. M. *et al.* The effects of habitat, climate, and Barred Owls on long-term demography of Northern Spotted Owls. *The Condor: Ornithological Applications* **118**, 57–116 (2016).
22. United States Fish and Wildlife Service. Northern Spotted Owl Take Avoidance Analysis and Guidance for Private Lands in California. *United States Fish and Wildlife Service*  
[https://www.fws.gov/yreka/NSO-TakeAvoidanceAnalysis\\_Att\\_A-B\\_2019-1101.pdf](https://www.fws.gov/yreka/NSO-TakeAvoidanceAnalysis_Att_A-B_2019-1101.pdf) (2019).
23. United States Fish and Wildlife Service. Recovery Plan for the Santa Rosa Plain: *Blennosperma bakeri* (Sonoma sunshine); *Lasthenia burkei* (Burke's goldfields); *Limnanthes vincularis* (Sebastopol meadowfoam); California Tiger Salamander Sonoma County Distinct Population Segment (*Ambystoma californiense*). (2008).
24. Habitat Enhancement Monitoring | California Sea Grant.  
<https://caseagrants.ucsd.edu/project/coho-salmon-monitoring/programs-and-research/habitat-enhancement-monitoring>.
25. The Russian River Coho Water Resources Partnership. Mill Creek Streamflow Improvement Plan. (2015).
26. PIT Tag Technology | California Sea Grant.  
<https://caseagrants.ucsd.edu/project/coho-salmon-monitoring/pit-tag-technology>.
27. Euphrat, F. D. *et al.* Protecting forests across landscapes and through generations: the Sonoma County Forest Conservation Working Group. (2012).
28. Prescribed Burning in California Wildlands Vegetation Management. *University of California Press*  
<https://www.ucpress.edu/book/9780520219458/prescribed-burning-in-california-wildlands-vegetation-management>.
29. Healdsburg Museum and Historical Society. *Healdsburg Museum and Historical Society*  
<http://www.healdsburgmuseum.org>.
30. Stavros, E. N., Abatzoglou, J. T., McKenzie, D. & Larkin, N. K. Regional projections of the likelihood of very large wildland fires under a changing climate in the contiguous Western United States. *Clim. Change* **126**, 455–468 (2014).
31. Clark, J., Sessions, J., Krankina, O. & Mannes, T. Impacts of Thinning on Carbon Stores in the PNW: A Plot Level Analysis. (2011).



32. North, M., Hurteau, M. & Innes., J. Fire Suppression and fuels treatment effects on mixed conifer carbon stocks and emissions. *Ecol. Appl.* **19**, 1385–1396 (2009).
33. Mill Creek | Sonoma Resource Conservation District. <https://sonomarc.org/district-watersheds/mill-creek/>.