4 WUI HAZARD AND RISK ASSESSMENT

There are several components to evaluating hazard and risk from WUI fires. "Hazards" are those existing bio-physical factors that, when combined, present a threat. "Risk" is a measurement of the potential consequences resulting from the hazard occurring. "Mitigations" are actions taken to reduce the hazard or risk in order to reduce the unwanted consequences of the WUI fire. The purpose of the study is to determine what factors are present that create a hazard and how to reduce risk. In this study, the hazard is the flammable vegetation and flammable buildings co-existing in an environmental susceptible to extreme fire behavior. To evaluate the "Risk Score" for a particular community or parcel, we measure hazard minus mitigations (Hazard – Mitigations = Risk), which will provide an estimate of the expected impact of a WUI fire occurring.

4.1 HAZARDS

4.1.1 FLAMMABLE VEGETATION

Native flammable vegetation: California's Mediterranean climate provides growing conditions for plants that are able to sustain long dry summers. Native plant species either are annuals that grow during wet winter and spring then die in summer or perennials with high oil content in order to withstand these annual summer droughts year after year. Many of these plants are also "fire adapted," meaning they expect natural fire to be part of their lifecycle and are resilient. The dead annuals and high oil content perennial plants are typically very flammable during late spring, summer, and fall. The burning intensity of these plants is directly related to ambient weather conditions and local topography.

Flammable ornamental vegetation: Several non-native plant species used in ornamental plantings share drought-tolerant plant characteristics of native plants and can be very flammable. These ornamentals may be as hazardous or even more hazardous than native species in areas that have weather conditions conducive to wildland fire. Similar to flammable native plants, burning conditions of flammable ornamental plants is directly related to ambient weather conditions.

4.1.2 FLAMMABLE BUILT ENVIRONMENT

Buildings in the WUI area are also a type of burnable "fuel." WUI fires, by definition, burn more than vegetation. They endanger people and livestock, and burn homes, businesses, critical infrastructure, and other built improvements. These burning buildings are not just "victims" of the WUI fire, they also contribute dramatically to fire spread. When buildings ignite they burn for an extended period of time and produce massive amount of radiant heat and windblown embers that blow downwind and ignite more vegetation and other buildings.

4.2 RISK

Risk is a measurement of the consequences of a WUI fire occurring and the resultant damage. Risk can include loss of buildings (homes and businesses) and critical infrastructure, impact to socioeconomic factors, or loss of environmentally sensitive species that are not fire adapted. Loss of some features (such as historic sites or critical infrastructure) is deemed unacceptable and merits extraordinary mitigations to reduce risk.

4.3 MITIGATIONS

Many methods are available to mitigate the available burnable fuel hazard, whether buildings or native or ornamental vegetation. Mitigations typically refer to reducing the amount of hazardous vegetation available to burn or the expected intensity of the fire when it does burn. Providing defensible space around structures is one example of reducing the hazard through the mitigation effort of removing and/or thinning of flammable vegetation. Structural mitigations include replacing wooden shake shingle roofs or preventing embers from entering attics through improved vent systems.

4.4 COMPONENTS OF RISK AND HAZARD

4.4.1 COMMUNITY VULNERABILITY

Community vulnerability is a measurement of bio-physical and socioeconomic conditions.

Bio-physical relates to flammable vegetation and buildings, weather, topography, road, and water systems. These factors help determine the level and nature of hazard that exists. Various mitigation methods can be applied to reduce the hazard and make the community safer.

- **Flammable vegetation:** Reducing the loading of hazardous fuels should reduce fire intensity. This can be achieved through communitywide defensible space compliance, proper landscape plantings and maintenance of open space or common owned lands in planned unit developments, and community fuel breaks.
- **Road systems:** Less expensive road system improvements by simple actions such as posting clear road signs, evacuation routes, and addresses can reduce injury. Tourist areas should have very clear signage for road names, evacuation routes, and identification of safe zones. Road systems surfaces are expensive and complicated to improve, widen, pave, and straighten roads. Adding secondary access to dead end/single access roads and road surface improvements may require long-term planning and financing. Coordination with land use planning agencies can help facilitate these improvements when new subdivisions or development occurs.
- **Water systems:** Water availability can have a significant effect on firefighters being able to suppress fires and protect buildings. Community water systems with proper volume in storage is ideal, followed by fire department accessible water tank storage on each parcel, and lastly with scattered water tanks throughout the community. If firefighters must shuttle water back and forth, success rates drop dramatically.
- **Property hygiene:** Property hygiene refers to the presence of clutter, debris piles, firewood stacks, lumber, or other flammables within the 100-foot defensible space zone. If the community characteristics are for generally poor hygiene, the risk of fire spreading is greater. Good hygiene reduces fire spread.

Socioeconomic conditions are circumstances related to the population of WUI areas including residents, visitors, businesses, and livestock.

- **Sense of well-being lost:** Following WUI fire where the community is seriously affected, tourist areas may lose customers for years if visitors believe area is unsafe or scenic beauty is damaged.
- **Community involvement:** When members of the community engage in FireSafe Councils, Community Emergency Response Team (CERT), or other neighborhood programs, it enhances public education and understanding of the hazard and mitigations to reduce risk.
- **Commercial and retail properties:** Impacts well beyond the loss of the building result when businesses burn. Employees lose jobs, tax revenue is lost, and customers are disadvantaged (sometimes seriously if this was the only service in the area, like the sole grocery store for several miles). It is common for businesses to never return due to economic losses suffered by owners.
- **Critical infrastructure:** Losses of critical infrastructure may have impacts well outside the fire area. For example, a small fire that burns microwave or cellular communications towers may impact customers several miles away. Some communications sites are critical for coordinating public safety other vital services. Electrical grid transmission lines frequently cross wildland areas and fires adjacent to them can cause catastrophic power failures.

4.4.2 EVACUATION COMPLEXITIES

Safe and proper evacuation of people (residents, workers, and visitors), pets, and livestock is a very critical component of WUI fires. Confusing road networks without good signage, narrow roads that do not allow two-way traffic, and dead end roads have contributed to injuries and fatalities of public and responders during WUI fires. Evacuations are the jurisdictional responsibility of law enforcement with assistance from fire and other agencies.

Most WUI fires require immediate "No Notice" evacuations, meaning little or no warning time exists between fire origin and the need for evacuation. There is likely a shortage of public safety responders to assist in the evacuation during early stages of a fire. Notification will be through Reverse 9-1-1 type phone calls or other mass notification systems, and people will need to plan and conduct their own self-evacuation. Carless populations, schools, rest homes, or other non-ambulatory facilities may require significant assistance in evacuation; planning to accommodate these facilities is crucial.

Coordination with Red Cross for shelter for evacuees is important. Many Red Cross shelters do not allow pets, so additional consideration for pet accommodation is necessary.

Livestock presents special evacuation considerations to provide access to livestock trailers entering the fire area while others are trying to evacuate. In addition, there will be a need for a temporary housing location for evacuated livestock and pets.

4.4.3 STRUCTURAL VULNERABILITY

Structures are vulnerable to damage from WUI fires from several sources. Defensible space compliance is very effective in reducing ignition from direct flame contact and radiant heat ignition from burning vegetation.

Most structure ignitions are from flying embers landing on flammable components of the building and setting the building on fire. The single most vulnerable area for flying ember caused ignition is wooden roofs and wooden siding. Flammable vegetation burning adjacent to structures and igniting the building through direct flame contact is the second most common source of ignition. The third source is from radiant heat from burning (vegetation or other burning buildings) close to the structure.

Burning structures can be the most significant flying ember and radiant heat generator. Embers can ignite neighboring structures, or if closer than 30 feet the radiant heat is likely to ignite the adjacent building.

Ignition-resistant building materials and assemblies similar to recommendations in current WUI building codes are most effective in reducing structural ignitions from flying embers and direct flame contact. In California, buildings built in designated SRA and WUI areas after 2008 are required to be built in accordance with California Building Code Chapter 7A., which is designed to prevent ember intrusion into the building envelope (especially attic) and ignition-resistant materials covering outside areas. Older buildings can be retrofitted to approach the same ignition resistance.

Ornamental landscape, particularly in foundation plantings, can expose buildings to ignition. Many ornamental plants are very flammable especially when in flower beds with flammable mulches, which serve as a receptive bed for flying embers. Plants ignite and expose siding and under eave area to direct flame contact.

4.4.4 Critical Infrastructure Vulnerability

Critical infrastructure is defined as electrical substations and transmission facilities; cellular, television, radio, and telecommunication sites; railroad structures; highway structures; navigation and coordination facilities; and other sites that are crucial to providing and coordinating essential services. Many of these sites are located on vulnerable ridges or mountaintops. Losses are not just the cost of replacing physical facility, but the cost associated with loss of the service, which can be significantly more than the facility costs. Figure 4.1 shows the critical infrastructure for the CWPP area.

4.4.5 Community Values at Risk

Every community has features that are significant to that community but may not be important to others. Schools, day care facilities, and other sites that require special attention during evacuation are very susceptible to WUI fires, whether it is something like the only grocery store for miles or the local community cultural icon. Loss of the grocery store inconveniences everyone in the community, not just the business owner. The icon may not be a historical landmark but is very special to the social fabric of the community. Identifying these local important sites and providing special planning or mitigations to avoid losses is crucial to community identity.

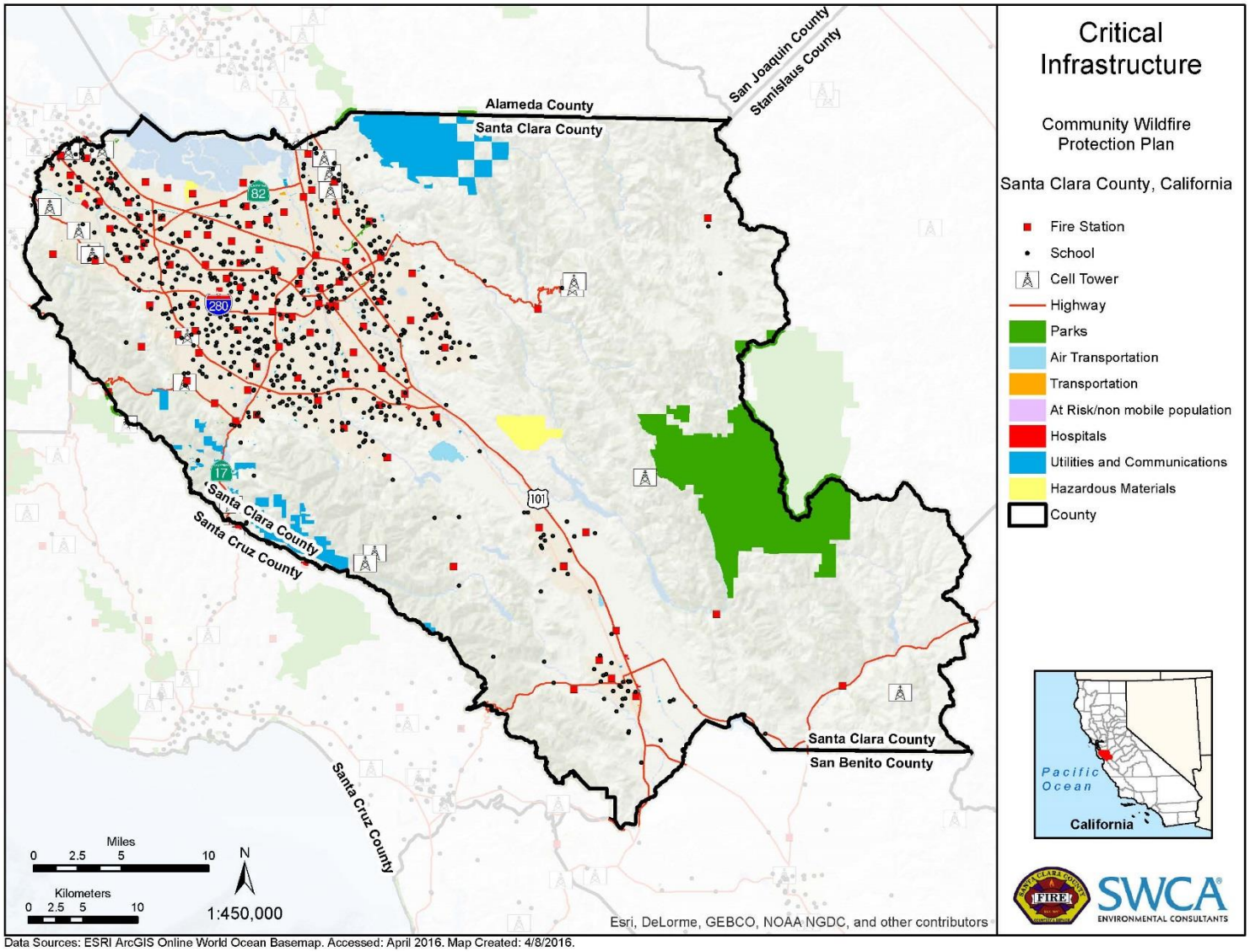


Figure 4.1. Critical infrastructure.

4.5 OVERVIEW AND PURPOSE OF HAZARD AND RISK ASSESSMENT

The purpose of hazard and risk assessment is to measure the potential impact of a WUI fire and what current and possible mitigations may have on the resultant risk. Understanding the probable impact of a WUI fire through examination of existing flammables (vegetation and buildings), weather patterns, and topography that influences fire behavior is essential to identifying the best mitigations to reduce risk. Various WUI fire mitigation methods are available; therefore, the hazard/risk model allows a means to evaluate the community and an individual parcel's vulnerability to the hazard and the effect of mitigation options to reduce the vulnerability.

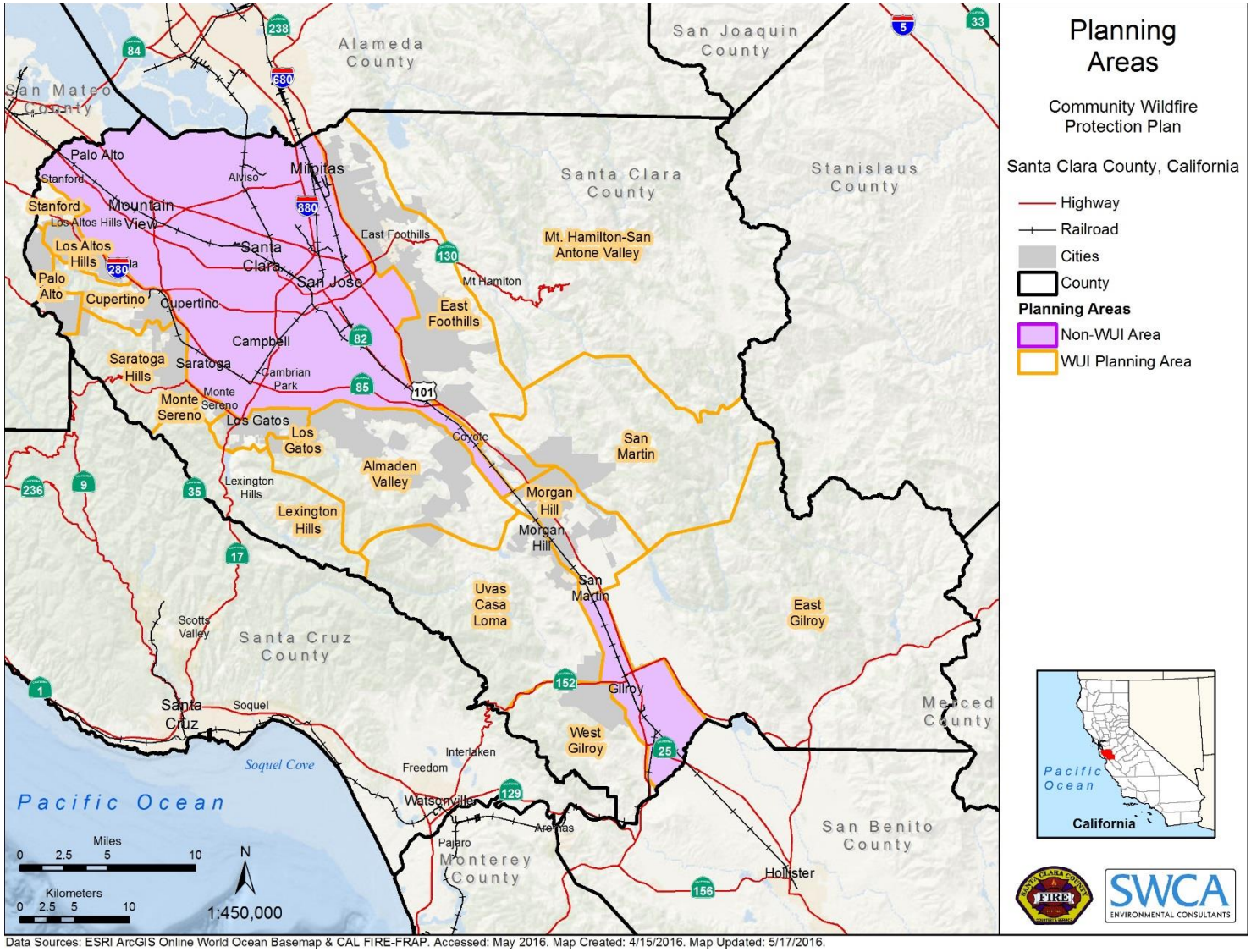
The model measures several factors that lead to hazard rating and evaluates mitigation factors at the community and parcel level. Evaluating the community, as well as the individual parcel, is essential in determining the total WUI risk. A low overall community hazard rating can be compromised by an outlier individual parcel that has a high hazard/risk score (i.e. the only home with a shake shingle roof in a WUI community). Likewise, a parcel with good mitigations for a low hazard score may still be a high risk if the overall community has a high hazard score (i.e. poor road network or overall poor defensible space compliance). Property owners and agencies can use the assessment model to maximize the effectiveness in reducing overall community and parcel risk by comparing different mitigation techniques.

4.5.1 IDENTIFICATION OF COMMUNITIES AT RISK

Communities at risk were developed based on the California Communities at Risk list, which identifies the following 14 communities.

- Cupertino
- East Foothill
- Gilroy
- Lexington Hills
- Los Alto Hills
- Los Gatos
- Milpitas
- Morgan Hill
- Monte Sereno
- Palo Alto
- San Jose
- San Martin
- Saratoga
- Stanford

The CWPP Core Team developed WUI planning areas based on this list (Figure 4.2).



Data Sources: ESRI ArcGIS Online World Ocean Basemap & CAL FIRE-FRAP. Accessed: May 2016. Map Created: 4/15/2016. Map Updated: 5/17/2016.

Figure 4.2. WUI planning areas.

4.6 RISK ASSESSMENT OVERVIEW

The risk assessment component of this CWPP was completed in three phases:

1. A countywide scale composite Fire Risk Analysis using fire behavior modeling.
2. A planning area scale on-the-ground assessment of WUI communities using the National Fire Protection Association (NFPA) 1144 Wildland Fire Hazard and Risk Severity Form.
3. A parcel scale risk assessment.

Each of these assessments provides increasing levels of detail from a county scale, to a planning area scale to a parcel level scale, which therefore provides Santa Clara County with a comprehensive assessment of wildfire risk and hazard.

4.6.1 COUNTYWIDE SCALE: COMPOSITE FIRE RISK ANALYSIS

The wildland fire environment consists of three factors that influence the spread of wildfire: fuels, topography, and weather. Understanding how these factors interact to produce a range of fire behavior is fundamental to determining treatment strategies and priorities in the WUI. In the wildland environment, vegetation is synonymous with fuels. When sufficient fuels for continued combustion are present, the level of risk for those residing in the WUI is heightened. Fire spreads in three ways: 1) surface fire spread—the flaming front remains on the ground surface (in grasses, shrubs, small trees, etc.) and resistance to control is comparatively low; 2) crown fire—the surface fire "ladders" up into the upper levels of the forest canopy and spreads through the tops (or crowns) independent of or along with the surface fire, and when sustained is often beyond the capabilities of suppression resources; and 3) spotting—embers are lifted and carried with the wind ahead of the main fire and ignite in receptive fuels; if embers are plentiful and/or long range (>0.5 mile), resistance to control can be very high. Spotting is often the greatest concern to communities in the path of a wildland fire. In areas where homes are situated close to timber fuels and/or denser shrubs and trees, potential spotting from woody fuels to adjacent fuels should be acknowledged.

Treating fuels in the WUI can lessen the risk of intense or extreme fire behavior. Studies and observations of fires burning in areas where fuel treatments have occurred have shown that the fire either remains on or drops to the surface, thus avoiding destructive crown fire. Also, treating fuels decreases spotting potential and increases the ability to detect and suppress any spot fires that do occur. Fuels mitigation efforts therefore should be focused specifically where these critical conditions could develop in or near communities at risk.

Because of the significant variation in weather, topography, and fuels in Santa Clara County, the risk assessment was run using regional weather inputs to take into account these variabilities.

4.6.2 FIRE BEHAVIOR MODELS

For this plan, an assessment of fire behavior has been carried out using well-established fire behavior models: FARSITE, FlamMap, BehavePlus, and FireFamily Plus, as well as ArcGIS Desktop Spatial Analyst tools. Data used in the Composite Risk/Hazard Assessment is largely obtained from LANDFIRE.

LANDFIRE

LANDFIRE is a national remote sensing project that provides land managers a data source for all inputs needed for FARSITE, FlamMap, and other fire behavior models. The database is managed by the U.S. Forest Service and the U.S. Department of the Interior and is widely used throughout the United States for land management planning. More information can be obtained from http://www.landfire.gov.

FARSITE

FARSITE is a computer model based on Rothermel's spread equations (Rothermel 1983); the model also incorporates crown fire models. FARSITE uses spatial data on fuels, canopy cover, crown bulk density, canopy base height, canopy height, aspect, slope, elevation, wind, and weather to model fire behavior across a landscape. In essence, FARSITE is a spatial and temporal fire behavior model. FARSITE is used to generate fuel moisture and landscape files as inputs for FlamMap. Information on fire behavior models can be obtained from http://www.fire.org.

FlamMap

Like FARSITE, FlamMap uses a spatial component for its inputs but only provides fire behavior predictions for a single set of weather inputs. In essence, FlamMap gives fire behavior predictions across a landscape for a snapshot of time; however, FlamMap does not predict fire spread across the landscape. FlamMap has been used for the Santa Clara County CWPP to predict fire behavior across the landscape under extreme (worst case) weather scenarios.

BehavePlus

Also using Rothermel's (1983) equations, BehavePlus is a multifaceted fire behavior model and has been used to determine fuel moisture in this process.

4.6.3 Fire Behavior Model Inputs

Fuels

The fuels in the planning area are classified using Scott and Burgan's (2005) Standard Fire Behavior Fuel Model classification system (Appendix F, Figure 4.3). This classification system is based on the Rothermel surface fire spread equations, and each vegetation and litter type is broken down into 40 fuel models. The general classification of fuels is by fire-carrying fuel type (Scott and Burgan 2005):

(NB) Nonburnable
(GR) Grass
(GS) Grass-Shrub
(SH) Shrub
(TU) Timber-Understory
(TL) Timber Litter
(SB) Slash-Blowdown

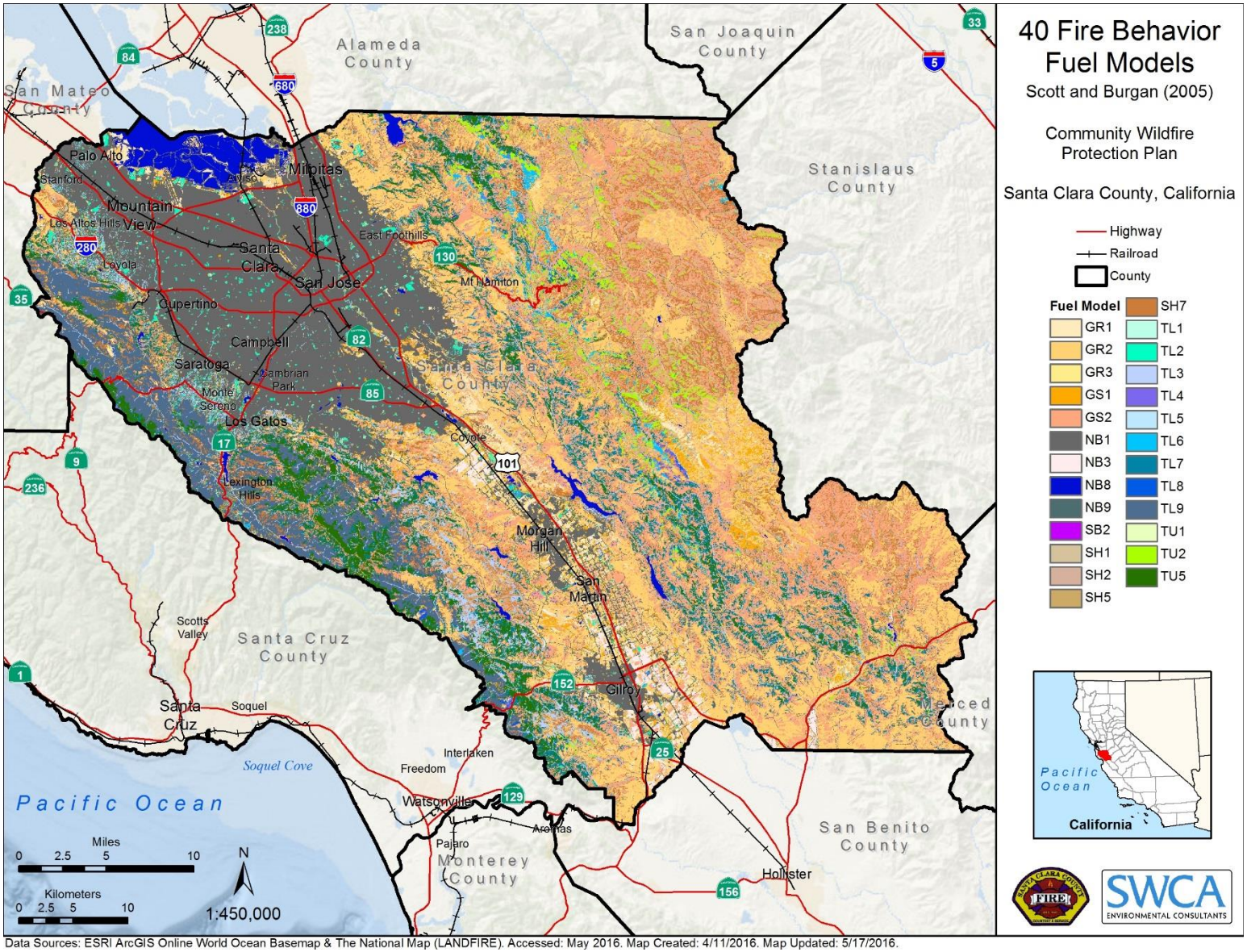


Figure 4.3. Fuel models in the CWPP planning area.

It is important to note that under current fire behavior methodologies, fire behavior simulations run throughout wildland vegetation with urban areas classified as "Non Burnable" under both the 13 Anderson (1982) fire models and the 40 Scott and Burgan (2005) fire models. Research is currently being done to model wildfire in the WUI, and these methodologies require high resolution imagery, 3D Light Detection and Ranging (LiDAR) data, and comprehensive ground surveying of structural materials and defensible space. In the absence of these data, it is possible to model flame height, crown fire activity, and rate of spread in the vegetation surrounding the WUI using FLAMMAP. Figures of predicted rate of spread and flame length are shown below Figure 4.4 and Figure 4.5).

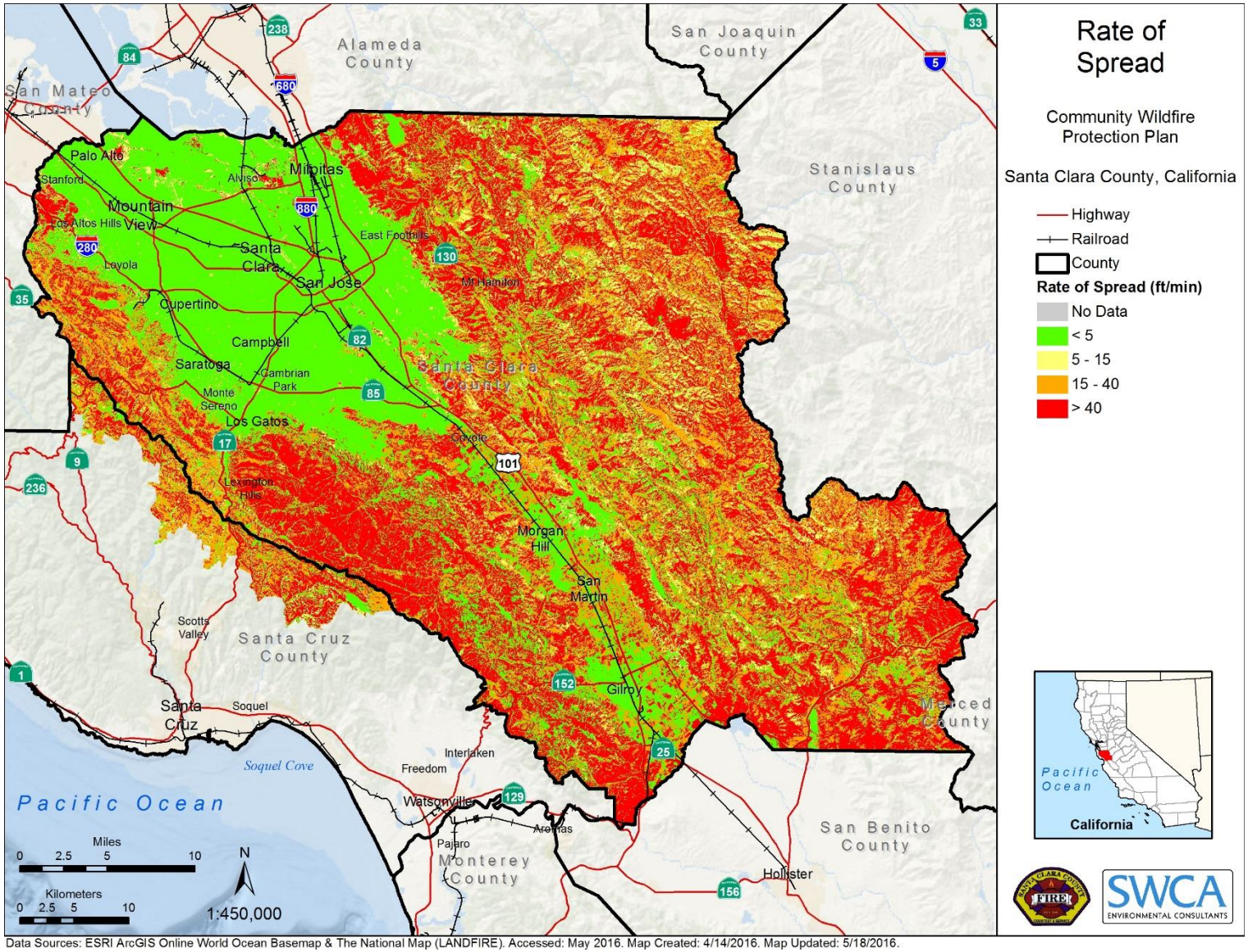


Figure 4.4. Predicted Rate of Spread using fire behavior modelling

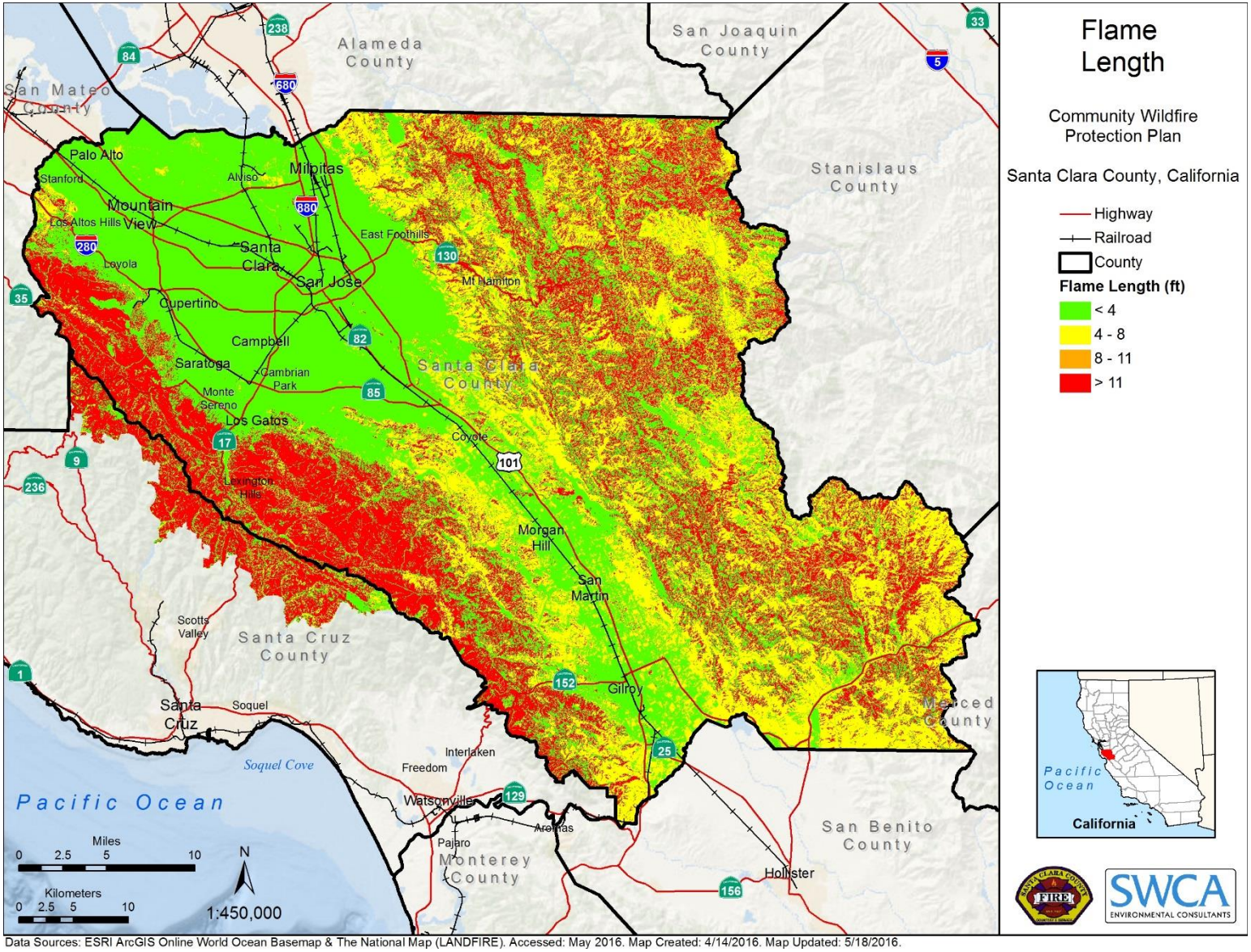


Figure 4.5. Predicted Flame Length using fire behavior modeling

Topography

Topography is important in determining fire behavior. Steepness of slope, aspect (direction the slope faces), elevation, and landscape features can all affect fuels, local weather (by channeling winds and affecting local temperatures), and rate of spread of wildfire.

Weather

Of the three fire behavior components, weather is the most likely to fluctuate. Accurately predicting fire weather remains a challenge for forecasters, particularly during drought conditions. As summer winds and rising temperatures dry fuels, conditions can deteriorate rapidly, creating an environment that is susceptible to wildland fire. Fine fuels (grass and leaf litter) can cure rapidly, making them highly flammable in as little as 1 hour following light precipitation. Low live fuel moistures of shrubs and trees can significantly contribute to fire behavior in the form of crowning and torching.

One of the critical inputs for FlamMap is fuel moisture files. For this purpose weather data have been obtained from FAMWEB (National Wildfire Coordinating Group 2012), a fire weather database maintained by the National Wildfire Coordinating Group. Remote automated weather stations were selected that would best represent each of the four geographic areas.

Using an additional fire program (FireFamily Plus) with the remote automated weather station data, weather files that included prevailing wind direction and 20-foot wind speed were created. Fuel moisture files were then developed for downed (1-, 10-, and -100 hour) and live herbaceous and live woody fuels. These files represent weather inputs in FlamMap; 95 to 100 percentile weather is used to predict the most extreme scenarios for fire behavior.

4.6.4 FLAMMAP OUTPUTS

The following is a discussion of the fire behavior outputs from FlamMap.

Flame Length

Figure 4.5 illustrates the flame length classifications for the planning area. Flame lengths are determined by fuels, weather, and topography. Flame length is a particularly important component of the risk assessment because it relates to potential crown fire (particularly important in timber areas) and suppression tactics. Direct attack by hand lines is usually limited to flame lengths less than 4 feet. In excess of 4 feet, indirect suppression is the dominant tactic. Suppression using engines and heavy equipment will move from direct to indirect with flame lengths in excess of 8 feet.

Fireline Intensity

Fireline intensity describes the rate of energy released by the flaming front and is measured in British Thermal Units per foot, per second (BTU/ft/sec). This is a good measure of intensity, and suppression activities are planned according to it. The expected fireline intensity throughout the planning area is similar in pattern to predicted flame length, as fireline intensity is a function of flame length.

Rate of Spread

The Rate of Spread of a fire is the relative activity of a fire in extending its horizontal dimensions. It is expressed as a rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area. Usually it is expressed in chains or acres per hour for a specific period in the fire's history. Figure 4.4 illustrates the rate of spread classifications for the planning area.

Crown Fire Potential

Crown fire activity in the planning area is confined to shrub and timber fuels; surface fire activity occurs in the grassland fuels.

Fire Occurrence/Density of Ignitions

Fire occurrence density has been determined by performing a density analysis on fire start locations with ArcGIS Desktop Spatial Analyst (based on Fire History data shown in Figure 3.4 in Section 3.4). The density analysis has been performed over a 5-mile search radius. The fire occurrence density is used to provide information on areas where human- and lightning-ignited fires are prevalent and hence could be more prone to fire in the future.

4.6.5 Geographic Information System Overlay Process

The fire behavior parameters described above and the fire occurrence density maps are placed into a geographic information system (GIS) Weighted Overlay Model, which "stacks" each geographically aligned dataset and evaluates an output value derived from each cell value of the overlaid dataset in combination with the weighted assessment. The resulting dataset contains only values 1 through 4 (1 = low, 2 = medium, 3 = high, 4 = extreme) to denote fire risk. This ranking shows the relative fire risk of each cell based on the input parameters.

Figure 4.6 is the final composite risk assessment for the planning area; it combines all the fire behavior parameters described above. The risk assessment classifies the County planning area into low, moderate, high, and extreme risk categories. The risk assessment has also been developed on a planning area scale. Maps are provided in the individual planning area Annexes.

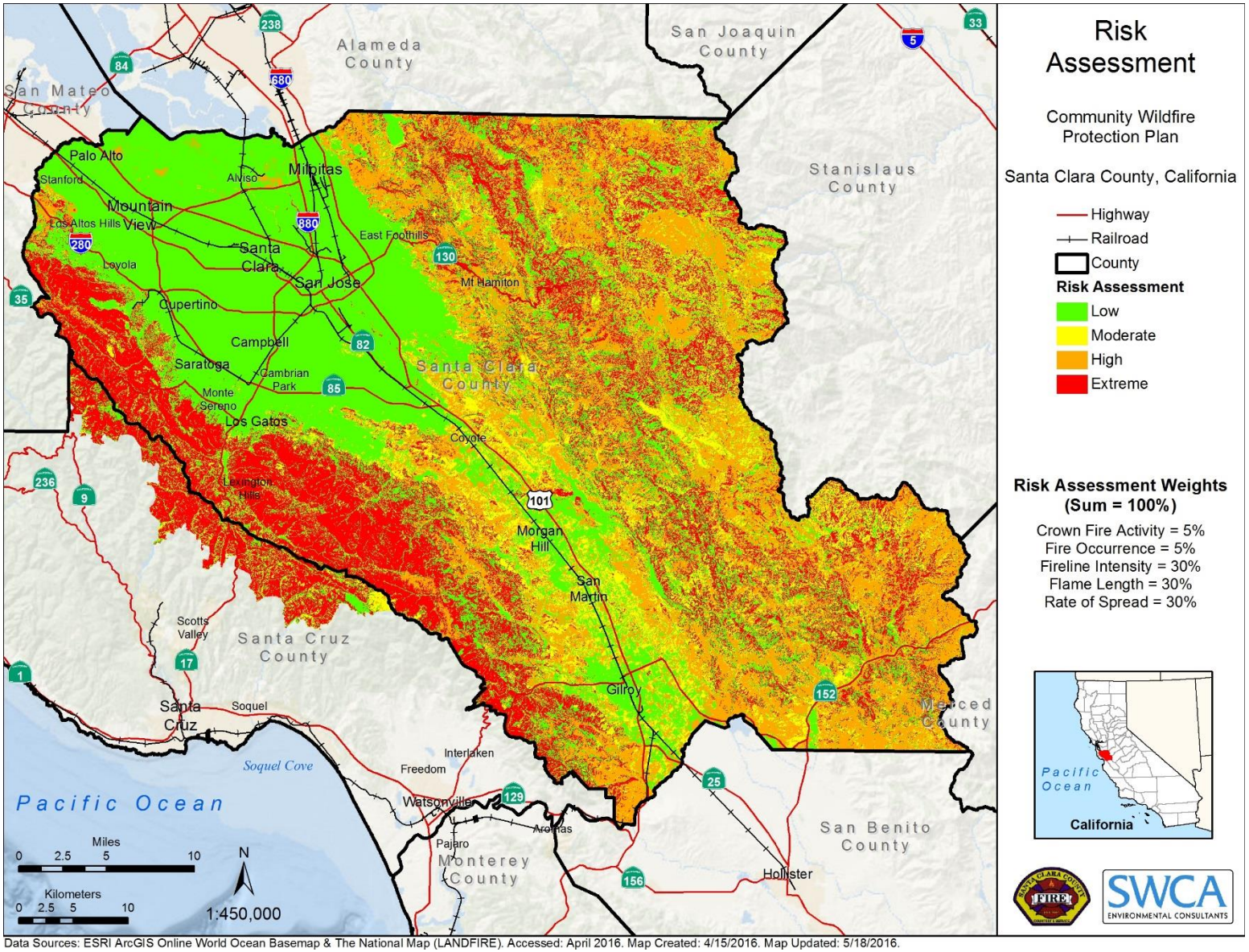


Figure 4.6. Countywide Scale Composite Fire Risk/Hazard Analysis

4.6.6 PLANNING AREA SCALE: NFPA 1144 WUI ASSESSMENTS

As part of the planning process, the Core Team identified several areas within the planning area boundary that are considered at the greatest risk from wildfire (Figure 4.2). In order to properly assess the hazards in and around these communities, a series of field days was implemented to carry out community assessments.

The assessments were conducted in January and February 2016 with assistance from fire agency staff. The community assessment was carried out using the NFPA Wildland Fire Risk and Hazard Severity Form 1144 (Appendix G). This form is based on the NFPA Standard for Reducing Structure Ignition Hazards from Wildland Fire 2013 Edition. The NFPA standard focuses on individual structure hazards and requires a spatial approach to assessing and mitigating wildfire hazards around existing structures. It also includes ignition-resistant requirements for new construction and is used by planners and developers in areas that are threatened by wildfire and is commonly applied in the development of Firewise Communities (for more information, see www.firewise.org).

The assessments were carried out at the scale of the planning area, with some exceptions where a number of communities within a single planning area exhibited very different hazard features—for example, in the Lexington Hills. Each individual planning area is described in the associated annexes to this document. Each area was rated based on conditions within the community and immediately surrounding structures, including access, adjacent vegetation (fuels), defensible space, adjacent topography, roof and building characteristics, available fire protection, and placement of utilities. Each score was given a corresponding adjective rating of low, moderate, high, or extreme. An example of the assessment form used in this plan can be found in Appendix G. The purpose of the community WUI assessment and subsequent hazard ratings is to identify fire hazard and risks and prioritize areas requiring mitigation and more detailed planning. These assessments should not be seen as tactical pre-suppression or triage plans. The community assessment helps to drive the recommendations for mitigation of structural ignitability, community preparedness, and public education. The assessment also helps to prioritize areas for fuels treatment based on the hazard rating.

The hazard ratings from the community assessment are provided in Table 4.1. This table also includes a summary of the positive and negative attributes of a community as they relate to wildfire risk.

Table 4.1. Results of the Community Risk Assessment at the Planning Area

Community/WUI Planning Area	NFPA 1144 Risk Rating	Composite GIS Risk Rating	Positive	Negative
Palo Alto	103 (High)	Moderate	• Surfaced roads and adequate width and turnaround. • Low slope in most areas, some steep sections. • Adjacent wildland to west and north are grass and managed every year by the City of Palo Alto. • Mixed construction- stucco and wood. • Large lot size reducing adjacency issues. • Adequate water supply via hydrants. • Organized homeowner association (HOA) to deliver strong safety message and take action. • Good visible house markers. • Well signposted. • Irrigated lawns and landscaping. • New construction, 7A compliant. • Most homes have Class A roofs.	• Landscaping concerns due to density of thick junipers and pines in close proximity to homes. • Wildlands to the south are heavy untreated brush. • Power lines above ground. • Homes old enough that there is no requirement for interior sprinklers. • Older homes with single paned windows prone to breaking in wildfire. • Presence of some wood shake roofs put homes and neighborhoods at risk.
Stanford	68 (Moderate)	Moderate	• Adjacent fuels are light. • Surfaced roads and adequate width and turnaround. • Low slope in most areas, some steep sections. • Adjacent wildland to west and north are grass and managed every year by the City of Palo Alto. • Mixed construction- stucco and wood. • Large lot size reducing adjacency issues. • Adequate water supply via hydrants. • Organized HOA to deliver strong safety message and take action. • Good visible house markers. • Well signposted. • Irrigated lawns and landscaping. • New construction, 7A compliant. • Most homes have Class A roofs.	• >30 feet of defensible space around most homes, but <100 feet around many. • Landscaping has some junipers and pines but lower levels than adjacent Palo Alto. • Power lines are above ground. • Homes old enough that there is no requirement for interior sprinklers. • Older homes with single paned windows prone to breaking in wildfire. • Presence of some wood shake roofs put homes and neighborhoods at risk.

Community/WUI Planning Area	NFPA 1144 Risk Rating	Composite GIS Risk Rating	Positive	Negative
Los Altos Hills	88 (High)	Moderate-High	• Under Santa Clara County Fire Department jurisdiction. • Good separation of adjacent structures, larger lot sizes. • New construction, 7A compliant. • Hydrants in most but not all areas. • Surfaced roads primarily. • Limited recent fire history. • Open space areas could serve as shelter-in-place in event of evacuation.	• Heavy concentration of eucalyptus trees—treatment program available. • >30 feet of defensible space around most homes, but <100 feet around many. • Some areas have poor yard hygiene. • Mix of construction types. Building construction includes wood siding, wooden decks, and fences that can act as fuses from vegetation to homes. • Single lane, narrow roads in some areas. • Some private roads with poor road maintenance and limited turn around for fire apparatuses. • Narrow gates. • Many old structures with wood shake roofs/siding. • Heavy fuel loading adjacent to homes as a result of thick underbrush and continuity of tree crowns. • CVAR: farm, retirement homes, open space areas, community horse barn.
Cupertino	81 (High)	Moderate - Extreme	• Surfaced roads but some steep routes. • Good visible house markers. • Well signposted. • Surfaced, maintained roads. • Reasonable water supply via hydrants but low pressure in some areas. • Irrigated lawns and landscaping. • Under Santa Clara County Fire Department jurisdiction. • HOAs for some subdivisions that can facilitate community organizing. • New construction, 7A compliant.	• Some heavy fuel loading adjacent to homes as a result of thick underbrush and continuity of tree crowns. • Thick fuels in canyon. • >30 feet of defensible space around most homes, but <100 feet around many. • Steep grades and varied topography. • Building construction includes wood siding, wooden decks, and fences that can act as fuses from vegetation to homes. • Adjacency of some residential structures. • Some homes >5 miles from fire response could result in slow response time. • Some gated dead-end roads. • Single lane, narrow roads. • Wood shake roofs present. • Propane tanks above ground. • Number of wineries and CVAR. • Heavy population density. • Some homes have limited set-back from slope.

Community/WUI Planning Area	NFPA 1144 Risk Rating	Composite GIS Risk Rating	Positive	Negative
Saratoga	90 (High)	Moderate-Extreme	• Surfaced roads but some steep routes. • Good visible house markers. • Well signposted; however, some signposting needs to be reflective. • Surfaced, maintained roads. • Irrigated lawns and landscaping. • Under Santa Clara County Fire Department jurisdiction. • HOAs for some subdivisions that can facilitate community organizing. • New construction, 7A compliant.	• Some homes >5 miles from fire response could result in slow response time. • Long windy road with steep grade. • Many dead end roads. • Reasonable water supply via hydrants in lower elevation areas, but hydrants needed at higher elevations. Encourage water tanks outside of urban service area. Some non-standard hydrants are present but need to ensure compatibility with fire department apparatuses. • >30 feet of defensible space around most homes, but <100 feet around many. • Some heavy fuel loading adjacent to homes as a result of thick underbrush and continuity of tree crowns. • Thick fuels in canyon. • Building construction includes wood siding, wooden decks, and fences that can act as fuses from vegetation to homes. • Poor roof construction, wood shake roofs present. • Cultural values at risk- Saratoga old town part of WUI, Montalvo Arts Center. • Mountain winery and concert venue—potential for large number of people to be present—mitigations have been made. • Some homes have limited setback from slope.
Monte Sereno	71 (High)	Moderate-Extreme	• New construction, 7A compliant. • Property owners have implemented some defensible space work and fuel reduction. • Good access on lower slopes. • Good proximity to emergency responders. • Well maintained, surfaced roads. • Irrigated lawns and landscaping. • Reasonable roofing construction. • Under Santa Clara County Fire Department jurisdiction.	• One way in and out. • Long windy road with steep grade. • Confusing road layout. • Limited turn around space for fire access and/or narrow driveways. • Heavy fuel loading adjacent to homes as a result of thick underbrush and continuity of tree crowns. • Reasonable water supply via hydrants in lower elevation areas, but hydrants needed at higher elevations. Encourage water tanks outside of urban service area. • Building construction includes wood siding, wooden decks, and fences that can act as fuses from vegetation to homes. • Some homes have limited setback from slope. • >30 feet of defensible space around most homes, but <100 feet around many.

Community/WUI Planning Area	NFPA 1144 Risk Rating	Composite GIS Risk Rating	Positive	Negative
Los Gatos	89 (High)	Moderate-Extreme	• Many newer 7A compliant homes. • Good signposting, though some non-reflective. • Less than 5 miles from fire response. • Good yard hygiene for most homes, landscaped yards. • Many larger lots with good separation between structures. • Number of open space areas to break continuity. • Good visible house markers. • Reasonable water supply via hydrants but low pressure in some areas. • HOAs for some subdivisions that can facilitate community organizing.	• Lots of new development. • CVAR: wineries, retirement homes, Sacred Heart Novitiate. • Very narrow, steep, and windy roads and driveways. • No turnaround on many roads and driveways. • Heavy fuel loading adjacent to homes as a result of thick underbrush and continuity of tree crowns. • Topographic concerns, steep grades. • Poor roof materials, some wood shake. • >30 feet of defensible space around most homes, but <100 feet around many. • Mix of construction types. Building construction includes wood siding, wooden decks, and fences that can act as fuses from vegetation to homes. • Narrow or no staging area for apparatuses, would block evacuation routes. • Many dead end spurs.
Redwood Estates	93 (High)	High-Extreme	• Good signage for most roads and marked evacuation routes on signs and road. • Well organized community, active in Santa Clara County FireSafe Council. • HOA assists with community organizing. • Less than 5 miles from fire response. • Good access to Highway 17 for rapid evacuation.	• Private roads. • Very narrow roads, hard to navigate if unfamiliar with area. • CVAR: store, post office, restaurant pavilion/ community center. • Lot of dead-end spurs. • Older construction but many remodels. • Two main access routes (Summit Road and Highway 17) but access still concern due to potential traffic load in event of closure of either main arteries. • >30 feet of defensible space around most homes, but <100 feet around many. • Mix of construction types. Building construction includes wood siding, wooden decks, and fences that can act as fuses from vegetation to homes. • Narrow or no staging area for apparatuses, would block evacuation routes. • Heavy fuel loading adjacent to homes as a result of thick underbrush and continuity of tree crowns. • Topographic concerns, steep grades. • Poor roof materials, some wood shake.

Community/WUI Planning Area	NFPA 1144 Risk Rating	Composite GIS Risk Rating	Positive	Negative
Summit Road	88 (High)	High-Extreme	• Fuel break work has been done in some areas. • Active Santa Clara County FireSafe Council and South Skyline Fire Safe Council projects. • Signage present regarding fire prevention. • New construction, 7A compliant. • Surfaced and maintained road. • Good separation of adjacent structures, larger lot sizes. • Signposting to visible and reflective.	• No hydrants, but wells available. Drafting is a possibility but need to ensure that option is compatible with fire department apparatuses and equipment. • Poor ingress-egress, narrow, windy road evacuation planning needed. • Hazard trees. • Narrow road. • Topographic concerns of ridge top and steep slopes. • Few passing places on road. • Tree mortality concerns— Sudden Oak Death. • Mix of construction types. Building construction includes wood siding, wooden decks, and fences that can act as fuses from vegetation to homes. • Open space areas adjacent to residential areas with dense forest and heavy fuel loading. • Some homes >5 miles from fire response could result in slow response time. • Geologic/seismic concerns. • Wood shake roofs present. • Aboveground utilities including propane tanks. • CVAR: wineries, Christmas tree farms.
Chemeketa Park	131 (Extreme)	High-Extreme	• Signposting has been updated. • Water supply available (Chemeketa Water Mutual), but rustic. • Redwood is dominant fuel but lots of needle cast and fuel accumulation. • High humidity area due to aspect and elevation.	• Very narrow roads, hard to navigate if unfamiliar with area. • One ingress/egress point to community. • Non-surfaced roads. • Defensible space < 30 feet around structure. • Topographic concerns, steep grades. • Homes have limited setback from slope. • Most homes have unrated roofs. • Combustible siding and deck. • Extreme difficulty accessing area with large fire apparatuses. • No turn around spaces. • Many homes built not to code. • Poor property maintenance. • Aboveground utilities and propane tanks. • Structure adjacency issues. • Private roads, poorly maintained.

Community/WUI Planning Area	NFPA 1144 Risk Rating	Composite GIS Risk Rating	Positive	Negative
Aldercroft Heights	116 (Extreme)	High-Extreme	• Good signposting and evacuation route marked. • Community that is active in Santa Clara County FireSafe Council. • Active fuel treatments throughout community, e.g., road brushed. • Good yard hygiene for most properties. • Evacuation route provided with bridge, not rated for engines but facilitates evacuation by residents. • Some newer 7A compliant homes. • Less than 5 miles from fire response.	• Water supply is limited— Sistine to water tank • Extreme difficulty accessing area with large fire apparatuses. • Aboveground utilities and propane tanks. • Private road and water but managed by associations. • Very narrow, steep and windy roads and driveways. • No setback from slope for most homes. • CVAR: cell sites. • Mix of construction types. Building construction includes wood siding, wooden decks, and fences that can act as fuses from vegetation to homes. • Narrow or no staging area for apparatuses, would block evacuation routes. • Evacuation drills needed. • No turnaround. • High elevation, steep vegetated slopes with highly flammable shrub component. • Many homes defensible space < 30 feet around structure. • Poor roof materials, some wood shake. • Topographic concerns, steep grades. • Many dead end spurs.
Morgan Hill (including Holiday Lake Estates and Jackson Oaks)	83 (High)	Moderate-High	• Firewise sign. • Active community in Santa Clara County FireSafe Council and fire prevention activities. • Open space areas break continuity and active fuel programs. • Surfaced and maintained roads. • Mostly good yard hygiene and maintenance of property • Morgan Hills City Water hydrant system. • Good signage, some non-reflective. • Weed abatement projects in effect. • HOA assists with community organizing. • Majority below ground utilities.	• Dry flammable vegetation type adjacent to homes and below homes on slopes. • Popular with visitors, potential large numbers during summer months. • One road in and out, evacuation concerns. • Narrow roads within residential areas may have limited turnaround space. • Small lots, limited separation between structures. • Some steep driveways. • Some dead-end spurs. • Some wood shake roofs. • One Engine Company close, but other resources are at some distance. • Topographic concerns— significant slope and limited setback for many homes. • Single access subdivisions. • >30 feet of defensible space around most homes, but <100 feet around many due to small lots. • Mix of construction types. Building construction includes wood siding, wooden decks, and fences that can act as fuses from vegetation to homes.

Community/WUI Planning Area	NFPA 1144 Risk Rating	Composite GIS Risk Rating	Positive	Negative
Gilroy	50 (Moderate)	Low-High	• Light fuels. • Open space: Henry Coe Range. • Rolling hills and less extreme grades. • Large lots and good separation. • Good defensible space around most homes, some <100 feet. • Good access. • Maintained roads and plentiful turnaround space. • Good signage. • Low fire occurrence. • Hydrants available but density is low.	• Livestock evacuation concerns. • Gated properties could impede access to emergency responders. • Mix of construction types. Building construction includes wood siding, wooden decks, and fences that can act as fuses from vegetation to homes. • CVAR: farms, grazing, orchards, vineyards, commercial property. • Some poorly rated roof materials. • Some homes > 5 miles from organized fire response. • Aboveground utilities. • Some oil and gas infrastructure.
Milpitas and East Foot Hills area	68 (Moderate)	Low-High	• Good fire response resources from San Jose Fire Department and CAL FIRE. • Roadside fuel treatments in progress. • Large open space areas break up residential areas. • Good yard hygiene for most homes, landscaped yards. • Non-continuous light fuels. • Sparse population in more rural areas. • Grazing helps in fuel reduction in some areas where appropriate.	• Diverse WUI, from distinct interface with heavily urban area to scattered residences in an intermix. Different planning needed for each type. • Scenic road ways may increase ignition potential—Ignition concerns related to Sierra Road—fireworks etc. • CVAR: Grand View Restaurant, Lick Observatory, Copernicus Peak communications site, Alum Rock Park. • >30 feet of defensible space around most homes, but <100 feet around many. • Mix of construction types. Building construction includes wood siding, wooden decks, and fences that can act as fuses from vegetation to homes. • Wood shake roofs and older construction in some areas. • Many dead-end spur roads. • Topographic concerns, rolling hills and some steep slopes. • Grassland fuels that are highly dynamic and impacted by seasonal climate fluctuations. • Flashy shrub fuels present on slopes below homes. • Slow response times to some more remote homes in the valley. • Improvements to road networks needed. • No distinct neighborhood associations to use to develop common interest for neighborhood level interactions for Firewise or CERT.

Note: some areas were broken down into smaller communities to show variations in hazards.

4.7 PARCEL LEVEL HAZARD/RISK ASSESSMENT MODEL

The parcel level hazard and risk assessment model has four major components:

1. **Community hazard assessment** examines the current and expected WUI conditions. Factors examined include FHSZ rating, weather conditions of assessment area, history of serious fires, fire ignition patterns and sources, parcel sizes, road network, evacuation factors, available water supply, presence of flammable vegetation, and other factors.
2. **Community mitigations** include community average of year building built (as it relates to whether the structure was built under more stringent WUI building codes), communitywide compliance with defensible space provisions, general property hygiene and community fuel breaks or other fire defense projects, community involvement in fire prevention education and outreach, and other factors.
3. **Parcel mitigations** include primary land use (residential, commercial, infrastructure), year buildings on the parcel were built, setback distance to nearby structures, roof type, siding materials, window type, venting systems, deck materials and ember resistance, defensible space compliance, property hygiene, special needs for evacuation, and other factors.
4. **Special adjustments** include certain parcel level factors such as historical or irreplaceable structures, cultural icons, facilities "too important" to lose, rare/endangered species not fire adapted, or other situations that highlight critical importance of mitigating that parcel.

Properly analyzing these factors also requires identification of WUI fire protection capacity, land management practices, jurisdictions, existing laws, ordinances, regulations, polices, and practices.

The parcel level risk assessment model was developed with the intention that over time a database of assessment data will be built for the County using the model as a framework. In lieu of a full dataset at this time, the model was tested using sample data from across the county. The results illustrate how the model will identify risk spatially and the potential of the model to aid in prioritization of parcel mitigations for risk reduction. For descriptions of each risk factor included in the model please see Appendix I.

4.8 RESULTS OF PARCEL LEVEL RISK ASSESSMENT

Community hazard – Structural risk assessments are conducted by first examining and scoring the community level hazard. Scores are given for the characteristics of each rating factor:[8] For Descriptions of each rating factor used in the model please refer to Appendix I.

- FHSZ
- Average parcel size
- Distance from flammable vegetation
- Extreme wind patterns
- Ignition history
- Serious fire history
- Road network
- Evacuation time to safe area
- Water supply

[8] Other ratings factors (e.g., response time) can be added if deemed important.

Community mitigations – Communitywide mitigations efforts will reduce the hazard score for the entire community. Each mitigation method has a different impact score.

- Average year built
- Fuel modifications/fuel breaks
- Communitywide defensible space compliance
- Average communitywide property hygiene
- Community involvement in Santa Clara County FireSafe Council/public education programs
- Community recognition as Firewise Community

Parcel mitigations – Parcel owners can significantly improve survivability for their properties by mitigations under their control. The parcel score includes the community hazard score because the parcel cannot separate itself from the surrounding hazard. It is possible for a parcel to have a very good parcel mitigation score, but have a poor overall score because the community has a high hazard rating (poor road network, lack of water, or poor communitywide defensible space compliance can adversely affect the parcel). Conversely, a community can have a good hazard score and the individual parcel can have a poor score; this could be a home with shake shingle roof in a WUI community where all other roofs are non-flammable.

- Property land use
- Year built
- Distance (set back) from nearest adjoining structures
- Roof materials
- Siding materials
- Exterior window type
- Venting types/screen size
- Deck floor materials, under deck storage, and ember resistance to underdeck area
- Flammable deck/patio furniture
- Defensible space compliance
- Ember/mulch bed proximity
- Property hygiene
- Evacuation assistance need
- Special adjustments for historical, cultural, or local icon(s)
- Special status species

4.8.1 Test Results of Parcel Level Hazard/Risk Assessment Model

The model was tested for six homes across Santa Clara County (Table 4.2). The score comprises of the four ratings, community hazard rating (CHR), community mitigation rating (CMR), total community score (TCS), and parcel mitigation rating (PMR). It is important to note that the scores can be negative (i.e., negative mitigation = increased hazard due to property maintenance). A negative score will increase the overall risk result of the model. As the general premise of the model is Fire Risk = Hazard – Observed Mitigations; if the observed mitigations are negative the overall fire risk will be higher.

Table 4.2. Test homes for Parcel Level Hazard/ Risk Assessment Model.

APN	Address_ Num	Address_Street	CHR	CMR	TCS	C_RISK	PMR	Special	Overall	Overall_Risk
55822002	20945	Panorama	417	-11	428	Extreme	-283	0	711	Extreme
55839041	19900	Old Santa Cruz Hwy	94	-3	97	High Risk	-311	0	408	Extreme
54441012	22219	Summit Road	111	42	69	Moderate	118	0	-49	Moderate
33630014	25584	Moody	41	40	1	Low Risk	105	0	-104	Low Risk
18248011	27201	Deer Springs Wy	65	50	15	Moderate	143	0	-128	Low Risk
34256035	10948	Sycamore Dr	65	26	39	Moderate	-233	0	272	Extreme

A major benefit of this model is that the model itself is calculated in a spreadsheet (such as Microsoft Excel), the results of which can then be transferred into ArcGIS using simple "join to table" function. The parcel can then be symbolized to show overall risk. Figure 4.7 is a sample from the test data to show how factors influence high or low risk in the model.

Panorama Los Gatos
EXTREME RISK
- Extreme community risk
- Very high FHSZ
- One lane no passing
- Pre 1975 structure
- Wood shingle siding

Moody Lane
LOW RISK
- Low community risk
- Low FHSZ
- 2-lane roads >24 feet
- Large community water supply
- Composition roof

Figure 4.7. Results of test model run for the Moody land and Panorama properties.

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