

APPENDIX P

Fire Protection Plan

Fire Protection Plan:

Belcaro at Sand Canyon

UPDATED NOVEMBER 2025

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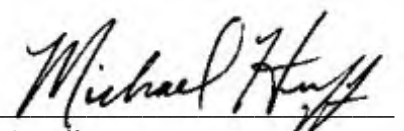
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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AMSL	Above Mean Sea Level
APN	Assessor’s Parcel Number
BLM	Bureau of Land Management
CAL FIRE	California Department of Forestry and Fire Protection
CBC	California Building Code
CC&Rs	Covenants, Codes and Restrictions
CCS	Coastal Sage Scrub
CFC	California Fire Code
CMU	Concrete Masonry Unit
DU	Dwelling Units
EMS	Emergency Medical Service
FAHJ	Fire Authority Having Jurisdiction
FMZ	Fuel Modification Zone
FPP	Fire Protection Plan
FRAP	Fire and Resource Assessment Program
GIS	Geographic Information System
HOA	Homeowner’s Association
IBHS	Insurance Institute for Business and Home Safety
LACFCD	Los Angeles County Flood Control District
LACoFD	Los Angeles County Fire Department
LRA	Local Responsibility Area
MFD	Multi-Family Dwelling
MPH	Miles Per Hour
NFPA	National Fire Protection Association
NPS	National Park Service
OEM	Office of Emergency Management
OSFM	Office of the State Fire Marshal
Project	Belcaro At Sand Canyon Project
RAWS	Remote Access Weather Station
SFD	Single Family Dwelling
SMFSR	State Minimum Fire Safe Regulations
USDA	United States Department of Agriculture
VHFHSZ	Very High Fire Hazard Severity Zone
WUI	Wildland Urban Interface

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Executive Summary

The Fire Protection Plan (FPP) has been prepared for the proposed Belcaro at Sand Canyon Project (Project) that consists of approximately 193.8 gross acres of vacant, undeveloped land in the City of Santa Clarita (City) in the easternmost portion of the City, as shown in Figure 1, Project Location Map. The project site is separated into two parts by the Southern Pacific Railroad, which runs east-west just south of the northern portion of the project site. The project site consists of the following Assessor Parcel Numbers (APNs): 2840-001-118, 2840-025-031, -032, -033, -034, -035, -045, and -047. The Santa Clarita General Plan's land use and zoning designations for the project site is Urban Residential 1 (UR1) (2.0 dwelling units/acre [du/ac]) and Non-Urban 5 (NU5) (1.0 du/ac). The project would convert vacant parcels into a gated senior community comprised of 341 age-restricted, detached single-family homes, a 3.1-acre recreation center, and 2.6 miles of publicly accessible trails across 193.8 gross acres. The project would result in the creation of 400 separate lots, consisting of 341 residential lots, one recreational lot, 21 private street lots, and 37 open space lots.

The project site is located approximately 26 miles north of downtown Los Angeles and is locally accessible via Lost Canyon Road and Oak Springs Canyon Road. Regionally, the project site is accessible from State Route 14 (SR-14) freeway via Sand Canyon Road, west of the project site. The project site is found on the Mint Canyon US Geologic Survey (USGS) 7.5-minute quadrangle, Township 4N, Range 15W, Sections 13, 14, 23, and 24. As shown on Figure 2, Existing On-Site and Off-Site Land Uses, the project site is bordered by the Santa Clarita River to the north (and further north—SR-14), existing single-family development to the west, Sand Canyon County Club to the south, and undeveloped land to the east. Unincorporated Los Angeles County is located east of the project site, and the Angeles National Forest is located 0.25-mile east of the project site. The surrounding land uses and zoning directly adjacent to the project site include Open Space (OS) to the north, NU5 to the east, NU5 and OS to the south, and UR1 to the east. Areas east and north of the project site are within the SEA Overlay zone.

The project would include a number of on-site and off-site circulation improvements. Primary access to the project site would be via Lost Canyon Road connecting to the proposed "A" Street on-site, and secondary access would be via Robinson Ranch Road, connecting to the proposed "J" Street. Currently, Lost Canyon Road terminates at the project boundary near the northwesternmost corner of the project site, where it turns southerly into Oak Springs Canyon Road. With project implementation, Lost Canyon Road would be extended into the project site, aligned east/west and generally parallel to the existing Southern Pacific Railroad to the south, and then would turn southerly. The on-site portions of Lost Canyon Road would include two 14-foot-wide travel lines, parkways, and a 12-foot-wide trail along its northern right-of-way.

The Project Site lies within an area considered a Local Responsibility Area (LRA) Very High Fire Hazard Severity Zone (VHFHSZ), as designated by the California Department of Forestry and Fire Protection (CAL FIRE) Office of the State Fire Marshal (OSFM). The Open Space area located north of the northern property boundary within the Santa Clarita River watershed is also designated as an LRA VHFHSZ, as shown on Figure 3, Fire Hazard Severity Zone Map. Fire hazard designations are based on topography, vegetation, and weather, amongst other factors. VHFHSZ designation does not indicate that an area is not safe for development. It does indicate that specific fire protection features that minimize structure vulnerability will be required, including compliance with provisions set forth in Chapter 7A of the California Building Code (CBC) and provisions for maintaining fuel modification zones, amongst others described in this FPP.

As described above, the project site consists of approximately 193.8 gross acres of vacant, undeveloped land. The project site is located within the City's Significant Ecological Area (SEA) Overlay Zone and includes biological resources, including trees, that are protected under the City's Municipal Code Section 17.38.080 (SEA - Significant Ecological Area Overlay Zone). Unpaved portions of Oak Springs Canyon Road intersect the project site, parallel to the project's southern boundary. Ruderal vegetation, grass, brush, and trees (including oak trees) cover the majority of the project site. Several dirt paths and roadways intersect the site, and are primarily used by off-road vehicles, horses, bicycles, and pedestrians. An existing water well is located in the northern portion of the project site. The project site has varying elevation and sits at an average elevation of 1,640 feet above mean seal level. The Project vicinity is subject to fire risk year-round due to climate, topography, and the regional fire environment; and is also subject to extreme weather conditions (i.e. Santa Ana Winds) that can heighten the likelihood of fire ignition and spread, and, considering the site's terrain and vegetation, may result in a fast-moving and intense wildfire.

This FPP evaluates and identifies the potential fire risk associated with the Project's land uses and identifies requirements for water supply, fuel modification and defensible space, access, building ignition and fire resistance, and fire protection systems, among other pertinent fire protection criteria. The purpose of the FPP is to generate and memorialize the fire safety requirements and standards of the LACoFD along with project-specific measures based on the unique conditions present on the Project Site, its intended use, and its fire environment.

As determined during the analysis of the site and its fire environment, the Project Site, in its current condition, may include characteristics that, under favorable weather conditions, could have the potential to facilitate fire spread. Under extreme conditions, wind-driven wildfires from the east/northeast are likely to cast embers onto the property. Once the Proposed Project is in operation, the on-site fire hazard would be lower than its current condition due to fire safety requirements that would be implemented on the site. The proposed residential structures would be built using ignition-resistant materials pursuant to the most recent County Fire and Building Codes (Chapter 7A - focusing on structure ignition resistance from flame impingement and flying embers in areas designated as high fire hazard areas), which are the amended 2022 California Fire and 2022 California Building. The Project would also comply with Chapter 49 of the CFC which discusses development requirements in Wildland Urban Interface Areas. This would be complemented by:

- Site-wide, ignition resistant landscapes,
- Perimeter fuel modification zone
- Improved water availability, capacity, and delivery system)
- Project area firefighting resources,
- Fire department access throughout the developed areas,
- Monitored defensible space/fuel modification,
- Interior, automatic fire sprinkler systems in all structures,
- Monitored interior sprinklers in applicable structures,
- Fire response travel times based on county response guidelines, and
- Other components would provide properly equipped and maintained structures with a high level of fire ignition resistance.

Post-wildfire saves and loss assessments have revealed specifics of how structures and landscapes can be constructed and maintained to minimize their vulnerability to wildfire. Among the findings were: how construction materials and methods protect homes, how fire and embers contributed to the ignition of structures, what effects fuel modification had on structure ignition, the benefits of fast firefighter response, and how much (and how reliable) water was available, were critically important to structure survivability. Following these findings over the last 20 years and continuing on an ongoing basis, the Fire and Building codes are revised, appropriately. Los Angeles County now contains some of the most restrictive codes for building within Wildland Urban Interface (WUI) areas that focus on preventing structure ignition from heat, flame, and burning embers.

Fire risk analysis conducted for the Project resulted in the determination that wildfire has occurred and will likely occur near the Project Area again, but the proposed Project would provide ignition-resistant landscapes (drought-tolerant and low-fuel-volume plants) and ignition-resistant structures, and defensible space with the implementation of specified fire safety measures. Based on modeling and analysis of the Project area to assess its unique fire risk and fire behavior, it was determined that the Los Angeles County standard of 200-foot-wide fuel modification zones (FMZs) would help considerably to set the site's structures back from off-site fuels. In the limited area where the southwest portion of the development abuts a California Department of Fish and Wildlife (CDFW) jurisdictional stream/channel, the FMZ will be reduced to less than 200 feet; however, the construction of a non-combustible, six-foot-tall, heat deflecting wall will compensate (as shown through modeling) for the reduced FMZ. The up to 200-foot-wide FMZ, when properly maintained, will effectively minimize the potential for structure ignition from direct flame impingement or radiant heat. The FMZs will be constructed from the structure outward toward undeveloped areas. As required in the CFC, the FMZs for the Project would be maintained in perpetuity by a funded Homeowner's Association (HOA) or similarly funded entity. For the purposes of this FPP, FMZs and "fuel breaks", as defined by Title 14 of the California Code of Regulations (14 CCR), Division 1.5, Chapter 7, subchapter 2, Articles 1-5 - State Minimum Fire Safe Regulations (SMFSR), serve the same function to protect structures and minimize the potential for structure ignition from adjacent combustible vegetation.

This FPP provides a detailed analysis of the Project, the potential risk from wildfire, and potential impacts on the LACoFD, as well as an analysis of meeting or exceeding the requirements of Los Angeles County. Further, the FPP provides requirements, recommendations, and measures to reduce the risk and potential impacts to acceptable levels, as determined by the LACoFD.

The tables below summarize the primary Project code features for fire protection which are required through applicable codes and regulations and the code-exceeding features which are implemented to further mitigate wildfire risks. Additionally, recommended Project design features for enhanced fire protection are summarized below.

Table 1. Primary Project Code Features

Feature No.	Description
1	Ignition Resistant Construction. All Project structures would be built to the ignition resistant construction requirements per the CBC Chapter 7A and the Los Angeles County Building Code (Title 26, Chapter 7A), Construction Methods for Exterior Wildfire Exposure. (Section 6.3 Ignition Resistant Construction)
2	Interior Fire Sprinklers. All structures, of any occupancy type, will be protected by an automatic, interior fire sprinkler system per CFC and County Fire Code Title 32. All structures Automatic internal fire sprinklers would be in accordance with National Fire Protection Association (NFPA) 13, 13D, or 13R and LACoFD installation requirements as required based on structure type, use, and size. (Section 5.3.3 Automatic Fire Sprinklers)
3	Fuel Modification Zones. The proposed Fuel Modification Zone Plan for the Belcaro at Sand Canyon Project Site includes a 5-foot Ember Resistant Zone, a minimum 30-foot wide irrigated setback area Zone A, a minimum 70-foot wide irrigated area Zone B, and a minimum 100-foot wide thinning area Zone C in most locations, in compliance with Los Angeles County Fire Code (Title 32, Fire, Section 4908) and exceeds the State minimum requirements of the SMFSR and 2022 California Fire Code (Section 4907 – Defensible Space), Government Code 51175 – 51189, and Public Resources Code 4291. (Section 5.4 Defensible Space and Vegetation Management). In the limited area where the southwest portion of the development abuts a California Department of Fish and Wildlife (CDFW) jurisdictional stream/channel, the FMZ will be reduced to less than 200 feet; however, the construction of a non-combustible, six-foot-tall, heat deflecting wall will compensate (as shown through modeling) for the reduced FMZ.
4	Roadside Fuel Modification Zones. The Project includes roadside FMZs that extend a minimum of 10 feet from the edge of any public or private roadway that may be used as access for fire-fighting apparatus or resources and are adjacent to naturally vegetated areas. Clear and remove flammable growth for a minimum of 10 feet on each side of the access roads. Roadside FMZs will be consistent with SRA SMFSR and Title 32 of the County Fire Code Section 325.10. Additional clearance beyond 10 feet may be required upon inspection per Title 32. (Section 5.4 Defensible Space and Vegetation Management)
5	Fire Apparatus Access. The project will provide code-compliant fire apparatus access roadways throughout the development and will vary in width and configuration but will all provide at least the minimum required unobstructed travel lanes, lengths, turnouts, turnarounds, and clearances. Project Site access, including road widths and connectivity, will be consistent with the County’s roadway standards and the 2022 CFC Section 503, County Fire Code Title 32, and County of Los Angeles Municipal Code Title 21, Subdivisions which meet or exceed the SMFSR. (Section 5.1 Fire Apparatus Access)
6	Water Availability. The Project will provide water and fire flow in accordance with the SMFSR and County Title 20, Section 20.16.060 for fire flow and fire hydrant requirements within a VHFHSZ. Fire Hydrants shall be located along fire access roadways as determined by LACoFD Fire Chief or Fire Marshal and current fire code requirements to meet operational needs.
7	Fuel Modification Maintenance Agreement. Per an approved Fuel Modification Zone Plan, the Project is required to maintain fuel modifications zones on an annual basis minimum in perpetuity. All fuel modification area vegetation management within the FMZs shall be completed annually prior to inspections each year and more often as needed for fire safety, as determined by the LACoFD. (Section 5.4.2 Fuel Modification Area Vegetation Maintenance Requirement).

Table 2. Recommended Project Design Features

Feature No.	Description
1	<p>Recommended Fuel Modification Zone 3rd Party Inspections Project Design Feature (PDF). To confirm that the Project’s FMZs and landscape areas are being maintained according to the FPP and the LACoFD’s fuel modification guidelines, the Project HOA would obtain an FMZ inspection and report from a qualified LACoFD-approved 3rd party inspector in May/June of each year certifying that vegetation management activities throughout the Project Site have been performed. If the FMZ areas are not compliant, the Project HOA will have a specified period to correct any noted issues so that a re-inspection can occur and certification can be achieved. Annual inspection fees are subject to the current Fire Department Fee Schedule.</p>
2	<p>Recommended Pre-Construction Vegetation Management PDF. Vegetation management requirements shall be implemented at commencement and throughout the construction phase in compliance with Chapter 33 of the CFC. Vegetation management for the Project area shall be performed pursuant to the FPP and LACoFD requirements on all building locations prior to the start of work and prior to any import of combustible construction materials. Adequate fuel breaks shall be created around all grading, site work, and other construction activities in areas where there is flammable vegetation to ensure that potential ignitions associated caused by construction activities do not transition offsite. Combustible materials will not be brought on-site without prior fire department approval regarding appropriate pre-construction fire safety features.</p>
3	<p>Recommended Wildfire Education Program PDF. The Belcaro at Sand Canyon Project will provide a Wildfire Education Program that provides targeted outreach to residents living in a fire risk area in order to foster a community that has fire adaptive capacity. The educational program would cover a wide range of information such as residential evacuation planning, defensible space guidelines, how to maintain fire protection features, activities in a fire risk area, and more, all provided in easy-to-understand, graphically based materials. The educational program will be based on a layered approach to wildfire awareness that includes both passive and active features. The program will be ongoing in order to maintain high wildfire awareness even as the community grows and evolves. The program features bi-annual email and mailers, a custom community website, community workshops and webinars, a new resident packet, an emergency alert campaign, fire watch groups, and an HOA fire safety committee.</p> <p>Furthermore, achievement of becoming a Firewise Community site recognition through Firewise USA including annual recertification is recommended. In order to become a Firewise Community site, a board or committee will need to be created, and the committee or board will then need to obtain a wildfire risk assessment that will need to be updated at least every 5 years. The board or committee will then need to develop an action plan that is required to be updated at least every 3 years. In addition to the wildfire risk assessment and action plans being created, the board or committee members will annually be required to host an educational event and meet the minimum investment requirements, as well as submit an annual renewal. A detailed list of the requirements the Belcaro community will need to follow has been included in Section 3.5.4 as well as in section 8 of this FPP.</p>

Project Code-Exceeding Feature

Feature No.	Description
1	Construction of a 6-foot non-combustible Fire Wall along southwest portion of the site. The Project includes the construction of a 6-foot non-combustible fire view wall (lower 1 to 2 feet is a concrete masonry unit (CMU) block wall and upper 4 to 5 feet is a dual pane, one pane tempered glazing window) to provide additional deflection along the perimeter of the lots in the southwest portion of the project where there are reduced fuel modification zones which are adjacent to areas identified as California Department of Fish and Wildlife (CDFW) jurisdictional stream areas. The fire view wall shall be constructed to function as a heat-deflecting wall.

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1 Introduction

This Fire Protection Plan (FPP) has been prepared for the proposed Belcaro at Sand Canyon Project in the City of Santa Clarita in Los Angeles County. The purpose of the FPP is to evaluate the potential impacts resulting from wildland fire hazards and identify the measures necessary to adequately mitigate those risks to a level consistent with County of Los Angeles (County) thresholds. Additionally, the purpose of the plan is to generate and memorialize the fire safety requirements of the Fire Authority Having Jurisdiction (FAHJ), namely the Los Angeles County Fire Department (LACoFD) as defined in 14 CCR 1270.01(I). The "Fire Authority" is defined as "A fire department, agency, division, district, or other governmental body responsible for regulating and/or enforcing minimum fire safety standards in the Local Jurisdiction" (14 CCR 1270.01(I)). Requirements and recommendations detailed in the FPP are based on site-specific characteristics, applicable code requirements, and input from the Project's applicant, project planners, engineers, and architects, as well as correspondence with the FAHJ.

As part of the assessment, the FPP has considered the fire risk presented by the Project Site including the property location and its topography, geology, surrounding combustible vegetation (fuel types), climatic conditions, fire history, and the proposed land use. The FPP addresses water supply, access, structural ignitability, ignition resistive building features, fire protection systems, and equipment, impacts on existing emergency services, defensible space, and vegetation management. The FPP also identifies fuel modification zones and recommends the types and methods of treatment that, when implemented and maintained, are designed to protect the Project's assets. The FPP also recommends measures for developers/builders, property owners, and the Homeowner's Association (HOA) to implement in order to reduce the probability of structural and vegetation ignition.

The Project is located within the boundaries of the LACoFD and thus the FPP addresses LACoFD's response capabilities and response travel time within the Project Area, along with projected funding for facility improvements and fire service maintenance.

The following tasks were performed toward the completion of this FPP:

- Gather site-specific climate, terrain, and fuel data,
- Collect site photographs. Field observations were used to augment existing digital site data in generating the fire behavior models and formulating the recommendations presented in the FPP. Refer to Appendix A, *Representative Site Photographs*, for site photographs of existing site conditions,
- Process and analyze the data using the latest geographic information system (GIS) technology,
- Predict fire behavior using scientifically based fire behavior models, comparisons with actual wildfires in similar terrain and fuels, and experienced judgment,
- Analyze and guide the design of proposed infrastructure,
- Analyze the existing emergency response capabilities,
- Assess the wildfire risk associated with the Project Site,
- Evaluate nearby firefighting and emergency medical response resources, and
- Detail how fire risk will be mitigated through a system of fuel modification, structural ignition resistance enhancements, and fire protection delivery system upgrades.

1.1 Project Summary

1.1.1 Location

The project site consists of approximately 193.8 gross acres of vacant land located south of State Route 14 (SR-14) within the City of Santa Clarita, California (Figure 1, Regional Location and Local Vicinity Map). The project site is separated into two parts by the Southern Pacific Railroad, which runs east-west just south of the northern portion of the project site. The project site is located approximately 26 miles north of downtown Los Angeles and is locally accessible via Lost Canyon Road and Oak Springs Canyon Road. Regionally, the project site is accessible from SR-14 freeway via Sand Canyon Road, west of the project site. The project site is located entirely within the City's jurisdictional boundaries, within the easternmost portion of the City. The project site is found on the Mint Canyon US Geologic Survey (USGS) 7.5-minute quadrangle, Township 4N, Range 15W, Sections 13, 14, 23, and 24. The project site consists of the following Assessor Parcel Numbers (APNs): 2840-001-118, 2840-025-031, -032, -033, -034, -035, -045, and -047.

The project site is zoned for low-density urban residential use and non-urban residential use (City of Santa Clarita 2011). Adjacent land uses include existing low-density residential developments and an equestrian facility along the western and southwestern boundary, a golf course (Sand Canyon Country Club) along the southeastern boundary, undeveloped/open space designated land to the north and east of the Project site, and a railroad (the Antelope Valley Line) bisecting the northern parcels of the Project (City of Santa Clarita 2011). The Angeles National Forest is located approximately 0.25-miles east of the Project boundary. An aerial of the project site and surrounding land uses is shown on Figure 2, Existing On-Site and Off-Site Land Uses. The Santa Clarita General Plan's land use and zoning designations for the project site is Urban Residential 1 (UR1) (2.0 dwelling units/acre [du/ac]) and Non-Urban 5 (NU5) (1.0 du/ac). The project site is bordered by the Santa Clarita River to the north (and further north—SR-14), existing single-family development to the west, Sand Canyon County Club to the south, and undeveloped land to the east. Unincorporated Los Angeles County is located east of the project site, and the Angeles National Forest is located 0.25-mile east of the project site. Primary access to the site will be via Lost Canyon Road connecting to the proposed "A" Street on-site, and secondary access would be via Robinson Ranch Road, connecting to the proposed "J" Street.

The Project Site lies within an area considered an LRA VHFHSZ, as designated by the California Department of Forestry and Fire Protection (CAL FIRE) - OSFM. The Open Space area located north of the northern property boundary within the Santa Clarita River watershed area is also designated as an LRA VHFHSZ, as shown on Figure 3, Fire Hazard Severity Zone Map.

1.1.2 Project Description

The Project would convert vacant parcels into a gated senior community comprised of 341 age-restricted, detached single-family homes, a 3.1-acre recreation center, and 2.6 miles of publicly-accessible trails across 193.8 gross acres. The project would result in the creation of 400 separate lots, consisting of 341 residential lots, one recreational lot, 21 private street lots, and 37 open space lots (as shown in Figure 4, Conceptual Site Plan). Table 3 provides a summary of the proposed project land uses, and the associated lot numbers and acreage.

Table 3. Summary of Project Uses

Land Use	Lot Numbers	Acres
Single Family (detached) age-restricted units	1 through 341	58.7
Recreation Area/Clubhouse	342	3.1
Private Streets/Driveways	343 through 363	21.6
Open Space	364 through 400	107.6
Public Streets (On-Site portion of Lost Canyon Road extension)	Not Applicable	2.8
Total		193.8

The 341 proposed residential lots would each consist single-family detached dwelling unit, for a total of 341 dwelling units on-site. The residential lots would range from approximately 5,000 to 7,500 square feet in size. The dwelling units would range in size from approximately 1,531 to 3,782 square feet. The floor plans include a minimum of two-bedroom, two-bathroom units, and a maximum of five-bedroom, 3.5-bathroom units. The dwelling units would be a minimum of one-story, with an optional secondary-story massing over a portion of the ground floor. All residential units would be situated in the southern portion of the project site (south of Southern Pacific Railroad) within 58.7 acres on Lots 1 through 341.

Primary access to the Project Site would be from Lost Canyon Road, connecting to the proposed “A” Street on-site. Currently, Lost Canyon Road terminates at the project boundary near the northwesternmost corner of the project site, where it turns southerly into Oak Springs Canyon Road. With project implementation, Lost Canyon Road would be extended into the project site, aligned east/west and generally parallel to the existing Southern Pacific Railroad to the south, and then would turn southerly. The on-site portions of Lost Canyon Road would include two 14-foot-wide travel lines, parkways, and a 12-foot-wide trail along its northern right-of-way. “A” Street would be the primary gated access road into the residential portion of the project site. On-site private streets (“A” Street through “I” Street and “K” Street through “O” Street) would provide vehicular and pedestrian access throughout the proposed residential community. These on-site private streets would consist of two 10-foot-wide travel lanes, one 8-foot-wide parallel parking area on each side of the street, 5-foot-wide sidewalks along both sides of the road, and associated curb and gutter improvements, for a total of 46-foot-wide roads. These private streets provide connectivity throughout the proposed single-family residential units on-site and would terminate in eight cul-de-sacs.

Finally, the Project would also be subject to the provisions of section 4291 of the Public Resources Code regarding brush clearance standards around structures and the Los Angeles County Fire Department guidelines for Fuel Modification Plans. Los Angeles County Fire Code (Title 32, Fire, Section 4907) is consistent with the 2022 California Fire Code (Section 4907 – Defensible Space), Government Code 51175 – 51189, and Public Resources Code 4291, which require that fuel modification zones be provided around every building that is designed primarily for human habitation or use within a VHFHSZ. A typical landscape/fuel modification installation per the County’s Fire Code consists of a 30-foot-wide Zone A and a 70-foot-wide Zone B for a total of 100¹ feet in width. An additional 100-foot-wide Zone C may be required for the areas adjacent to natural-vegetated, open space areas. The Proposed Project aligns with LACoFD requirements and will consist of a 30-foot-wide Zone A and a 70-foot-wide Zone B (both Zones A and B will be irrigated) and a 100-foot thinning Zone C. A Fuel Modification Plan shall be reviewed and

¹ In accordance with section 325.2.1 of the Los Angeles County Fire Code, Clearance of Brush and Vegetation Growth “Extra Hazard”, it may be determined by the fire official that some sites pose an extra hazard. In such cases, Fuel Modification Zones may exceed 100 feet but not exceed 200 feet from structures. Based on modeled fire behavior, it was determined that 200- foot FMZs would provide adequate defensible space for the Project.

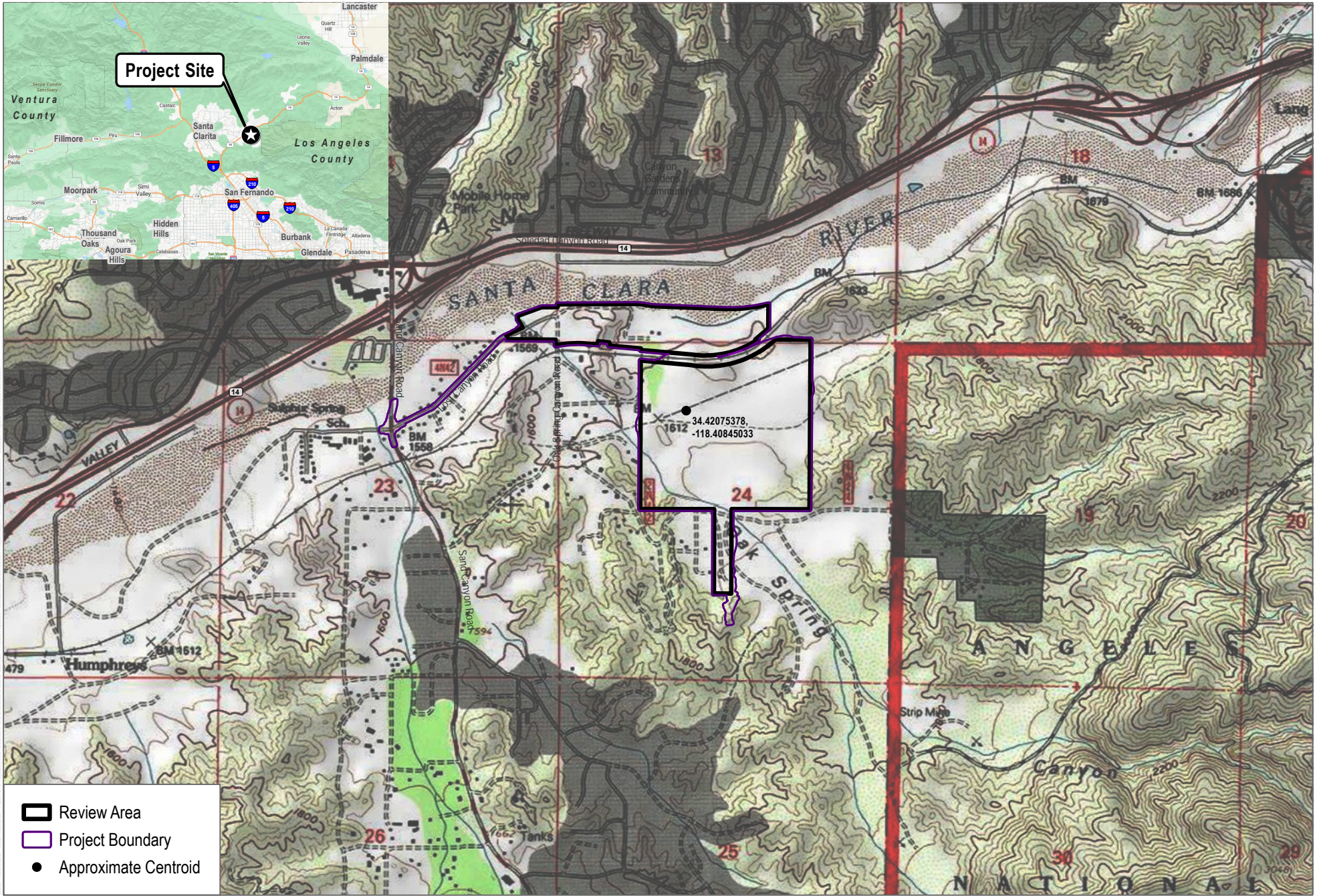
approved by the Forestry Division of the LACoFD for consistency with defensible space and fire safety guidelines. The FMZs will be constructed from the structure outward toward undeveloped areas. An FMZ is a strip of land where combustible vegetation has been removed and/or modified and partially or completely replaced with more adequately spaced, drought-tolerant, fire-resistant plants in order to provide a reasonable level of protection to structures from wildland fire.

1.1.3 Current Land Use

As previously stated, the project site consists of approximately 193.8 gross acres of vacant, undeveloped land that is zoned for low-density urban residential use and non-urban residential use (City of Santa Clarita 2011). Adjacent land uses include existing low-density residential developments and an equestrian facility along the western and southwestern boundary, a golf course (Sand Canyon Country Club) along the southeastern boundary, undeveloped/open space designated land to the north and east of the Project site, and a railroad (the Antelope Valley Line) bisecting the northern parcels of the Project (City of Santa Clarita 2011). The Angeles National Forest is located approximately 0.25-miles east of the Project boundary. An aerial of the project site and surrounding land uses is shown on Figure 2, Existing On-Site and Off-Site Land Uses. The Santa Clarita General Plan's land use and zoning designations for the project site is Urban Residential 1 (UR1) (2.0 dwelling units/acre [du/ac]) and Non-Urban 5 (NU5) (1.0 du/ac). Unpaved portions of Oak Springs Canyon Road intersect the project site, parallel to the project's southern boundary. Ruderal vegetation, grass, brush, and trees (including oak trees) cover the majority of the project site. Several dirt paths and roadways intersect the site, and are primarily used by off-road vehicles, horses, bicycles, and pedestrians. An existing water well is located in the northern portion of the project site.

The project site is bordered by the Santa Clarita River to the north (and further north—SR-14), existing single-family development to the west, Sand Canyon County Club to the south, and undeveloped land to the east. Unincorporated Los Angeles County is located east of the project site, and the Angeles National Forest is located 0.25-mile east of the project site. And as identified in the Phase I Environmental Site Assessment (ESA) prepared for the project site, according to historical aerial photographs and topographic maps, an east-west trending old railroad grade ran through the center of the southern portion of the project site until circa 1950 when a new railroad track was constructed that currently operates and is separating the northern and southern portions of the project site (Stantec 2023).

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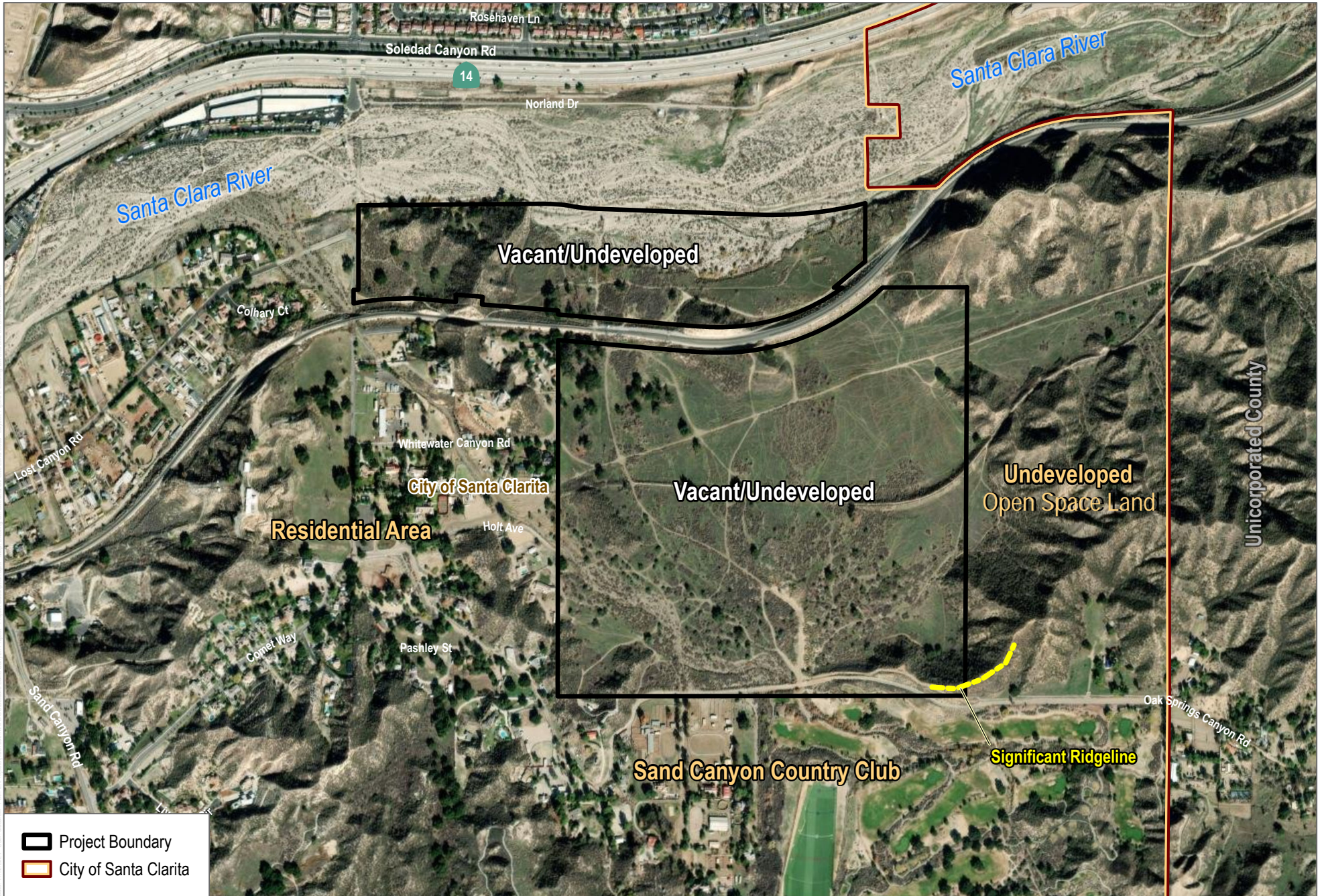
SOURCE: USGS Topo 7.5-Minute Series; Bing Aerial Map
 Mint Canyon Quadrangle - Township 4N Range 15W Section 24



FIGURE 1

Regional Location Map

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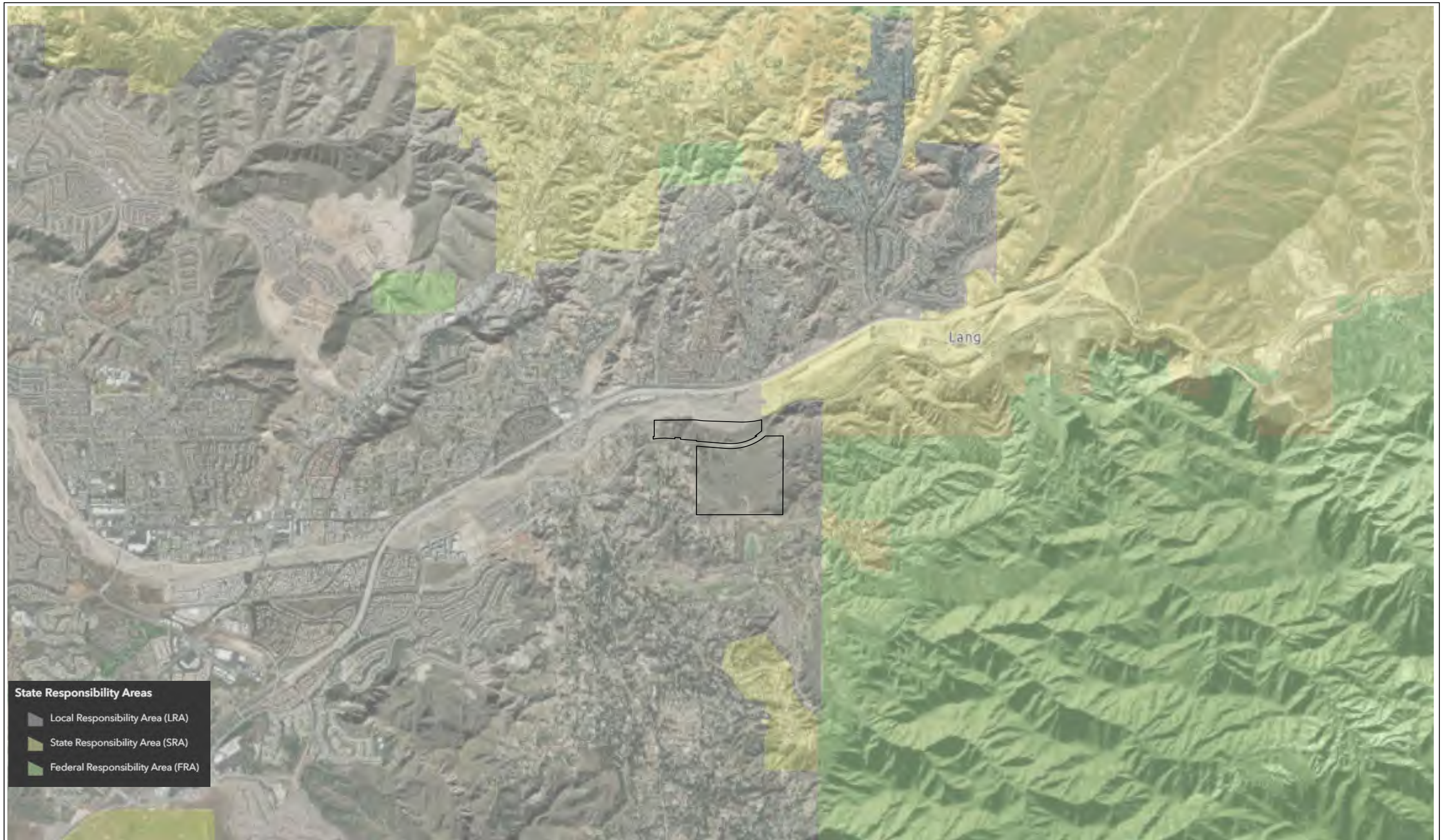


SOURCE: Maxar 2022



FIGURE 2
Existing On-Site and Off-Site Land Uses
 Belcaro at Sand Canyon Project Fire Protection Plan

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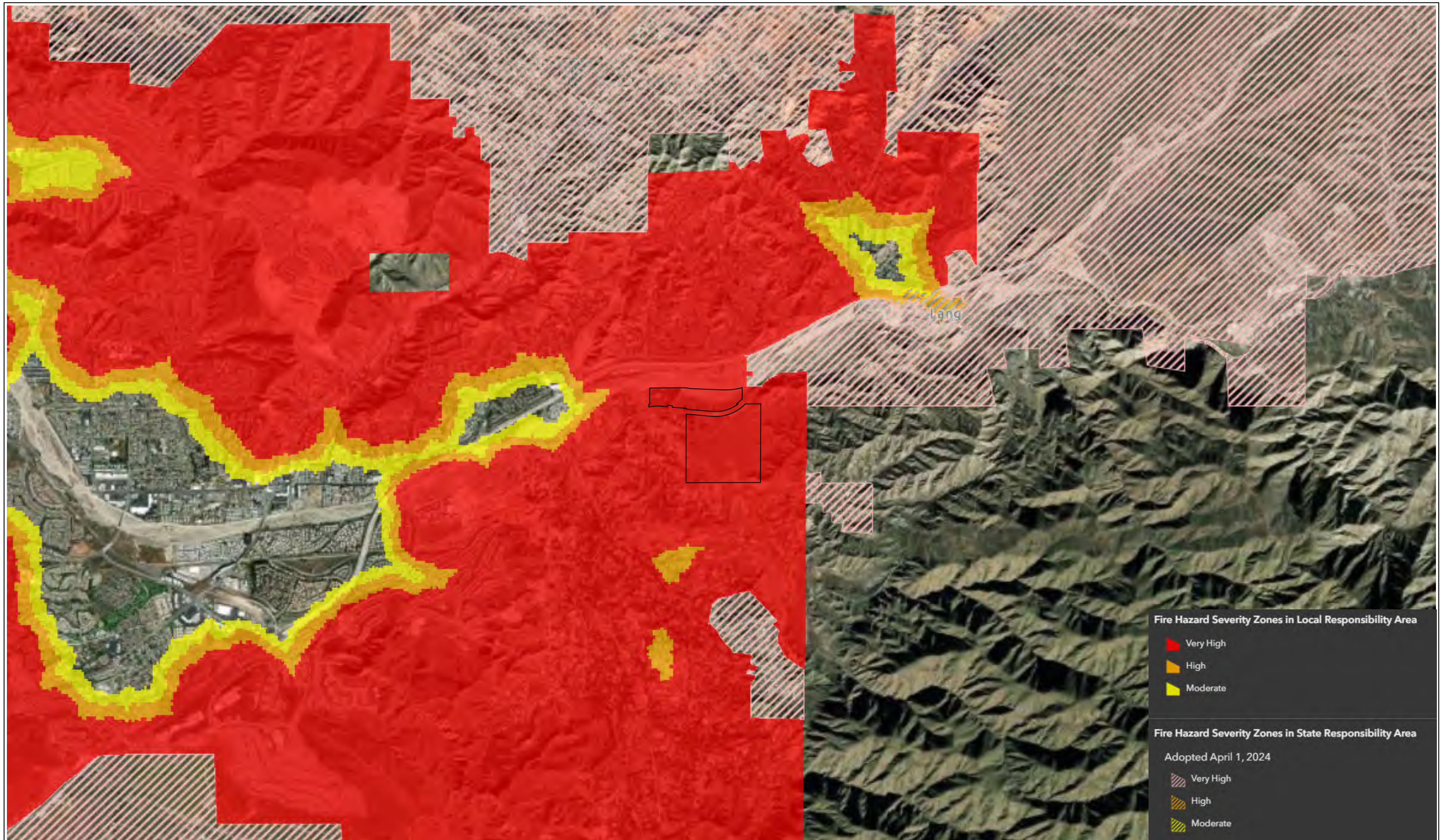
SOURCE: PARCELS-GIS; FIRE DATA- CALFIRE



FIGURE 3a

SRA and LRA Designated Areas

Belcaro at Sand Canyon Project Fire Protection Plan



SOURCE: PARCELS-GIS; FIRE DATA- CALFIRE



0 1,000 2,000 Feet

FIGURE 3b

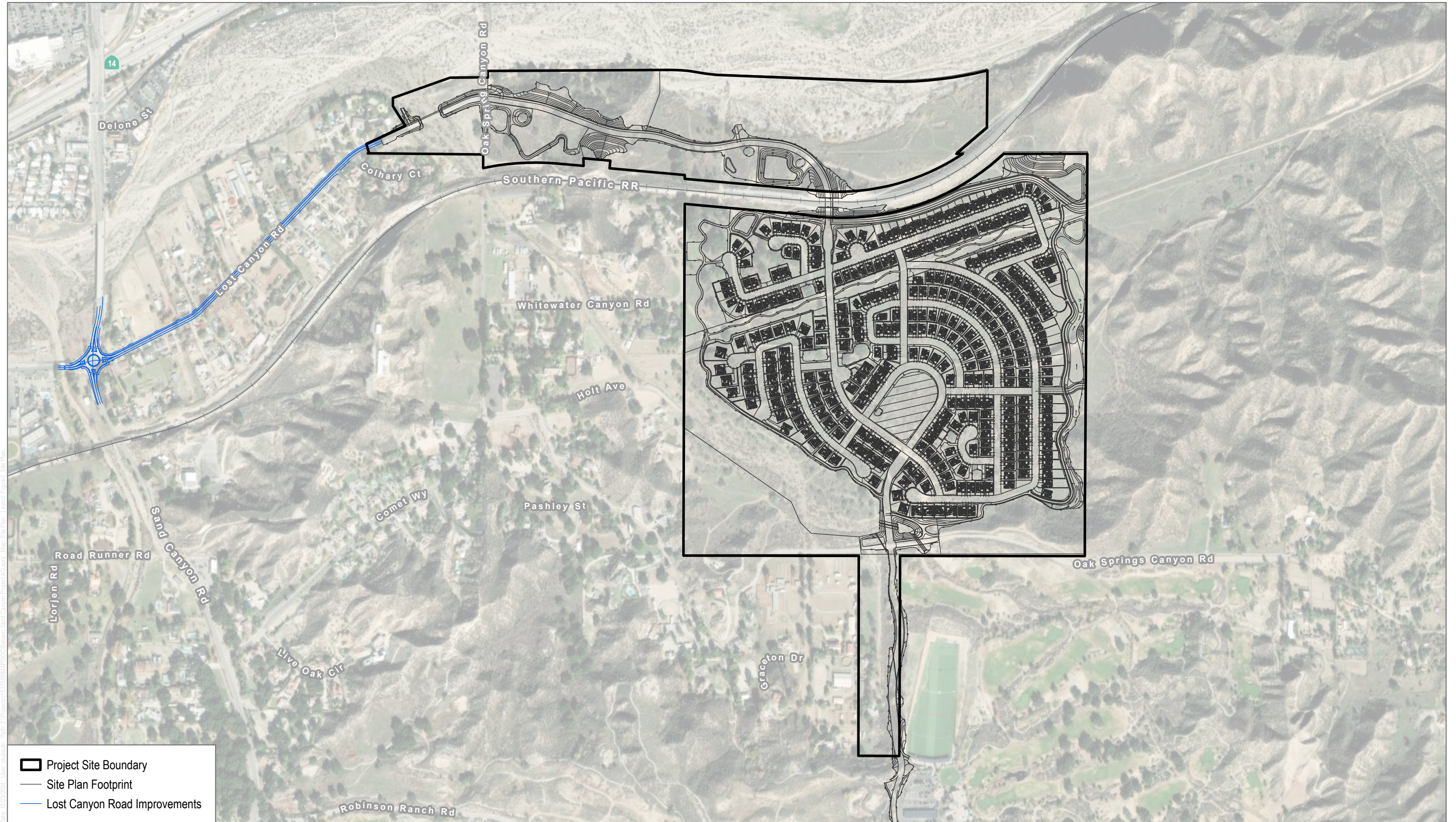
SRA and LRA FHSZ Map

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SOURCE: Groundlevel, 2024

FIGURE 4
Conceptual Site Plan
 Belcaro at Sand Canyon Project



SOURCE: Esri World Imagery 2022; Alliance Land Planning & Engineering 2024

FIGURE 4a
Site Plan

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1.2 Applicable Codes/Existing Regulations

The FPP demonstrates that the Project would comply with applicable portions of Title 32 of the Los Angeles County Code, as amended, which adopts by reference the 2022 edition of the California Fire Code (CFC) with Supplements. Title 32 is hereafter referred to as the Los Angeles County Fire Code (2023 or current edition) or “Fire Code”. The Project also shall comply with Chapter 7A of the 2022 California Building Code (CBC) with Supplements; the 2022 California Residential Code, Section 237; and the 2024 Edition of the International Fire Code as adopted by the County. The Project would also be subject to the provisions of section 4291 of the Public Resources Code regarding brush clearance standards around structures and the Los Angeles County Fire Department guidelines for Fuel Modification Plans. Should changes to the codes occur between completion of this document and the initiation of construction, the more stringent requirements shall apply.

Chapter 7-A of the CBC addresses exterior structural ignition resistance and ember penetration into homes, a leading cause of structure loss from wildfires (California Building Standards Commission 2022). Thus, code compliance is an important component of the requirements of this WSP, given the Project’s wildland-urban interface (WUI) location and the entirety of the Project Site being within an area considered an LRA -VHFHSZ, as designated by CAL FIRE - OSFM. The Open Space area located north of the northern property boundary within the Santa Clarita River watershed area is also designated as an LRA VHFHSZ, as shown on Figure 3, Fire Hazard Severity Zone Map. Fire hazard designations are based on topography, vegetation, and weather, among other factors with more hazardous sites, including steep terrain, unmaintained fuels/vegetation, and WUI locations. Projects situated in a VHFHSZ require fire hazard analysis and the application of fire protection measures to create defensible communities within these WUI locations.

As described in this FPP, the Project would meet applicable code requirements for building in these higher fire hazard areas or meet the intent of the code through the application of site-specific fire protection measures. These codes have been developed through decades of wildfire structure save and loss evaluations to determine why buildings were lost to fire or why they survived. The resulting fire codes now focus on mitigating former structural vulnerabilities through construction techniques and materials so that the buildings are resistant to ignitions from direct flames, heat, and embers, as indicated in the 2022 California Building Code (Chapter 7-A, Section 701A Scope, Purpose, and Application) (California Building Standards Commission 2022).

1.2.1 Applicable Federal Codes/Existing Regulations

1.2.1.1 National Fire Protection Association (NFPA) Codes, Standards, Practices, and Guides

NFPA codes, standards, recommended practices, and guides are developed through a consensus standards development process approved by the American National Standards Institute. NFPA standards are recommended guidelines and nationally accepted good practices in fire protection, however, they are not laws or regulations. Automatic Fire Sprinklers for the Project would be chosen and installed in accordance with NFPA 13. NFPA 13 is the standard for the design and installation of automatic fire sprinkler systems in a building. It provides the requirements for the type of system needed in a particular occupancy, water supply, sprinkler head flow and pressures, the locations of sprinkler heads, and installation of the system. This standard is referenced by the California Fire Code.

1.2.1.2 International Fire Code

The International Fire Code (IFC) addresses a wide variety of hazardous conditions to life and property, including fire, explosions, and hazardous materials handling or usage. Although it is not a federal regulation but a product of the International Code Council, the IFC places an emphasis on prescriptive and performance-based approaches to fire prevention and fire protection systems. The IFC is updated every three years and uses a hazard classification system to determine the appropriate measures to be incorporated to protect life and property. Other times these measures include construction standards and specialized equipment. The IFC uses a permit system based on hazard classification to ensure that the required measures are instituted. The 2021 edition of the IFC is adopted by the County.

1.2.2 Applicable State and Local Codes/Existing Regulations

1.2.2.1 State

The 2022 Strategic Fire Plan for California reflects CAL FIRE's focus on (1) fire prevention and suppression activities to protect lives, property, and ecosystem services, and (2) natural resource management to maintain the state's forests as a resilient carbon sink to meet California's climate change goals and to serve as important habitat for adaptation and mitigation. Strategic Fire Plan goals include the following (State Board of Forestry and Fire Protection and CAL FIRE 2019):

1. Identify and evaluate wildland fire hazards and recognize life, property, and natural resource assets at risk, including watershed, habitat, social and other values of functioning ecosystems. Facilitate the collaborative development and sharing of all analyses and data collection across all ownerships for consistency in type and kind.
 - A. Promote and support local land use planning processes as they relate to: (a) protection of life, property, and natural resources from risks associated with wildland fire, and (b) individual landowner objectives and responsibilities.
 - B. Support and participate in the collaborative development and implementation of local, county, and regional plans that address fire protection and landowner objectives.
 - C. Increase fire prevention awareness, knowledge, and actions implemented by individuals and communities to reduce human loss, property damage, and impacts to natural resources from wildland fires.
 - D. Integrate fire and fuels management practices with landowner/land manager priorities across jurisdictions.
 - E. Determine the level of resources necessary to effectively identify, plan and implement fire prevention using adaptive management strategies.
 - F. Determine the level of fire suppression resources necessary to protect the values and assets at risk identified during planning processes.
 - G. Implement post-fire assessments and programs for the protection of life, property, and natural resource recovery.

CAL FIRE is currently in the process of drafting the 2024 Strategic Fire Plan for California.

1.2.2.2 California Government Code

California Government Code Sections 51175 through 51189 along with Public Resources Code Sections 4201 – 4204, provide guidance for classifying lands in California as fire hazard areas and provide requirements for management of property within those lands. CAL FIRE is responsible for classifying FHSZs based on statewide criteria and makes the information available for public review. Further, local agencies must designate, by ordinance, VHFHSZs within their jurisdiction based on the recommendations of CAL FIRE.

Section 51182 sets forth requirements for maintaining property within fire hazard areas, such as defensible space, vegetative fuels management, and building materials and standards. Defensible space around structures in fire hazard areas must consist of 100 feet of fuel modification on each side of a structure, but not beyond the property line unless findings conclude that the clearing is necessary to significantly reduce the risk of structure ignition in the event of a wildfire. Clearance on adjacent property is only conducted following written consent by the adjacent owner. Further, trees must be trimmed from within 10 feet of the outlet of a chimney or stovepipe, vegetation near buildings must be maintained, and roofs of structures must be cleared of vegetative materials. Exemptions may apply for buildings with an exterior constructed entirely of nonflammable materials.

1.2.2.3 California Public Resource Code

The Project would comply with applicable sections of the California Public Resource Code (PRC). Notable sections of the PRC are as follows:

- **Public Resource Code Section 4290, Fire Safety Standards** – PRC Section 4290 requires minimum fire safety standards related to defensible space that apply to residential, commercial, and industrial building construction in State Responsibility Area lands and lands classified and designated as VHFHSZs. These regulations include road standards for fire apparatus access, standards for signs identifying roads and buildings, fuel breaks and green belts, and minimum water supply requirements. It should be noted that these regulations do not supersede local regulations which are equal to or exceed the minimum regulations required by the state. Projects situated in a VHFHSZ require fire hazard analyses and the application of fire protection measures to create ignition-resistant structures and defensible communities within these WUI locations. VHFHSZ designations do not, in and of themselves, indicate that it is unsafe to build in these areas.
- **Public Resource Code Section 4291, Defensible Space** – PRC Section 4291 requires a reduction of fire hazards around buildings located adjacent to a mountainous area, forest-covered lands, brush-covered lands, grass-covered lands, or land that is covered with inflammable material. It is required to maintain a minimum of 100 feet of vegetation management around all buildings and is the primary mechanism for conducting fire prevention activities on private property within CAL FIRE jurisdiction. Further, PRC 4291 requires the removal of dead or dying vegetative materials from the roof of a structure, and trees and shrubs must be trimmed from within 10 feet of the outlet of a chimney or stovepipe. Exemptions may apply for buildings with an exterior constructed entirely of nonflammable materials.
- PRC Section 4741 states that CAL FIRE shall assist local governments in preventing future wildland fire and with vegetation management problems by making its wildland fire prevention and vegetation management expertise available to local governments.
- PRC Sections 4292-4296 and 14 CCR 1246 address vegetation clearance standards for electrical utilities. They include standards for clearing around energy lines and conductors.

1.2.2.4 California Code of Regulations

The Project would be subject to relevant sections of the California Code of Regulations (CCR). More specifically, it would follow portions of the CCR that contain regulatory requirements that relate to fire safety, accessibility, water supply, and development in fire hazard areas.

Title 14, Natural Resources

California Code of Regulations (CCR) Title 14, Division 1.5, Chapter 7, Subchapter 2 and 3, Fire Hazard, sets forth requirements for defensible space and provides alternate options if the required distances cannot be achieved. For example, options that have similar practical effects include noncombustible block walls or fences; 5 feet of noncombustible material horizontally around a structure; or installing hardscape landscaping or reducing exposed windows on the side of structures with less than 30-foot setbacks.

Title 19, Public Safety

CCR Title 19 addresses public safety and includes State Fire Marshal requirements (CCR, Title 19, Division 1), which incorporate general fire and safety standards regarding fire department access and egress, fire alarms, emergency planning, and evacuation procedures.

Title 19, Division 2, Chapter 1, Standardized Emergency Management System Regulations

The Standardized Emergency Management System (Emergency System) regulations are described in CCR Title 19, Division 2, Chapter 1. The Emergency System is required by the California Emergency Services Act to manage multi-agency and multi-jurisdictional responses to emergencies in California, and to coordinate among all levels of government and affected agencies. The Emergency System unifies all elements of California's emergency management community into a single, integrated system, and standardizes key elements.

Title 24, California Building Standards Code

The California Building Standards Code (CCR Title 24) contains provisions for building and safety standards, including fire safety standards for new buildings that are provided in the California Building Code (CCR Title 24, Part 2) and the California Fire Code (CFC) (CCR Title 24, Part 9). These standards apply to all occupancies in California, except where state agencies and local governing bodies adopt more stringent standards.

Title 24, Part 2, California Building Code

The California Building Code includes several chapters relevant to fire safety and protection that address types of construction, fire and smoke protection features, construction materials and methods, rooftop construction, and building emergency ingress and egress.

Chapter 7A of the California Building Code regulates building materials, systems, and/or assemblies used in the exterior design and construction of new buildings within a fire hazard area. Fire hazard areas as defined by the California Building Code include areas identified as an FHSZ within an SRA or a WUI fire area. The purpose of Chapter 7A is to establish minimum standards for the protection of life and property by increasing the ability of structures in a fire hazard area to resist the intrusion of flames or embers projected by a wildfire, and to contribute

to a systematic reduction in structural losses from a wildfire. New buildings in such areas must comply with the ignition-resistant construction standards outlined in Chapter 7A.

California Residential Code

The California Residential Code (CRC) is a comprehensive set of regulations governing the construction of one- and two-family dwellings, as well as townhouses that are three stories or less. It is based on the 2024 International Residential Code (IRC) and has been specifically tailored to address California's unique climate, geological conditions, and other regional factors.

The CRC outlines requirements for building design, structural systems, and materials. It covers everything from foundations to roofs, including framing, insulation, and fire-resistant construction. It emphasizes energy efficiency, seismic safety, and accessibility standards. It also includes specific provisions address issues like flood hazard areas, coastal construction, and wildfire risk. The CRC mandates fire-resistant materials, smoke alarms, and fire sprinkler systems and ensures safe egress routes, emergency lighting, and proper ventilation. Stairways, handrails, and guardrails are also addressed.

1.2.2.5 2022 California Fire Code

The Project would comply with the 2022 California Fire Code (CFC) (CCR Title 24, Part 9). The CFC establishes regulations to safeguard against the hazards of fire, explosion, or dangerous conditions in new and existing buildings, structures, and premises. The CFC also establishes requirements intended to provide safety for and assistance to firefighters and emergency responders during emergency operations. The provisions of the Fire Code apply to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal, and demolition of every building or structure throughout California. The CFC includes regulations regarding fire-resistance-rated construction, fire protection systems such as alarm and sprinkler systems, fire services features such as fire apparatus access roads, means of egress, fire safety during construction and demolition, and WUI areas. Specific code compliance features are discussed in Section 5 Buildings, Infrastructure, and Defensible Space.

Chapter 49 of the California Fire Code provides guidelines aimed at preventing the spread of wildfires towards and away from structures in Wildland-Urban Interface (WUI) Fire Areas. It's designed to address the risk of wildfires engulfing buildings, endangering lives, and overwhelming firefighting efforts, as well as causing significant property damage. The chapter aims to minimize these risks by setting both performance and prescriptive standards for construction and development in areas designated as having Moderate, High, or Very High Fire Hazard Severity Zones, encompassing State Responsibility Areas (SRA) and Local Responsibility Areas (LRA). Key elements include the development of fire protection plans, landscape strategies, and ongoing vegetation management, along with the establishment and upkeep of defensible space.

1.2.2.6 Assembly Bill 3074

Assembly Bill 3074 was passed into law in 2020 and requires a third zone of defensible space. The law requires the Board of Forestry and Fire Protection to develop regulations for the ember-resistant zone (Zone 0) within 0 to 5 feet of a structure by January 1, 2023. Within this zone, fuels reduction would be more intense and be designed to keep fire and embers from ignition material that could spread fire to a structure.

Zone 0 requirements have not yet been officially written into regulation, however, it's anticipated that adoption by the Board of Forestry rulemaking will be in January 2026.

1.2.3 County Codes and Ordinances

1.2.3.1 Los Angeles County Code of Ordinances

1.2.3.1.1 Title 32 - Fire Prevention

The Los Angeles County Board of Supervisors adopted the 2022 edition of the California Fire Code with amendments. This code acts as the enforcement Code in all areas within Los Angeles County where the Los Angeles County Fire Department is the authority having jurisdiction. The Los Angeles County Fire Department also protects the State Responsibility Areas (SRA) within the County under contract with Cal Fire. In its role as the County Fire Warden, they aid in enforcing all laws, ordinances and any rules or regulations adopted by the State Board of Forestry and Fire Protection and State Fire Marshal relating to fires or to fire prevention and protection.

Section 326, Activities in Wildfire Risk Area, is applicable to all areas within the Los Angeles County Fire Department jurisdiction and all other unincorporated areas of the County. Section 326 includes various requirements intended to mitigate conditions tending to cause or allow rapid spread of fires.

1.2.3.1.1.1 Los Angeles County Fire Department Guidelines for Fuel Modification Plans.

Section 4908.1 of the Los Angeles County Fire Code requires the submittal of a fuel modification plan and preliminary approval prior to any subdivision of land; or, have final approval prior to the issuance of a permit for any permanent structure used for habitation; where, such structure, or subdivision is located within areas designated as a Fire Hazard Severity Zone within State Responsibility Areas or VHFHSZ within the Local Responsibility Areas, according to applicable Fire Hazard Zone maps. The fuel modification plan shall be reviewed by the Forestry Division of the Fire Department for defensible space, fire safety, and compliance with Sections 325.2.1, 325.2.2, 325.10, and 503.2.1 of the LA County Fire Code, the Fire Department's fuel modification guidelines, and California Code of Regulations, Title 14, Division 1.5, Chapter 7, subchapter 2.

1.2.3.1.2 Title 26 - Building Code

County building regulations are defined in Title 26 of the Los Angeles County Code of Ordinances. The County Code adopts Chapter 1, Divisions 1 and 2 of the California Building Code in its entirety, except as amended in Title 26. Title 26 amends standards related to structural hardening and the definition of "Fire Hazard Severity Zone," and it defines the County's High Fire Hazard Area. Structural fire protection standards are addressed in the building codes and address structural hardening requirements for buildings within a High Fire Hazard Area and are consistent with Chapter 7A of the California Building Code. Structural hardening requirements address roofing, exterior coverings, decking materials, windows and doors, eaves, and vents, among others. The intent of these requirements is to minimize the potential for structural ignition through radiant or convective heat exposure or ember intrusion.

1.2.3.2 Los Angeles County Operational Area Emergency Operations Plan

The County of Los Angeles Operational Area Emergency Operations Plan (OAEOP) updated in 2023 addresses both the County's planned response to extraordinary emergency situations impacting unincorporated areas of the County

as well as Operational Area (OA) coordination. This plan does not apply to day-to-day emergency incidents, or the established procedures used to respond to and manage such emergencies. Rather, this plan focuses on the operational concepts related to all-hazards emergency response and recovery, including maintaining the County's continued compliance with the National Response Framework (NRF), National Incident Management System (NIMS), National Disaster Recovery Framework (NDRF), California Standardized Emergency Management System (SEMS), principles of the Incident Command System (ICS), and the National Preparedness Goal. It facilitates multiagency and multijurisdictional coordination during emergency operations, public information functions, resource management, and recovery efforts.

1.2.3.3 County of Los Angeles All Hazard Mitigation Plan

The 2020 County of Los Angeles All Hazard Mitigation Plan is intended to identify hazards and risks in the County and guide appropriate response. The plan defines the community profile, the planning process, and discusses mitigation strategies.

1.2.4 City Codes and Ordinances

1.2.4.1 Santa Clarita Municipal Code

1.2.4.1.1 Title 17 - Zoning

The City of Santa Clarita Land Use and Development Code is Title 17, Zoning, of the Santa Clarita Municipal Code. The Development Code carries out the policies of the Santa Clarita General Plan by classifying and regulating land use and structures within the City. The Development Code is adopted to protect and promote the public health, safety, comfort, convenience, prosperity, and regional welfare of residents and businesses in the City of Santa Clarita.

1.2.4.1.2 Title 22 - City Fire Code

The City Fire Code is Title 22 of the Santa Clarita Municipal Code. The City of Santa Clarita has adopted and amended the 2022 California Fire Code as duly adopted by the County of Los Angeles in Title 32 of the Los Angeles County Code. The Fire Code is adopted to protect life and property from fire and explosion hazards in buildings and premises in the City of Santa Clarita.

1.2.4.2 City of Santa Clarita General Plan

1.2.4.2.1 Land Use Element

Goal LU3 emphasizes healthy and safety neighborhoods for all residents. Objective LU 3.3 of the goal focuses on ensuring that the design of residential neighborhoods include measures to reduce impacts from hazards. Areas subject to wildland fire danger are required to have adequate setbacks, fuel modification areas, and emergency access routes. Further, all new residential developments are required to provide adequate emergency access, and subdivision and site designs must permit ready access by public safety personnel throughout the development review process.

1.2.4.2.2 Safety Element

Goal S3 focuses on the protection of public safety infrastructure and property from fires. The goal includes five objectives that emphasize maintaining acceptable service levels, providing fire protection services in wildland interface and urban areas, maintaining acceptable emergency response times, maintaining development standards and land use regulations that prioritize fire safe developments, and working with relevant organizations/agencies for fire prevention, protection, and response.

1.2.4.3 Santa Clarita Local Hazard Mitigation Plan

The 2021 Santa Clarita Local Hazard Mitigation Plan is intended to identify hazards in the city and guide appropriate community response to reduce risk and potential future losses in the city. The plan defines the planning process, community profile, hazard identification and risk assessment, mitigation strategies, and plan implementation.

1.2.5 California Attorney General’s Office Best Practices for Analyzing and Mitigating Wildfire Impacts of Development Projects Under the California Environmental Quality Act

The California Office of the Attorney General issued (October 2022) guidance (Guidance) outlining best practices for analyzing and mitigating wildfire impacts of development projects under the California Environmental Quality Act (CEQA). The Guidance is intended to help local governments’ evaluation and approval considerations for development projects in fire-prone areas, and to help project design in a way that minimizes wildfire ignition and incorporates emergency access and evacuation measures. Importantly, the Guidance does not impose additional legal requirements on local governments, nor does it alter any applicable laws or regulations.

Attorney General’s Best Practices for Analyzing Project’s Impacts on Wildfire Risks:

Baseline Conditions

The Guidance states that an EIR’s discussion of existing environmental (baseline) conditions should include information about open space areas and habitats within the project area that may be fire prone, a discussion of fire history and fuels on the project site and existing available water supplies for firefighting. The Project’s FPP provides details regarding each of these baseline conditions, including the off-site preserved areas, a detailed assessment of fire history within 5 miles of the Project, and confirmation that the Project will be provided water necessary for firefighting.

Thresholds of Significance

The Guidance encourages local governments to develop and apply thresholds of significance to identify when an increase in wildfire risk is considered a “significant impact” under CEQA. Relevant factors to this determination include: (1) the project’s impacts on ignition risk; (2) the likelihood of fire spread; and (3) the extent of exposure for existing and new residents, based on various fire scenarios. The Guidance notes that “wildfire ignitions are primarily human-caused in California.” This FPP evaluates the Project’s potential for increasing wildfire risk and is based on the location and its fire environment, Project land uses and their potential for fire ignitions, and provided design features that are proven fire safety and protection measures that provide protection from wildfire and have the dual

role of minimizing the potential for on-site fire moving into the off-site areas. These features are described throughout this FPP and include low-ignition potential landscapes of pavement and irrigated, maintained vegetation, fuel modification zone buffers, ignition resistant structures that would not easily ignite, and an aware on-site population with management outreach and enforcement of fire prevention measures.

Modeling

The Guidance encourages modeling fire scenarios to “quantify” increased wildfire risks resulting from a project adding more people to wildfire prone areas and assessing risks. This FPP models fire scenarios utilizing BehavePlus fire behavior modeling to estimate fire intensity and flame lengths. The models confirm that the Project’s provided defensible space buffers are sufficient to slow wildfire spread and keep it from impacting the site. These same results, coupled with the fire protection features detailed in this FPP are shown to perform a dual role of 1) minimizing the potential for fire starts on site, 2) providing suppression capabilities both within structures and by nearby firefighting resources to quickly control ignitions that do occur, 3) creating and maintaining wide fuel modification buffers that reduce fire intensity and slow fire spread – all of which minimize the likelihood of a Project fire spreading off-site into open space areas. Likewise, neighboring developed areas and their provided protections required by LACoFD perform a similar function during wildfires in the Project area.

Qualitative Assessment

The Guidance indicates that complying with CEQA includes an EIR qualitatively assessing relevant variables to quantify the project’s impact on the risk of wildfire, specifically:

Project Density – Project density influences how likely a fire is to start or spread and how likely it is that occupants will be in danger. The Guidance states that “Fire spread and structure loss is more likely to occur in low- to intermediate-density developments.” The Project is considered a high-density, consolidated development, converting the developed area to ignition resistant landscapes with no inclusion of unmaintained vegetation within the converted footprint. The nearest open space vegetation is separated from the site’s ignition resistive structures by 100- to 200-foot-wide maintained Fuel Modification Zones. The buildings are clustered and present one, defensible interface, unlike lower density development which incorporates fuels within and around buildings and multiple building interfaces, a condition that is significantly harder to defend and creates multiple exposures when compared with the Project’s master planned community condition.

Location in the Landscape – Where a project’s structures are placed in the landscape relative to fire environment features, such as vegetation, topographical features, and wind alignments also influences wildfire risk Terrain including wind corridors or steep slopes may increase risk while flatter terrain and natural fire breaks may reduce risk if the project is “strategically located” should be considered. The Project creates a flat pad on which the Project’s structures and infrastructure are placed. While terrain and fuels in the Project’s vicinity may intensify wildfire behavior, these factors have been evaluated and confirmed that even under the extreme weather conditions that have been recorded in the area, the provided defensible space and ignition resistant structures are appropriately designed to minimize the potential for structure ignitions.

Water Supply and Infrastructure – Water supply and infrastructure needed to address firefighting within the project site should be analyzed as part of evaluating wildfire risk impacts under CEQA. The analysis should consider the potential loss of water pressure or power during a fire. As indicated in Section 6.3.1, The Santa Clarita Valley Water Agency (SCWA) has confirmed that internal waterlines will supply sufficient fire flows and pressure to meet the

demands for required on-site fire hydrants and interior fire sprinkler systems for all structures. Fire flow is based off of code requirements which address a fire in a single structure.

Mitigating Wildfire Risk – Potential Measures

The Guidance specifies that Project-provided mitigation measures should be combined and tailored to the specifics of the project, the surrounding landscape, and nearby existing uses. The Guidance emphasizes that CEQA requires lead agencies to consider and adopt feasible mitigation measures to avoid or reduce wildfire risk. Potential mitigation measures recommended by the Guidance may reduce a project’s wildfire risk impacts to a less than significant level. The Project is consistent with the recommendations included in the Guidance, include:

Increasing residential density and consolidated project design, relying on higher density infill developments “as much as possible” – The Project resembles a consolidated design and extends existing and ongoing development

Avoiding and minimizing low-density development patterns or “leapfrog-type” developments with undeveloped wildland between developed areas – While the Project occurs in an area that is not directly adjacent existing urban landscapes, it relies on a clustering design to increase density and minimize open space areas to present a defensible wildland urban interface.

Decreasing a project’s “edge” or wildland interface area and creating buffer zones and defensible space measures within and adjacent to the project – The Project minimizes edge by creating a clustered design and provides FMZ and specific alternative materials and methods to mitigate reduce the potential for wildfire encroachment. In the Wildland Urban Interface, structure ignitions are more likely in non-clustered, interspersed development based on the presence of flammable vegetation between structures. The Project’s design creates a continuous interface between development and wildlands reducing the overall structural exposure to wildland vegetation. The Project does not feature unmaintained vegetation within the converted footprint.

Siting projects to maximize the role of low-flammability landscape features and limiting development along steep slopes and amidst rugged terrain – The Project occurs within an area that includes steep terrain to the east and flammable fuels. However, potential wildfire impacts at the Belcaro at Sand Canyon Project will be mitigated through the sites layered fire protection features including a wide Fuel Modification Zone, setbacks from slopes, ignition resistant construction measures, and other fire protection infrastructure in alignment with County and State Fire Codes.

Undergrounding power lines – The Project’s power lines will be undergrounded, eliminating the potential for electrical transmission line-caused fires on the site.

Upgrading building materials and installation techniques beyond applicable building code requirements to increase a structure’s resistance to heat, flames and embers (i.e. “fire hardening”) and requiring fire-hardened communication facilities (including internet) to the project site – The Project is consistent with this guideline recommendation given the Project’s buildings will be designed in conformance with the latest ignition-resistant building design measures California Building Code Chapter 7-A. As discussed in this FPP, structures constructed to current Fire Code standards and located within a master-planned community have proven to be highly resistant to ignition during a wildfire. Communication facilities will be provided via underground or protected above ground conduits.

Requiring on-site water supply and/or storage to augment ordinary supplies that may be lost during a wildfire – The Project will be consistent with County Fire Code and California Fire Code Section 903.2 for fire flow and fire hydrant requirements within a VHFHSZ. The Project water supplier will prepare a detailed Water Supply Assessment under SB 610 that confirms that it has the capacity needed for domestic and firefighting needs. The Project provides connections from internal waterlines to significant water main lines that will supply sufficient fire flows and pressure to meet the demands for required onsite fire hydrants and interior fire sprinkler systems for all structures. Water supply must meet the minimum fire flow requirements of the California Fire Code, Appendix B.

Parking limitations to ensure access roads are not clogged with parked vehicles – Parking limitations will be implemented to ensure access roads are not clogged with parked vehicles. This will include prohibiting parking in fire lanes or other designated areas. Parking will not prevent emergency access within fire apparatus access roads. Access roads will not be obstructed by designated parking areas and where parking is prohibited, signage and/or curb marking will be provided, and illegally parked vehicles will be towed.

Placement of development close to adequate emergency services, existing or planned ingress/egress, and designated evacuation routes – The Project is located adjacent to regional transportation networks with multiple points of access. The Project is within an acceptable distance to existing and planned fire stations with sufficient response times to all planned structures. The Project provides new surface streets and connects to existing streets and is near major highway/freeway corridors, facilitating emergency vehicle ingress.

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2 Existing Setting: Project Study Area Conditions, Risk Factors, and Fire History

2.1 Environmental Setting and Field Assessment

After review of available digital Study Area information, including topography, vegetation types, fire history, and the Project's development footprint, a Dudek Fire Protection Planner conducted a site evaluation on June 25, 2024, in order to confirm/acquire site information, document existing site conditions, and to determine potential actions for addressing the protection of the Project's structures. While on-site, Dudek's Fire Planners assessed the area's topography, natural vegetation, fuel loading, surrounding land use, and general susceptibility to wildfire. The field tasks that were completed included:

- Topography evaluation
- Vegetation/fuel assessments
- Photograph documentation of the existing condition
- Confirmation/verification of hazard assumptions
- Off-site, adjacent property fuel and topography conditions
- Surrounding land use confirmations
- Necessary fire behavior modeling data collection
- Ingress/egress documentation
- Nearby Fire Station reconnaissance

Study Area photographs were collected (refer to Appendix A, *Representative Site Photographs*), and fuel conditions were mapped using aerial images. Field observations were utilized to augment existing site data in generating the fire behavior models and formulating the requirements and recommendations detailed in the FPP.

2.2 Site Characteristics and Fire Environment

Fire environments are dynamic systems and include many types of environmental factors and site characteristics. Fires can occur in any environment where conditions are conducive to ignition and fire movement. Areas of naturally vegetated open space like those found on and adjacent to the Project site, are typically comprised of conditions that may be favorable to wildfire spread. The three major components of the fire environment are topography, vegetation (fuels), and climate. The state of each of these components and their interactions with each other determines the potential characteristics and behavior of a fire at any given moment. It is important to note that wildland fire may transition to urban fire if structures are receptive to ignition. Structure ignition depends on a variety of factors and can be prevented through a layered system of protective features including fire-resistive landscapes directly adjacent to the structure(s), application of known ignition resistive materials and methods, and suitable infrastructure for firefighting purposes. Understanding the existing wildland vegetation and urban fuel

conditions on and adjacent to the site is necessary to understand the potential for fire within and around the Project Site.

The following sections discuss the characteristics of the Project Site and the surrounding region, local climate and fire history within and adjacent to the property on a regional scale. The project is similar concerning topography, vegetative cover, and proximity to adjacent residential areas, available access, and planned use. The intent of evaluating conditions at a macro-scale provides a better understanding of the regional fire environment, which is not constrained by property boundary delineations.

2.2.1 Climate

The Project Site, like much of Southern California, is influenced by the Pacific Ocean and a seasonal, migratory subtropical high-pressure cell known as the “Pacific High.” Wet winters and dry summers with mild seasonal changes characterize the Southern California climate. This climate pattern is occasionally interrupted by extreme periods of hot weather, winter storms, or dry, easterly Santa Ana winds. August is the average warmest month with an average high temperature of 92 degrees Fahrenheit (°F) and December is the coolest month on average with a low of 42°F. Rainfall occurs primarily between October and April, with the maximum average precipitation occurring in January. The mean annual rainfall for the region is approximately 17.35 inches of rain per year (LACPW 2024).

From a regional perspective, the fire risk in southern California can be divided into three distinct “seasons” (Nichols et al. 2011, Baltar et al 2014). The first season, the most active season and covering the summer months, extends from late May to late September. This is followed by an intense fall season characterized by fewer but larger fires. This season begins in late September and continues until early November. The remaining months, November to late May cover the mostly dormant, winter season. Mensing et al. (1999) and Keeley and Zedler (2009) found that large fires in the region consistently occur at the end of wet periods and the beginning of droughts.

Typically, the highest fire danger in southern California coincides with Santa Ana winds which can occur from September to March, most commonly occurring from October through March. The Santa Ana wind conditions are a reversal of the prevailing southwesterly winds that usually occur on a region-wide basis near the end of fire season during late summer and early fall. They are dry, warm winds that flow from the higher desert elevations in the east through the mountain passes and canyons. As they converge through the canyons, their velocities increase. Localized wind patterns on the Project Site are strongly affected by both regional and local topography.

The prevailing wind pattern is from the west (on-shore), but the presence of the Pacific Ocean causes a diurnal wind pattern known as the land/sea breeze system. During the day, winds are from the southwest (sea), and at night winds are from the northeast (land). Wind speeds average approximately 10 mph throughout the year. Hourly gust speeds average approximately 20 mph throughout the year, with monthly average highs of approximately 40-45 mph between October and April and approximately between 25 and 35 between May and September (FEMS 2024). The highest wind velocities are associated with downslope, canyon, and Santa Ana winds. The mountainous areas to the east of the Belcaro at Sand Canyon Project Site includes topography that would create unusual weather conditions, thus the site is subject to periodic extreme fire weather conditions that occur throughout foothill portions of Los Angeles County.

The proposed Project would be located in the Santa Clarita Valley California Fire Zone 288 of the National Weather Service (NWS) and National Oceanic and Atmospheric Association (NOAA)’s zoning system. Since 2006, 122 Red Flag Warnings (RFW) were issued within California Fire Zone 288. The NWS defines an RFW as environmental conditions where warm temperatures, very low humidities, and stronger winds are expected to combine to produce an increased risk of fire danger and Santa Ana winds often create such conditions. By looking at the historical

frequency of Red Flag Warnings for a given region, one can anticipate an approximate of such events annually in the future. On average, approximately 7 RFW events can be expected to occur each year. However, this has ranged from as little as 1 to as many as 17, and individual events can vary in duration. Approximately 80% of the RFWs occurred between October and January (Iowa State University, 2024). This emphasizes the unique fire danger experienced during autumn months when dry fuels from the end of the seasonal drought coincide with the extreme wind events associated with RFW conditions.

2.2.2 Topography

Topography influences fire risk by affecting fire spread rates. Typically, steep slopes result in faster fire spread up-slope and slower spread down-slope. Terrain that forms a funneling effect, such as canyons, canyon features (chimneys or chutes), or saddles on the landscape can result in especially intense fire behavior. Conversely, flat terrain tends to have little effect on fire spread, resulting in fires that are driven by vegetation and wind. Topographic features funnel or channel winds when they are aligned with common wind patterns and fuels, which facilitate fire spread and increase the potential for more extreme wildfire behavior in the region.

The Project Site is located alongside the Santa Clarita River to the north and west of the San Gabriel Mountains and Angeles National Forest. The Project Site is bisected by the Metrolink Valley Subdivision rail line running east to west. Topography within the review area is generally flat but undulating with slopes scattered along the Santa Clarita River, the eastern boundary of the project, and the project's southwestern corner. Elevation ranges from approximately 1,550 feet above mean sea level (amsl) in the northwestern corner of the review area to 1,730 feet amsl in the southeastern corner of the review area.

2.2.3 Vegetation (Fuels)

The proposed project site and surrounding areas primarily support chamise chaparral, coastal sage scrub and non-native grassland plant communities. Vegetation types were derived from an on-site field assessment of the project site. The adjacent lands have similar vegetation types. The vegetation cover types were assigned a corresponding fuel model for use during site fire behavior modeling that were derived from the Scott and Burgan Fire Behavior Fuel Model Classifications (see Figure 5, Fire Behavior Fuel Model Classification Map). Section 3.0 describes the fire modeling conducted for the Project Area.

Extensive vegetation type mapping is useful for fire planning because it enables each vegetation community to be assigned a fuel model, which is used in a software program to predict fire behavior characteristics, as discussed in Section 3.1, Fire Behavior Modeling. The area proposed for development and within the project grading limits would be converted to ignition resistant landscapes, roads, structures, and landscaped vegetation following project completion. Vegetative fuels within proposed fuel modification zones will be removed or structurally modified (removing the dead and dying portions of a plant). as a result of development, altering their current structure and species composition, irrigation and maintenance levels, resulting in a perimeter wildfire buffer. With the conversion of the off-site landscape to an ignition-resistant development, wildfires may still encroach upon and drop embers on the site but would not be expected to burn through the development site or produce sustainable spot fires due to the lack of available fuels. The project, once developed, would not facilitate wildfire spread and would reduce projected flame lengths to levels that would be manageable by firefighting resources for protecting the site's structures, especially given the ignition resistance of the structures and the planned ongoing maintenance of the entire site landscape. The project would implement the latest fire protection measures, including fuel modification along the perimeter edges of the development.

As a part of the Biological Resources Technical Report (updated July 2025) by Dudek, a total of 21 vegetation associations within 15 vegetation alliances and three land cover types were mapped within the project site based on general physiognomy and species composition. These vegetation communities mapped to the association level consist of eight native upland scrub communities, six native upland chaparral communities, one native upland woodland community, four native riparian communities, and two semi-natural upland communities. Additionally, three developed or disturbed land cover types not described in the California Natural Community List were mapped within the project site. These vegetation communities and land cover types acreages are presented in Table 4 (Vegetation Communities and Land Cover Types within the Project Site), and their spatial distributions are presented in Figure 6, Vegetation Communities and Land Cover Types. Representative photos of the site are included in Appendix A, Representative Site Photos.

Table 4. Vegetation Communities and Land Cover Types within the Study Area

Alliance/ Land Cover Type- Common Name	Alliance- Scientific Name	Association	Sensitive ¹	Study Area (acres)
Native Upland Scrub Communities				
Big sagebrush scrub	<i>Artemisia tridentata</i> shrubland	<i>Artemisia tridentata</i> - <i>Ericameria nauseosa</i>	No	8.60
		<i>Artemisia tridentata</i> ssp. <i>parishii</i>	Yes	28.02
California brittle bush-ashy buckwheat scrub	<i>Encelia californica</i> - <i>Eriogonum cinereum</i> shrubland	<i>Encelia californica</i>	Yes	0.63
California buckwheat scrub	<i>Eriogonum fasciculatum</i> shrubland	<i>Eriogonum fasciculatum</i> - <i>Artemisia tridentata</i>	Yes	3.24
California sagebrush- (purple sage) scrub	<i>Artemisia californica</i> - (<i>Salvia leucophylla</i>) shrubland	<i>Artemisia californica</i>	No	6.76
		<i>Artemisia californica</i> - <i>Salvia leucophylla</i>	No	1.43
Deerweed-silver lupine- yerba santa scrub	<i>Acmispon glaber</i> - <i>Lupinus albifrons</i> - <i>Eriodictyon</i> spp. shrubland	<i>Eriodictyon crassifolium</i>	No	5.67
Fourwing saltbush scrub	<i>Atriplex canescens</i> shrubland	<i>Atriplex canescens</i>	No	1.53
Subtotal Native Upland Scrub Communities ²				55.87
Native Upland Chaparral Communities				
Basket bush-river hawthorn-desert olive patches	<i>Rhus aromatica</i> - <i>Crataegus rivularis</i> - <i>Forestiera pubescens</i> shrubland	<i>Rhus aromatica</i>	Yes	2.49
Chamise chaparral	<i>Adenostoma fasciculatum</i> shrubland	<i>Adenostoma fasciculatum</i>	No	1.80
		<i>Adenostoma fasciculatum</i> - (<i>Ceanothus cuneatus</i>)	No	15.16

Table 4. Vegetation Communities and Land Cover Types within the Study Area

Alliance/ Land Cover Type– Common Name	Alliance– Scientific Name	Association	Sensitive ¹	Study Area (acres)
		<i>Adenostoma fasciculatum– Eriogonum fasciculatum</i>	No	1.79
Holly leaf cherry–toyon– greenbark ceanothus chaparral	<i>Prunus ilicifolia– Heteromeles arbutifolia– Ceanothus spinosus</i> shrubland	<i>Prunus ilicifolia</i> ssp. <i>ilicifolia</i>	Yes	10.95
Tucker oak chaparral	<i>Quercus john-tuckeri</i> shrubland	<i>Quercus john-tuckeri</i>	No	3.53
<i>Subtotal</i> ²				35.72
Native Upland Woodland Communities				
Coast live oak woodland and forest	<i>Quercus agrifolia</i> woodland and forest	<i>Quercus agrifolia</i>	No	6.71
<i>Subtotal</i> ²				6.71
Native Riparian Communities				
Scale broom scrub	<i>Lepidospartum squamatum</i> shrubland	<i>Lepidospartum squamatum–Atriplex canescens</i>	Yes	2.45
		<i>Lepidospartum squamatum–Eriogonum fasciculatum</i>	Yes	16.42
Fremont cottonwood forest and woodland	<i>Populus fremontii– Fraxinus velutina–Salix gooddingii</i> forest and woodland	<i>Populus fremontii</i>	Yes	1.27
		<i>Populus fremontii–Salix laevigata</i>	Yes	0.42
<i>Subtotal</i> ²				20.57
Semi-Natural Upland Communities²				
Non-native grassland	N/A	N/A	No	57.63
Upland mustards or star- thistle fields	<i>Brassica nigra–Centaurea (solstitialis, melitensis)</i> herbaceous semi-natural	<i>Hirschfeldia incana</i>	No	13.81
<i>Subtotal</i> ²				71.44
Non-Natural Land Cover Types				
Disturbed habitat	N/A	N/A	No	14.89
Ornamental plantings	N/A	N/A	No	0.85
Urban/Developed land	N/A	N/A	No	2.52
<i>Subtotal</i> ²				18.26
Total ²				208.57

Table Notes: N/A = Not Applicable.

¹ Sensitive vegetation alliances or associations as identified in the most current California Natural Community List, released on June 1, 2023 (CDFW 2023).

² Totals may not sum due to rounding.

As presented in Table 4, the majority of the vegetation on the Project site are associated with non-native grasslands (27.6%), big sagebrush scrub (17.6%), chamise chaparral (9.0%), and scale broom scrub (9.0%). The majority of the land cover types on the Project site are associated with disturbed habitat (7.1%). The project's vegetation communities are described below.

2.2.3.1 Vegetation Fuel Dynamics

The vegetation communities and land cover types described above are used to model fire behavior, discussed in Section 3.0 of this FPP. Variations in vegetative cover type and species composition have a direct effect on fire behavior. Some plant communities and their associated plant species have increased flammability based on plant physiology (resin content), biological function (flowering, retention of dead plant material), physical structure (bark thickness, leaf size, branching patterns), and overall fuel loading. For example, non-native grass-dominated plant communities become seasonally prone to ignition and produce lower intensity, higher spread rate fires. In comparison, sage scrub plant communities that are more prevalent around the project site can produce higher heat intensity and higher flame lengths under strong, dry wind patterns, but does not typically ignite or spread as quickly as light, flashy grass fuels. The corresponding fuel models for each of these vegetation types are designed to capture these differences (See Figure 5). Vegetation distribution throughout the project site varies by location and topography but is primarily dominated by southern California coastal sage scrub, with chaparral, non-native grasses, and some oak trees present as well.

Variations in vegetative cover type and species composition have a direct effect on fire behavior. Some plant communities and their associated plant species have increased flammability based on plant physiology (resin content), biological function (flowering, retention of dead plant material), physical structure (leaf size, branching patterns), and overall fuel loading. Hazardous fuels include live and dead vegetation that exists in a condition that readily ignites; transmits fire to adjacent structures or ground, surface, or overstory vegetation; and is capable of supporting extreme fire behavior. All vegetation burns, however, some plants exhibit characteristics that make them more flammable than others. Flammability can be defined as a combination of ignitability, combustibility, and sustainability. Ignitability is the ease of or the delay of ignition; combustibility is the rapidity with which a fire burns; and sustainability is a measure of how well a fire continues to burn with or without an external heat source (White and Zipperer 2010). Flammability is influenced by several factors, which can be classified into two groups: physical structure (e.g., branch size, leaf size, leaf shape, surface-to-volume ratio, and retention of dead material) and physiological elements (e.g., volatile oils, resins, and moisture content) (Moritz and Svihra 1996; UCCE 2016; UCFPL 1997; White and Zipperer 2010). Plants that are less flammable have low surface-to-volume ratios, high moisture contents, and minimal dead material or debris. Examples of such plants include agave and olive trees. More flammable species have high surface-to-volume ratios, exhibit low moisture contents, contain volatile oils, and have high levels of dead material or debris (Moritz and Svihra 1996; UCFPL 1997; UCCE 2016; White and Zipperer 2010). Examples of such plants include pampas grass, juniper, and pine. Plant condition and maintenance is also an important factor in flammability potential. Some plants that have more flammable characteristics can become less flammable if well maintained and irrigated. Conversely, plants can be explosively flammable when poorly maintained, situated on south-facing slopes, in windy areas, or in poor soils (Moritz and Svihra 1996).

It is critical to consider the dynamic nature of vegetation communities. Wildfire disturbances have dramatic impacts on plants themselves and plant community composition. Heat shock, accumulation of post-fire charred wood, and change in photoperiods due to removal of shrub canopies may all stimulate seed germination of certain plant species. This type of germination is common in chaparral and scrub plant communities. Fire presence and absence at varying cycles or regimes affect plant community succession. The succession of plant communities, most notably

the gradual conversion of shrublands to grasslands with high-frequency fires and grasslands to shrublands with fire exclusion, is highly dependent on the fire regime. The post-fire response for most species is vegetative reproduction and stimulation of flowering and fruiting. The combustion of aboveground biomass alters seedbeds and temporarily eliminates competition for moisture, nutrients, heat, and light. Species that can rapidly take advantage of the available resources will flourish. Further, biomass and associated fuel loading increase over time, assuming that disturbance or fuel reduction efforts are not diligently implemented.

Coastal Scrub

Coastal scrub is a type of chaparral, commonly referred to as a soft chaparral. This type of chaparral is flashier than hard chaparral species and is more influenced by daily changes in humidity. Coastal scrub vegetation is generally associated with annual grasslands and oak woodlands and can tolerate drier conditions than these associated habitats. Coastal scrub vegetation may be interspersed with chaparral vegetation, most commonly on south facing slopes. Coastal scrub is tolerant of very steep terrain and is commonly observed on steeper slopes. Coastal scrub is considered a moderately fine fuel that is loosely compacted with a moderate fuel load. Coastal scrub has a high surface area-to-volume ratio, requiring less heat to remove fuel moisture and raise fuel to ignition temperature. It is subject to early seasonal drying in the late spring and early summer but does not fully cure in the way that grasses do. Compared to chaparral, coastal scrub tends to have a lower content of volatile organic compounds (VOCs). The live fuel moisture content reaches its low point in the late summer and early fall months. Dead fuels consist mainly of 1-hour and 10-hour fuel sizes, or twigs and small stems ranging from 0.25 inches to 1 inch in diameter. Coastal scrub has potential for a high rate of spread, rapid ignition, and extreme fire behavior.

Annual Grasslands

Herbaceous vegetation in the Planning Area is largely represented by annual grasslands. Herbaceous plant species have non-woody stems and generally complete their life cycle in a single growing season. Invasive grasses, forbs, and noxious weeds may also be a component of herbaceous vegetation types. Trees and shrubs may also be present in this vegetation type; however, absolute tree and shrub cover is often less than 10%.

Grasses are fine fuels that are loosely compacted with a low fuel load.² Grasses have a high surface-area-to-volume ratio, requiring less heat to remove fuel moisture and raise the fuel to ignition temperature. They are also subject to early seasonal drying in late spring and early summer. Live fuel moisture content in grasses typically reaches its low point in early summer, and grasses begin to cure soon after. Due to these characteristics, grasses have the potential for a high rate of spread, rapid ignition, and facilitation of extreme fire behavior. Grasses are the vegetation type in the Project area with the highest risk for wildfire ignition. Their low overall fuel loads typically result in faster moving fires with lower flame lengths and heat output. Untreated grasses can help spread a fire into other adjacent surface fuel types (e.g., shrubs) or facilitate surface to crown fire³ transition where they exist beneath tree canopies.

As described, vegetation plays a significant role in fire behavior. A critical factor to consider is the dynamic nature of vegetation communities. Fire presence and absence at varying cycles or regimes affect plant community succession. A succession of plant communities, most notably the gradual conversion of shrublands to grasslands with high-frequency fires and grasslands to shrublands with fire exclusion, is highly dependent on the fire regime.

² The amount of available and potentially combustible material, usually expressed as tons per acre (NWCG 2022).

³ A crown fire is a forest fire that advances, often at great speed, from treetop to treetop.

Biomass and associated fuel loading will increase over time, assuming that disturbance or fuel reduction efforts are not diligently implemented.

Wildfire disturbances can also have dramatic impacts on plants and plant composition. Heat shock, accumulation of post-fire charred wood, and change in photo periods due to removal of shrub canopies may all stimulate seed germination. The post-fire response for most species is vegetative reproduction and stimulation of flowering and fruiting. The combustion of aboveground biomass alters seedbeds and temporarily eliminates competition for moisture, nutrients, heat, and light. Species that can rapidly take advantage of the available resources will flourish. It is possible to alter successional pathways for varying plant communities through manual alteration. This concept is a key component in the overall establishment and maintenance of the proposed FMZs on the Project Site. FMZs are landscape areas that minimize fire spread progressively through various restrictions, treatments, and maintenance. FMZs provide a buffer between off-site fuels and the urbanized landscapes that have the dual benefit of protecting communities while also protecting habitats by minimizing the potential for project-related ignitions.

2.2.4 Historic Wildland Fires and Ignitions

Fire history is an important component of a site-specific FPP. Fire history data provides valuable information regarding fire spread, fire frequency, ignition sources, and vegetation/fuel mosaics across a given landscape. One important use for this information is as a tool for pre-planning. It is advantageous to know which areas may have burned recently and therefore may provide a tactical defense position, what type of fire burned on the site, and how a fire may spread. Fire is an important process in many of California's ecosystems, and it is becoming increasingly evident that fire regimes (including fire frequency, severity, extent, spatial patterning, etc.) have been greatly altered in some vegetation types by land use patterns and altered ecosystem processes associated with Euro-American settlement (i.e., after 1850) (Sugihara *et al.* 2006, Stephens *et al.* 2007, Skinner *et al.* 2009). In pre-settlement California, fire return intervals (FRIs) varied significantly by vegetation type and region. The fire regime of chaparral communities is that of mostly stand-replacement crown fire at moderate intervals. Estimated historical (1880s-1940s) fire-return intervals for chamise-redshank and mixed chaparral range from 30 to 90 years, with a MFRI (mean fire-return interval) of 55 years. Estimated range for montane chaparral is 15 to 50 years, with a MFRI of 27 years. Determining fire-return intervals is difficult for chaparral because little evidence of past stand age and stand conditions remain after stand-replacement fire. Estimates of historical fire-return intervals in chaparral are based on fire scars on remnant trees adjacent to chaparral, historical written accounts, cover type maps, and photographs (Kip Van de Water and H. Safford, 2011).

Fire history represented in the FPP uses the California Department of Forestry and Fire Protection (CAL FIRE) Fire and Resource Assessment Program (FRAP) database. FRAP summarizes fire perimeter data dating to the late 1800s, but it is incomplete due to the fact that it only includes fires over 10 acres in size and has incomplete perimeter data, especially for the first half of the 20th century (Syphard and Keeley 2016). However, the data does provide a summary of recorded fires and can be used to show whether large fires have occurred in the Project area, which indicates an increased probability of future wildfires.

According to available data from the CAL FIRE in the FRAP database⁴, one-hundred and seventy-two (172) fires have burned within 5 miles of the Project Site since the beginning of the historical fire data record (1878) with the oldest fire occurring in 1911. Of the 172 fires, six (6) fires have occurred onsite with the most recent fires occurring

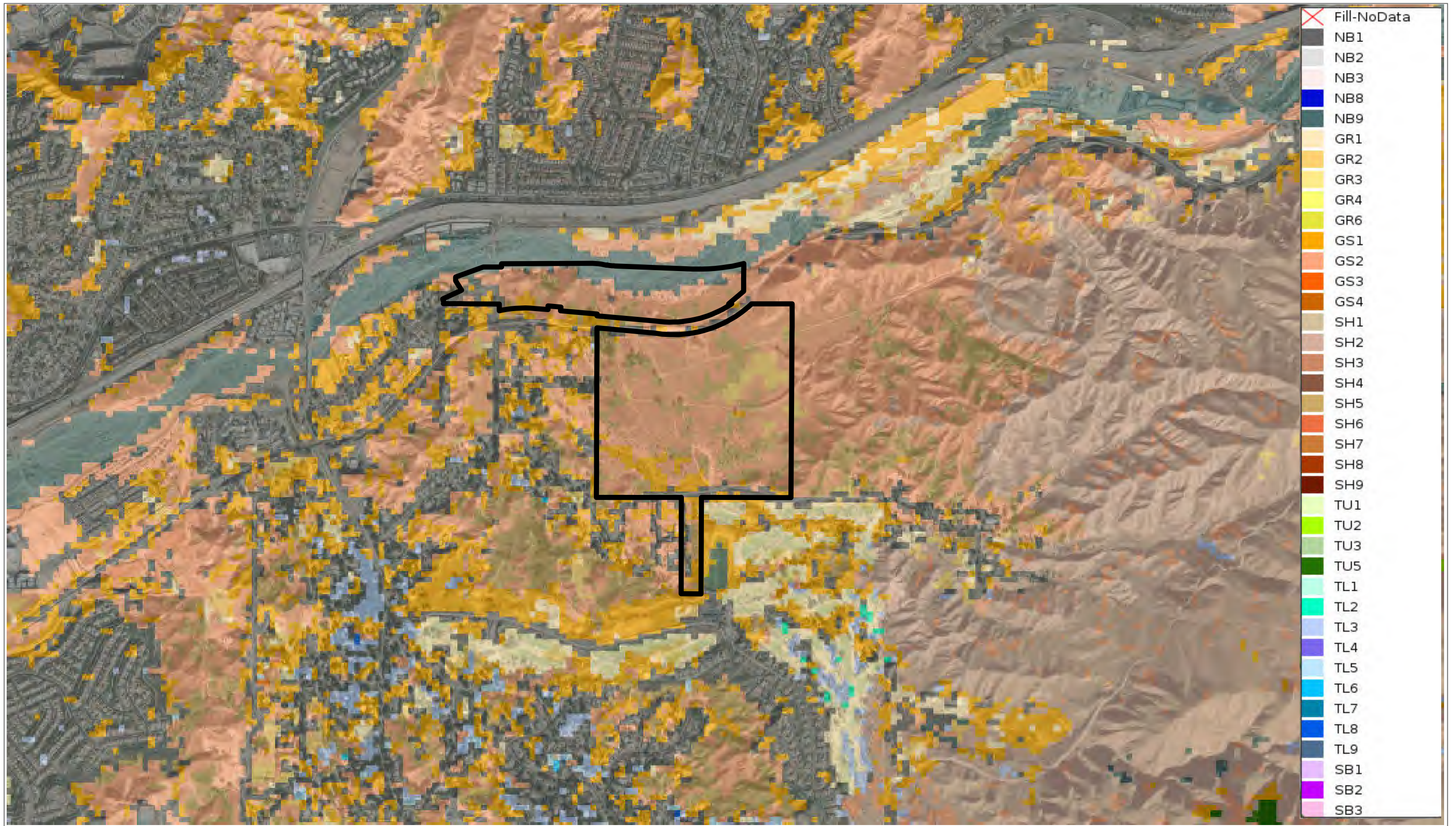
⁴ Based on polygon GIS data from CAL FIRE's FRAP, which includes data from CAL FIRE, USDA Forest Service Region 5, BLM, NPS, Contract Counties and other agencies. The data set is a comprehensive fire perimeter GIS layer for public and private lands throughout the state and covers fires 10 acres and greater between 1878–2023.

on site being the 1984 Live Oak Fire which burned approximately 96 acres, the 2016 Sand Fire which burned approximately 41,418 acres, and the 2019 Tick Fire which burned approximately 4,600 acres. Recorded wildfires within 5 miles range from 10 acres to 160,833 acres (2009 Station Fire) and the average fire size is approximately 2,724 acres (including the 2009 Station Fire, but not fires smaller than 10 acres). The 2023 Agua Fire (approximately 426 acres), the 2021 Golden Fire (approximately 20 acres) and the 2020 Soledad Fire (approximately 1,525 acres) are the most recent fires to have occurred within 5 miles of the Project. The LACoFD may have data regarding smaller fires (less than 10 acres) that have occurred on the site that have not been included herein. Fire history for the general vicinity of the Project Site is illustrated in the map in Figure 7, *Fire History Map*.

As shown on that map, parts of the Project Site have been subject to fire 1, 2, and 3 times. Based on an analysis of the fire history data set, specifically, the years in which the fires burned, the average interval between wildfires within 5 miles of the Project Site was calculated to be zero with intervals ranging between 0 (multiple fires in the same year) to 7 years. Based on the analysis, it is expected that there will be wildland fires within 5 miles of the Project Site at a minimum on average every year and at a maximum every 7 years as observed in the fire history record.

While a fire approaching from the south or west during more typical on-shore weather patterns is possible, based on fire history, wildfire risk for the Project Site is associated primarily with a Santa Ana wind-driven wildfire burning or spotting onto the site from the north or east. The proximity of the Project Site to large expanses of open space to the north, east, and northeast and the terrain within the Angeles National Forest, including multiple sub-drainages and canyons, has the potential to funnel Santa Ana winds, thereby increasing local wind speeds and increasing wildfire hazard in the Project vicinity.

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SOURCE: LANDFIRE Viewer, 2024

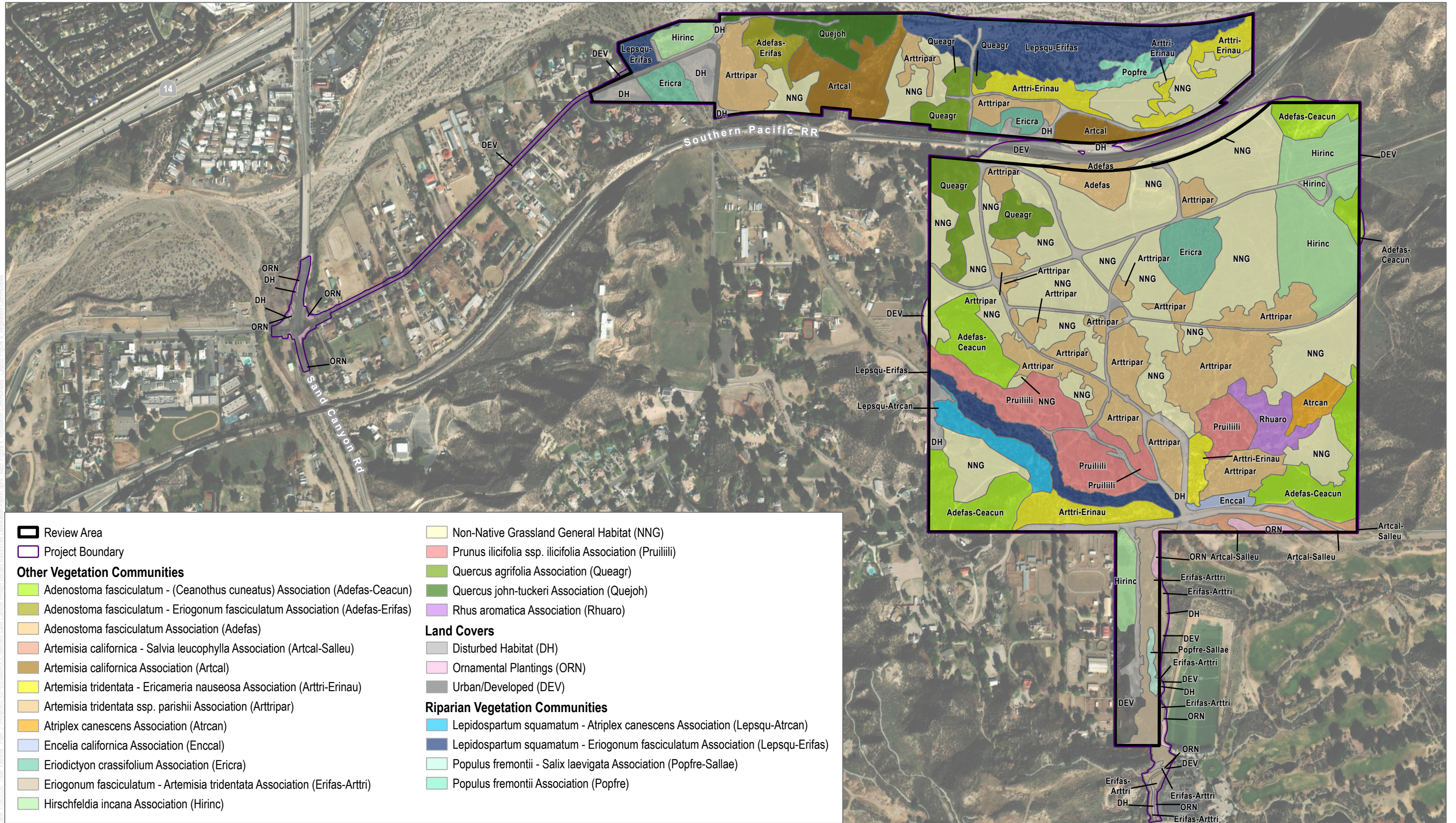


FIGURE 5

Fire Behavior Fuel Models Map

Belcaro at Sand Canyon Project Fire Protection Plan

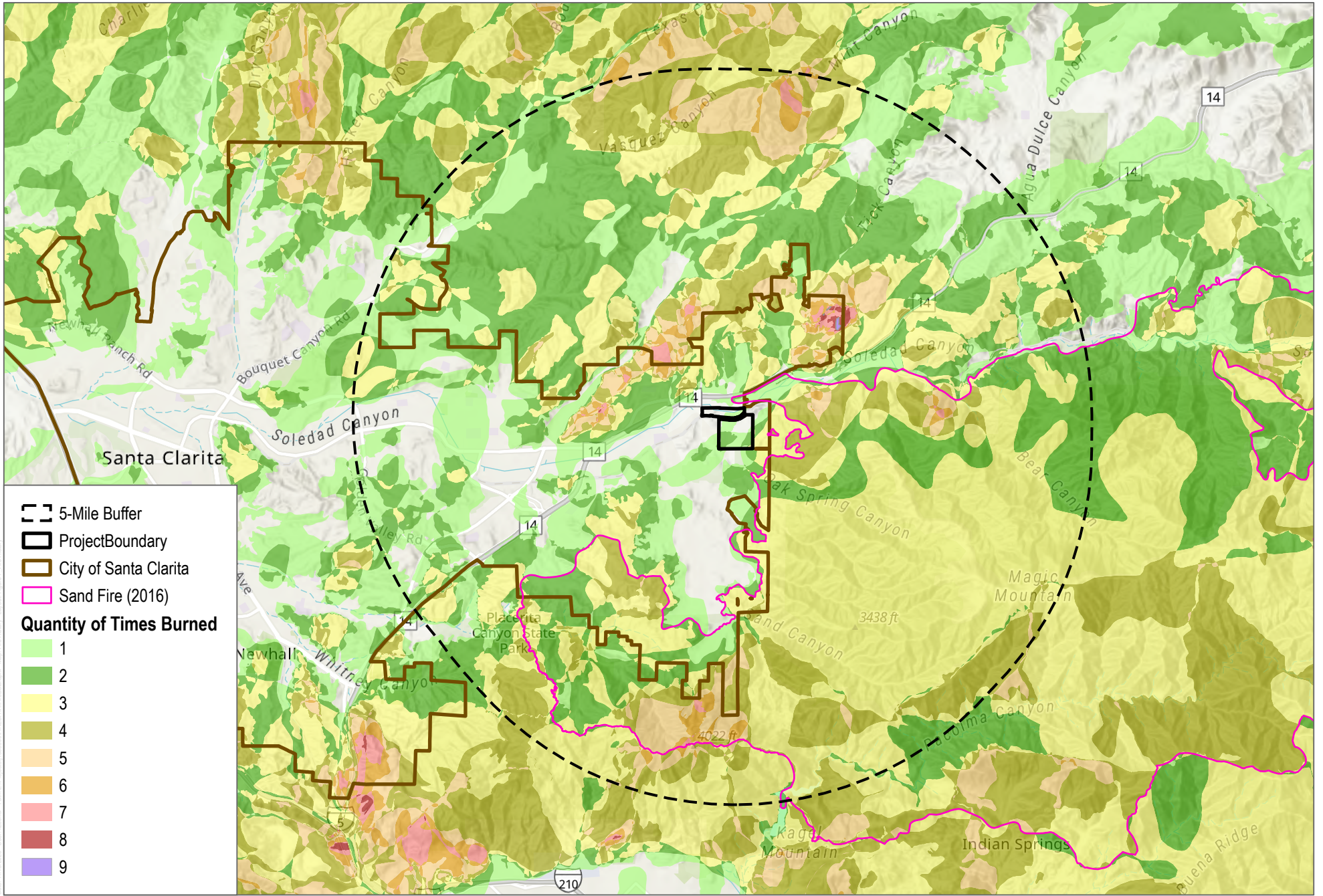
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SOURCE: Maxar 12/8/2022

FIGURE 6
Vegetation Communities
 Belcaro Sand Canyon Project Fire Protection Plan

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SOURCE: USGS National Map 2025



FIGURE 7

Fire History

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2.3 Existing Fire Hazard

Based on the existing conditions, the existing fire hazard in the Project is potentially significant. The current conditions as they relate to topography, climate, land use, and vegetation have the potential to facilitate a significant wildfire. Additionally, as described above in Section 2.2.5 Historic Wildland Fires, the area has been subject to a large number of fires with an average return interval of at least every 7 years, however likely sooner than that. Further, it is expected the wildfires will continue to burn within the Project's vicinity.

The Project site exhibits a significant fire hazard regarding vegetation/fuels, climate, and topography. The Project site largely supports non-native grasslands, chaparral communities, and big sagebrush scrub. These vegetation types are flammable, especially during fire season, and the grasslands facilitate fire spread across the landscape. Hourly gusts speeds average 20 mph throughout the year, with monthly average highs of approximately 40-45 mph between October and April, which are largely associated with Santa Ana winds. The Project site is relatively flat; however, the eastern boundary of Project site is exposed to a large expanse of undeveloped, naturally vegetated lands that extend to the San Gabriel Mountains and Angeles National Forest. The San Gabriel Mountains and Angeles National Forest to the east can channel Santa Ana winds towards the project site, igniting onsite vegetation, and spreading fire across the landscape. The vegetation/fuels, climate, and topography increase the potential for more extreme wildfire behavior on and within the vicinity of the Project site.

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3 Analysis of Offsite Ignition Risk

3.1 Analysis of Wildfire Risk from Adding New Residents

Humans (i.e., human related activities or human created features, services, or processes) are responsible for the majority of California wildfires (Syphard et al. 2007; Romero-Calcerrada et al. 2008). Certain human activities result in sparks, flames, or heat that may ignite vegetative fuels without proper prevention measures in place. These ignitions predominantly occur as accidents, but may also be purposeful, such as in the case of arson. Roadways are a particularly high source for wildfire ignitions due to high usage and vehicle caused fires (catalytic converter failure, overheated brakes, dragging chains, tossed cigarettes, and others) (Harris 2019; Dudek 2008). In Southern California, and Los Angeles County, the population living at, working in, or traveling through the wildland urban interface is vast and provides a significant opportunity for ignitions every day. However, it is a relatively rare event when a wildfire occurs, and an even rarer event when a wildfire escapes initial containment efforts. Approximately 90 to 95 percent of wildfires are controlled below 10 acres (CAL FIRE n.d.).

Research indicates that the type of clustered, master planned developments, like Belcaro at Sand Canyon, are not associated with increased vegetation ignitions (Syphard & Keeley, 2015). Syphard and Keeley (2015) summarize all wildfire ignitions included in the CAL FIRE Fire and Resource Assessment Program (FRAP) database – dating back over 100 years. They found, in the case of one Southern California county (San Diego County), equipment-caused fires were by far the most numerous, and these also accounted for most of the area burned, followed closely by the area burned by power line fires. This pattern is consistent beyond San Diego County and is applicable in Los Angeles County. Ignitions classified as equipment caused frequently resulted from exhaust or sparks from power saws or other equipment with gas or electrical motors, such as lawn mowers, trimmers or tractors and associated with lower density housing. In San Diego County, and in areas like the Santa Clarita Valley, ignitions were more likely to occur close to roads and structures, and at intermediate structure densities.

As Exhibits 1 and 2 illustrate, community design and density directly influence susceptibility to fire because in clustered developments, there is one interface (the community perimeter) with the wildlands whereas lower density development creates more structural exposure to wildlands, less or no ongoing landscape maintenance (an intermix rather than interface), and consequently more difficulty for limited fire resources to protect well-spaced homes. The intermix includes housing amongst the unmaintained fuels whereas the proposed project converts all fuels within the footprint and provides a wide, managed fuel modification zone separating homes from unmaintained fuel and creating a condition that makes defense easier. Syphard and Keeley go on to state that “The WUI, where housing density is low to intermediate is an apparent influence in most ignition maps” further enforcing the conclusion that lower density, interspersed housing poses a higher ignition risk than higher density, clustered communities. They also state that “Development of low-density, exurban housing may also lead to more homes being destroyed by fire” (Syphard et al. 2013). As discussed in detail throughout this FPP, Belcaro at Sand Canyon is a planned ignition resistant community designed to include professionally managed and maintained fire protection components, modern fire code compliant safety features and specific measures provided where ignitions are most likely to occur (such as roadways). Therefore, the development of the Belcaro at Sand Canyon Project would not be expected to materially increase the risk of vegetation ignitions.

Exhibit 1. Example higher density development. Homes are ignition resistant and excludes readily ignitable vegetative fuels throughout and provides a perimeter fuel modification zone. This type of new development requires fewer fire resources to defend and can minimize the likelihood of on-site fires spreading off-site.



Exhibit 2. Example of “moderate density” development. Homes are located on larger properties and include varying levels of ignition resistance and landscape / fuel modification provision and maintenance. This type of development results in a higher wildland exposure level for all homes and does not provide the same buffers from wildfire encroaching onto the site, or starting at a structure and moving into the wildlands as a higher density project.



Exhibit 3. Example of “lower density” development. Homes are interspersed amongst wildland fuels, are of varying ages, and include varying levels of fuel modification zone setbacks. Homes are exposed on most or all sides by flammable vegetation and properties rely solely on owners for maintenance, are often far distances from the nearest fire station, and have minimal buffer from on-site fire spreading to wildlands.



Moreover, frequent fires and lower density housing growth may lead to the expansion of highly flammable exotic grasses that can further increase the probability of ignitions (Keeley et al. 2012). This is not the case with the proposed project as the landscapes are managed and maintained to remove exotic fuels that may be established over time.

As discussed above, research indicates that it is less likely for higher density developments to be impacted by wildfires than lower density developments. The same protections that starve wildfire of fuels and minimize or prevent wildfire from transitioning into a higher density community or moderate density with high maintenance levels also serve to minimize or prevent on-site fires from transitioning into the wildlands. Further, the requirement that all structures include interior fire sprinklers significantly reduces the likelihood that a building fire spreads to the point of flashover, where a structure will burn beyond control and produce embers. Interior sprinklers are very efficient, keeping fires to the room of origin, or extinguishing the fire before the fire transitions to other structures or until the responding firefighters arrive. Similarly, the irrigated fuel modification zones are positioned throughout the development areas as well as the first zones on the perimeter of the Project. Irrigated zones include plants with high internal moisture and spacing between plants and plant groups that 1) make it difficult to ignite and 2) make it difficult for fire to spread plant to plant. Lastly, the future human presence on-site result in fast detection of fires and fast firefighter response, a key in limiting the growth of fires beyond the incipient stage.

If a wildfire were to ignite from human activity today, fire detection and response could likely be delayed due to the remoteness of the area not directly visible from populated areas. Delayed detection could contribute to delayed response to the scene due to the lack of site access. Fire size up (determining the needed firefighting resources) and requests for additional resources, including aerial support, also may be delayed in comparison to post-construction of the Belcaro at Sand Canyon Project. With the Project, motorized activities on the trails would be prohibited and enforced. If a hiker or mountain biker was to start a fire, detection and response would be anticipated on a fast timeline due to the residents that would be living within the community with the ability to detect fires

throughout the property. The quick detection and call to 911 would result in quick response from the onsite fire station, which can reach anywhere within the Project quickly. If a fire is detected and cannot be accessed by a responding fire engine, it can be sized up and additional aerial and other support requested quickly.

3.2 Structural Ignition Resistance Regulatory Requirements

In WUI areas, homes can be considered fuel as well as an ignition point for wildfires. The WUI fire problem is structural; therefore, the best mitigation is to reduce the likelihood of building ignition occurring. (Zhou, 2013). Structural characteristics play a large role in whether or not a building burns, which is important in WUI environments as ill-prepared structures may also serve as fuel (Gorte, 2011). Preventing the ignition of structures can result in the reduction of fire spread in surrounding WUI areas (Maranghides & Mell, 2012). The benefit of structure-based mitigation is that it not only lowers the onsite risk but also lowers the risk of wildfire across a landscape (Mockrin et al., 2020).

The proposed structures within the Project will be built utilizing the most current construction methods designed to mitigate wildfire exposure, required by County Fire, at the time of construction. Within the limits established by law, construction methods intended to mitigate wildfire exposure will comply with the wildfire protection building construction requirements contained in the Los Angeles County Building Code and the 2022 CBC including the following:

1. California Building Code, Chapter 7A
2. Los Angeles County Building Code, Chapter 7A
3. Los Angeles County Residential Code, Section R327
4. Los Angeles County Referenced Standards Code, Chapter 12-7A

Construction practices respond to the requirements of the County Fire Code Title 32 and the Los Angeles County Building Code (Title 26, Chapter 7A), "Construction Methods for Exterior Wildfire Exposure." These requirements include the ignition resistant requirements found in Chapter 12-7A of the Los Angeles County Referenced Standards Code. A key component to addressing the wildfire problem is to address the structural ignition. (Zhou, 2013). Addressing structural ignition potential is an effective mitigation strategy for preventing wildfires and increasing WUI ignition resistance (Zhou, 2013). Research has found that structural characteristics, especially roofing, play a significant role in reducing a structure's vulnerability to fire and the likelihood of burning (Gorte, 2011; Knapp et al., 2021; Kolden & Henson, 2019; Manzello et al., 2011; Syphard et al., 2017; Zhou, 2013). Further, reducing a structure's likelihood of ignitions reduces the risk for the individual homeowners and the risk associated with fire spreading to other homes or wildland areas (Mockrin et al., 2020). While these standards will provide a high level of protection to structures in this development and should reduce or eliminate the need to order evacuations, there is no guarantee of assurance that compliance with these standards will prevent damage or destruction of structures by fire in all cases.

The 7A Materials and Construction Methods for Exterior Wildfire Exposure (CBC) chapter detail the ignition resistant requirements for the following key components of building safely in wildland-urban interface and fire hazard severity zones. Each of the critical exterior building features summarized below has been addressed within Chapter 7A to minimize the potential for structural ignition from wildfire exposure as well as from airborne embers.

3.2.1 Roofing Assemblies

Roofing shall comply with Chapter 7A and Chapter 15 of the CBC. Roof assemblies shall be a Class A rating in accordance with ASTM E108 or UL790. Where the roof allows a space between the roof covering and roof decking the space shall be constructed to prevent the intrusion of embers, or is installed over a combustible deck, be fire stopped with a 72 In cap sheet meeting the ASTM D3909 Standard Specification for “Asphalt Rolled Roofing Surfaces with Mineral Granules”, shall be installed over the roof deck. Bird stops are to be used at the eaves, and hip and ridge caps will be mudded in to prevent the intrusion of embers. Roof valley flashing shall be no less than 0.019 inches No. 26 gauge galvanized sheet corrosion-resistant metal installed over no less than one layer of minimum 72 lb. mineral surfaced nonperforated cap sheet compliant with ASTM D3909, at least 36 inches wide running the full length of the valley. Gutters shall be provided with means to prevent the accumulation of embers.

Wood shake shingles and wood shakes are prohibited in any Fire Hazard Severity Zone regardless of classification per LACBC Section 705A.2.

3.2.2 Vents and Openings

Any vent openings, enclosed eaves soffit spaces, enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters, and underfloor ventilation shall comply with Section 1203 and Section 706A.1 through 706A.3 of the CBC and Section 706A of the LACBC. All vents and openings shall be fully covered with Wildland Flame and Ember Resistant vents approved and listed by the California State Fire Marshal or WUI vents listed in ASTM E2886. This also applies to any gable ends, ridge ends, crawl spaces, foundations, and all other vents that mount onto a vertical wall. Vents shall not be installed on the underside of eaves or cornices unless they are WUI vents as described above.

3.2.3 Exterior Wall Covering

Exterior walls shall comply with Section 707A.3 of the CBC and be either noncombustible or ignition-resistant. This applies to exterior wall coverings, exterior wall assembly, exposed undersides or eaves or soffits, undersides of porch ceilings, the underside of floor projections, and exterior underfloor areas.

3.2.4 Open Roof Eaves

Any exposed roof deck material on the underside of open roof eaves shall either be noncombustible, ignition resistant, one layer of 5/8 inch thick Type X gypsum, or 1-hour fire resistive exterior wall assembly designed for exterior fire exposure using gypsum panel and sheeting in accordance with CBC Section 707A.4.

3.2.5 Closed Roof Eaves and Soffits

Enclosed eaves and soffits shall comply with CBC Section 707A.5. The exposed underside of enclosed eaves or soffits shall be protected by either noncombustible material, ignition-resistant material, one layer of 5/8 inch Type X gypsum sheeting, 1-hour fire resistive exterior wall assembly, assemblies that meet the performance criteria in Section 707A.10 or assembly that meet the performance criteria in State Fire Marshall (SFM) Standard 12-7A-3.

3.2.6 Floor Projections and Underfloor Protection

The underside of floor projections must comply with Section 707A.7 of the CBC. The exposed underside of a cantilevered floor projection, where a floor assembly extends over an exterior wall, must be protected by noncombustible materials, ignition-resistant materials, one layer of 5/8 in Type X gypsum, 1-hour fire resistive exterior wall assembly that meets the criteria in Section 707A.10, or meets performance criteria in SFM Standard 12-7A-3. The underfloor area of an elevated or overhanging building shall be enclosed in accordance with CBC Section 707A.8.

3.2.7 Underfloor Appendices

When required by County Fire, the underside of overhanging appendages shall be enclosed per CBC Section 707A.9. Or the underside of the exposed underfloor shall consist of noncombustible material, ignition-resistant material, one layer of 5/8 inch Type X gypsum, 1-hour fire resistive exterior wall assembly, or meets the performance criteria in SFM Standard 12-7A-3 or ASTM E2957.

3.2.8 Windows, Skylights, and Doors

Assemblies shall meet one of the following requirements:

- Be constructed of multiplane glazing with a minimum of one tempered pane meeting the requirements of Section 2406 Safety Glazing.
- Be constructed of glass block units.
- Have a fire-resistive rating of no less than 20 minutes per National Fire Protection Association (NFPA) 257.
- Be tested to meet the performance requirements of SFM Standard 12-7A-2.

Skylights shall be protected by a non-combustible mesh screen with openings of no more than 1/8 inches. Wall assemblies behind structural glass veneers shall comply with Section 707A.3 of the CBC.

3.2.9 Exterior Doors

Exterior doors shall be constructed as follows:

- Noncombustible material
- Ignition-resistant construction
- A solid wood core that has stiles and rails no less than 1 3/8-inch-thick and panels no less than 1 ¼ inch thick.
- Fire-resistance rating of no less than 20 minutes per NFPA 252
- Surface or cladding that meets the performance criteria of CBC Section 707A.3.1 when tested per ASTM E2707 or SFM Standard 12-7A-1.

Garage doors shall resist the intrusion of embers by preventing gaps between doors and roof openings at the top, bottom, and sides of doors. Gaps cannot exceed 1/8 inch and shall be controlled by either weather stripping that meets ASTM D638 and ASTM G155, weather stripping shall also have a V-2 or better flammability rating, be constructed so that doors overlap onto jams and headers, or the garage door jams and headers are covered with metal flashing.

3.2.10 Decking

Any deck, porch, balcony, or stairs within 10 feet of a building shall comply with CBC Section 709A. The walking surface shall either comply with Section 709A.4 when tested per ASTM E2632 and ASTM E2726, ignition-resistant material, material that meets the criteria of SMF Standard 12-7A-4 and SFM Standard 12-7A-5, noncombustible material, any material that meets SFM Standard 12-7A-4A when attaches to exterior walls that are noncombustible or ignition-resistant or any material that meets Section 709A.5 and is attached to an exterior wall that is noncombustible or ignition-resistant.

3.2.11 Accessory Structures

Accessory structures are applied to buildings covered by LACBC Section 710A.3, Exception 1 as well as any building that requires a permit including but not limited to trellises, arbors, patio covers, gazebos, and similar structures within less than 3 feet of the building or otherwise determined by County Fire. Buildings that are less than 120 square feet in floor area and are more than 30 feet but less than 50 feet from structures shall be noncombustible or ignition-resistant per CBC Section 704A.2. No requirements shall apply to an accessory building or miscellaneous structures when located at least 50 feet from an applicable building. Applicable accessory buildings and attached miscellaneous structures, or detached miscellaneous structures that are installed at a distance of fewer than 3 feet from an applicable building, shall comply with LACBC Section 710A. Structures that meet the requirements of an accessory or miscellaneous structures shall be noncombustible or ignition resistant per CBC Section 704A.2.

3.3 Examples of Communities Designed Against Wildfire

When communities incorporate the regulatory requirements and wildfire-resistance measures like the ones described above, they can offer a safer landscape that is resistant to WUI fire disasters. Researchers and fire professionals are increasingly emphasizing the importance of not only fire-resilient homes but also fire-resilient neighborhoods, which can be achieved through planned development that is less vulnerable to fire (Moritz & Bustic, 2020; Ewing & Maier, 2016). Wildfire impacts on neighborhoods can be mitigated through the pattern and layout of new developments, the incorporation of community-wide design features and protective measures, and compliance with modern fire-protective building codes (Barrett, 2019; Ewing & Maier, 2016). Data from past wildfire events supports that mitigation induced by modern building codes yields significant benefits to neighboring structures, which can decrease structure-to-structure spread (Baylis & Boomhower, 2021).

The 2017 Thomas Fire in Santa Barbara and Ventura Counties consumed over 1,000 homes predominately during the high wind events in the first few days of the incident (Kolden & Henson, 2019). The unincorporated area of Montecito is classified as VHFHSZ and has significant fire history inclusive of home loss (Kolden & Henson, 2019). Two decades prior to the Thomas Fire, the Montecito Fire Protection District started to address wildfire vulnerability in the community using place-based reduction strategies (Kolden & Henson, 2019). These strategies focused on recurring structural ignition potential, fire-resistant materials, structural modifications, increasing defensible space, fire scaping, and developing a fire protection code (Kolden & Henson, 2019). As a result, when the Thomas Fire, during Sundowner winds, spread to Montecito, the area experienced minimal damage and was largely passed over (Kolden & Henson, 2019). By having mitigation not be isolated to wildland areas or just to homes, but implemented on multiple scales, Montecito was able to effectively protect not just the WUI areas, but the entire community.

The 2007 Witch Creek fire was one of the most destructive fires in California’s history and destroyed thousands of homes in San Diego County (Mutch et al., 2011). However, after the 1990 Paint Fire in Santa Barbara County and the 1991 Oakland Hills Tunnel Fire the San Diego community started efforts to become adaptive to a very high fire hazard environment (Mutch et al., 2011). Developers of five master-planned communities (the Bridges, the Crosby, Cielo, Santa Fe Valley, and 4S Ranch) worked with the Rancho Santa Fe Fire Protection District to build the communities specifically with wildfire in mind (IBHS, 2008). They implemented fire codes, and developed restricted defensible space rules, home hardening measures, and vegetation restrictions; all of which were maintained and enforced by the HOA (Mutch et al., 2011). As a result, when the Witch Creek fire spread to Rancho Santa Fe in the five communities that adopted this approach no homes were lost versus the older communities which were heavily impacted (Mutch et al., 2011).

Additionally, the following communities which feature similar fire protection measures as the Project have experienced minimal to no fire encroachment as a result of their design:

- Casino Ridge, Yorba Linda (2008 Freeway Complex Fire)⁵
- Serrano Heights, Anaheim Hills (2007 Santiago Fire)⁶
- Cielo, Rancho Santa Fe (2007 Witch Creek Fire)⁷
- 4S Ranch, San Diego (2016 brush fire, 2007 Witch Creek Fire)⁸
- Stevenson Ranch Fire, Santa Clarita (2003 Simi Fire)⁹
- Orchard Hills, Irvine (2020 Silverado Fire) ¹⁰

This data supports that master-planned wildfire-resilient communities built to modern standards provide resilient and fire-resistant housing. Design features that comply with Chapter 7A of the California Building Code decrease the wildfire vulnerability of individual buildings (Quarles & Pohl, 2019). When these features are adopted on a community-wide scale, and coupled with fuel modification zones and community-level buffers, the features enhance overall wildfire resilience of the community (IBHS, 2021). This community-wide approach is critical in reducing fire risk because of the importance of preventing structure-to-structure ignition within a neighborhood in order to prevent conflagrations (Moritz & Bustic, 2020).

Analysis of the State Fire Marshal’s statistics also indicates that homes built to CBC Chapter 7A standards effectively reduce fire risks for homes built in the WUI (Grijalva, 2025, attached as Appendix E to this Fire Protection Plan). A study that focused on the 2018 Camp Fire found that homes built in 1997 or later fared substantially better than homes built prior to 1997 (Valachovic et al., 2021). Another source indicates that a 2008 or newer home in California is substantially less likely to be destroyed than a 1990 home experiencing identical wildfire exposure, and that there is strong evidence that these effects are due to state and local building code changes (Baylis & Boomhower, 2021).

New master-planned wildfire-resilient communities in VHFHSZs are planned, approved and implemented with numerous fire-safety features and measures. These fire safety features and measures contrast with some older built environments impacted by the 2025 fires in Los Angeles County. See Exhibit 4, which evaluates risk factors

⁵ (Orange County Fire Authority, 2008)

⁶ (FEMA, n.d.)

⁷ (Mutch et al., 2011)

⁸ (Audencial, 2016)

⁹ (Murphy 2003)

¹⁰ (Grijalva, 2025, attached as Appendix H to this Fire Protection Plan)

associated with some older built environments impacted by the 2025 fires in Los Angeles County and distinguishes those risk factors with wildfire resistance measures in a modern, master-planned wildfire-resilient community (Orchard Hills) that did not suffer significant structural damage despite being directly impacted by the 2020 Silverado Fire during an extreme wind event.¹¹ As shown in Exhibit 4, modern, master-planned wildfire-resilient communities in VHFHSZs within the County, such as the Modified Project, include key wildfire safety features and measures, such as:

- Chapter 7A ignition resistant construction
- Annually maintained fuel modification zone
- Ember resistant chapter 7A structures
- Modern code compliant roadways
- Multiple ingress/egress points
- Modern code compliant turnarounds
- Modern code compliant roadways
- HOA maintained landscaping
- Minimal vegetation between structures
- Irrigated landscaping
- Modern code compliant road widths that allow emergency access

In contrast, some of the older built environments impacted by the 2025 fires lacked many of these safety features and were characterized by higher-risk attributes, such as:

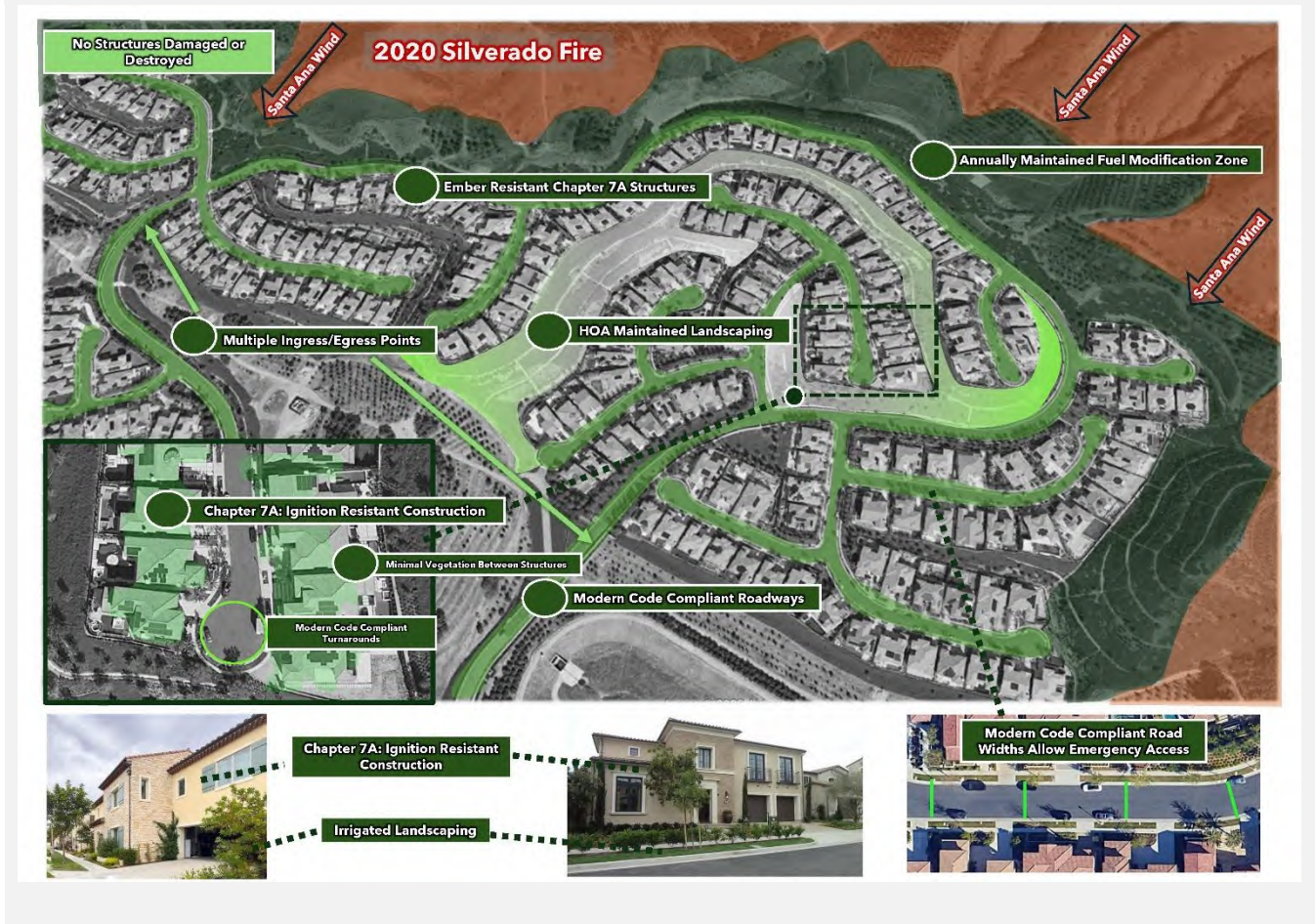
- Non-modern structures that lack ember resistance
- Construction not designed for exterior wildfire exposure or resistance to embers
- No fuel modification zones or lack of fuel modification zone maintenance
- Lack of interior landscaping area maintenance
- Narrow road widths (non-compliant with modern codes)
- Hazardous vegetation between structures

In sum, the Modified Project site is designed and planned as a master-planned, wildfire-resilient community that will be implemented and maintained compliant with regulatory requirements and mitigation under the oversight of Los Angeles County Fire. The Modified Project takes a multi-scaled approach to fire protection through wildfire education, ignition prevention, fuels management, increased response capacity, and ignition-resistant construction. The Modified Project has been designed to ensure adequate water supply to ensure consistency for fire protection purposes. The water supply system, encompassing reservoirs, pressure tanks, elevated tanks, water mains, and other fixed systems, would be installed and maintained according to state and NFPA standards and would be

¹¹ Exhibits 5 and 6 specifically evaluate the 2025 Palisades Fire and Eaton Fire due to the extreme damages from these fires. Exhibits 5 and 6 are also representative of potential risk factors to other older built communities affected by the 2025 fires, including without limitation, the Hurst Fire, Hughes (Castaic) Fire, and Lidia Fire located in and around the Santa Clarita Valley. The Hurst Fire (approximately 799 acres burned), Hughes (Castaic) Fire (approximately 10,425 acres burned), and Lidia Fire (approximately 395 acres burned) resulted in rapid responses by fire-fighting professionals and evacuation orders, but structural impacts were not substantial, particularly when compared to damages in other areas of the County.

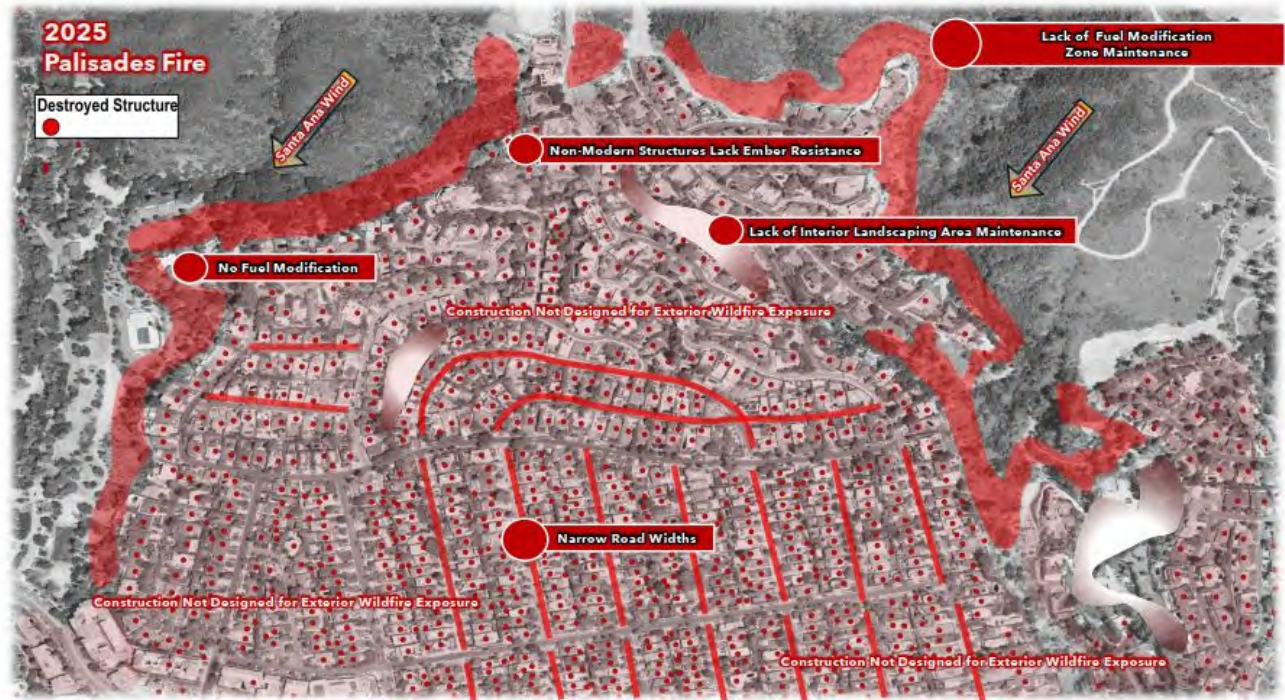
capable of providing the required fire flow.¹² The dual benefit of creating a development that can prevent a fire is that it offers protection to the surrounding communities and the environment. The requirements and recommendations outlined in the FPP have been designed specifically for the proposed construction in VHFHSZ and HFHSZ areas and can significantly reduce the potential threat to offsite areas.

Exhibit 4. Planned Wildfire Resilient Community Features



¹² The Modified Project will include design features such as 12-inch-diameter water supply lines within internal roadways, fire hydrants spaced no more than 600 feet apart for single-family residential and no more than 300 feet apart for multi-family residential, commercial, and institutions, and NFPA 13, 13R, and 13D automatic sprinkler systems for all structures of any occupancy type.

Exhibit 5. Palisades Community Features



Hazardous Vegetation Between Structures
Construction Not Designed for Exterior Wildfire Exposure or Resistance to Embers

Narrow Road Widths (Non-compliant with modern codes)

Lack of Fuel Modification Zone Maintenance

Exhibit 6. Eaton Community Features



3.4 Fire Protection Features' Beneficial Effect on Wildfire Ignition Risk Reduction

Each of the fire protection features provided as part of the code requirements or customized for this Project are based on the FPP's evaluation work to protect the Project site, its structures and their occupants from wildfires as well as reduce the risk of wildfire originating from the Project site and spreading to existing developments within the Project's vicinity. These features also have a similar positive impact on the potential for wildfire ignitions caused by the Project and its inhabitants.

As mentioned previously, the ignition resistant landscapes and structures and the numerous specific requirements would minimize the ability for an on-site fire to spread to off-site fuels, as follows:

1. **Ignition resistant, planned and maintained landscape** – all site landscaping of common areas and fuel modification zones will be subject to strict plant types that are lower ignition plants with those closest to structures requiring irrigation to maintain high plant moistures which equates to difficult ignition. These areas are closest to structures, where ignitions would be expected to be highest, but will be prevented through these ongoing maintenance efforts.
2. **Fuel Modification Zone around perimeter of project** – the FMZ is a minimum of 100 feet for the majority of the Project and includes FMZs up to 200 feet or the property boundary, where structures are adjacent to natural open space. The FMZ includes specifically selected plant species, very low fuel densities (only 30% retention of native plants in outer zones and irrigated inner zones), and ongoing HOA funded and applied maintenance, resulting in a wide buffer between the developed areas and the off-site native fuels. Where there is less than 100 feet, additional fire protection features such as code-exceeding structural hardening are provided to compensate and provide the same level of protection.
3. **Annual FMZ inspections** – the Belcaro at Sand Canyon HOA's CCRs shall require annual fuel modification inspections to be conducted to confirm and document compliance with fuel modification maintenance requirements, as defined in the Los Angeles County Fire Department (LACoFD)-approved Fuel Modification Plan. The HOA shall obtain a fuel modification zone (FMZ) inspection and report in May/June of each year to document and certify that vegetation management activities throughout the Project site have been performed. If the FMZ areas are not compliant, the HOA shall have a specified period to correct any noted issues, and re-inspection shall be required to achieve the annual certification of compliance. Documentation of compliance shall be retained by the HOA.
4. **Ignition resistant structures** – all structures will be built to the Chapter 7A (CBC) ignition resistant requirements that have been developed and codified as a direct result of post-fire save and loss assessments. Since homes can be considered as fuel for wildfires in WUI areas, these measures ensure that homes are designed, built and maintained to withstand fire and embers. It must be noted that the wide FMZs would not result in wildfire directly next to these structures. Homes and buildings can be built in the VHFHSZs and WUI areas when they are part of an overall approach that contemplates wildfire and provides design features that address the related risk. A structure within a VHFHSZ that is built to these specifications can be at lower risk than an older structure in a non-fire hazard severity zone. The ignition resistance of on-site structures would result in a low incidence of structural fires, further minimizing potential for Project-related wildfires.
5. **Interior fire sprinklers** – sprinklers in residences are designed to provide additional time for occupants to escape the home. Sprinklers in multi-family and commercial structures are designed to provide structural protection. The common benefit of fire sprinklers is that they are very successful at assisting responding

firefighters by either extinguishing a structural fire or at least, containing the fire to the room of origin and delaying flash over. This benefit also reduces the potential for an open space vegetation ignition by minimizing the possibility for structure fires to grow large and uncontrollable, resulting in embers that are blown into wildland areas. This is not the case with older existing homes in the Project's vicinity that do not include interior sprinklers.

6. **Fire access roads** – roads provide access for firefighting apparatus. Project roads provide code-consistent access throughout the community. Better access to wildland areas may result in faster wildfire response and continuation of the fire agencies' successful control of wildfires at small sizes.
7. **Powerlines** - All new permanent powerlines would be underground for fire safety purposes, which would eliminate the risk of ignitions via contact between transmission lines and tree canopies, other vegetation, etc.
8. **Water** – providing firefighting water throughout the Project with fire hydrants accessible by fire engines is a critical component of both structural and vegetation fires. The Project provides firefighting water volume, availability and sustained pressures to the satisfaction of the LACoFD. Water accessibility helps firefighters control structural fires and helps protect structures from and extinguish wildfires.

3.5 Off-site Wildfire Impacts

It is a rare event when a wildfire escapes initial containment efforts. Approximately 90 to 95% of wildfires are controlled below 10 acres (CAL FIRE 2019). Studies (Keeley & Syphard 2018; Syphard et al. 2007; Syphard & Keeley 2015) show the ignition resistance and fire safety awareness of the project and its population influences the likelihood of fire ignitions and the potential for fire to spread off-site into adjacent wildland fuels and negatively impact existing communities. As the research indicates, humans can drive wildfire ignition risk, but not discussed, they can also reduce it. When fire protection is implemented at the parcel level and leverages ignition resistant building materials, infrastructure improvements, and landscape design the wildfire risk can be significantly reduced in the surrounding environment (Newman et al., 2013). When wildfire is planned for and incorporated into the building design, such as with this project, it can not only withstand wildfire, but prevent it. This prevention benefits the project and the surrounding areas by reducing the landscape level fire risk. Further, given the project's multi-scaled approach to fire protection, it is unlikely that the project site would be a significant source of ignitions and result in increased off-site impacts related to wildfire, as discussed herein.

Common ignition sources in southern California are related to powerlines and vehicles (Keeley & Syphard, 2018). Powerlines-based ignitions are a major concern with respect to off-site wildfire impacts. However, this risk can be mitigated by burying powerlines, as they would be throughout the project site. Burying powerlines significantly eliminates a potential ignition source within the project site and benefits the larger vicinity. The remaining highest likelihood of vegetation ignitions in the project area would be related to existing roads used by project residents and employees. However, the project provides roadside fuel modification along all roads it creates. These efforts reduce or minimize the ability for a vehicle related spark, catalytic converter failure, or other ignition source to ignite and spread fire from the roadsides into unmaintained fuels. The on-site roadways would comply with all fire department access requirements and be adjacent to fuel modification. Therefore, even if ignition were to occur on the project interior roadways it is highly unlikely it would spread beyond the project site and due to the level of hardscape and the adjacent fuel modifications areas, would result in patchy and slow fire spread and reduced fire intensity.

Reducing WUI exposure can address protection of a wide range of highly valued resources and can offer protection to critical resources, habitat communities, and landscapes (Scott et al., 2016). Despite the potential for more

frequent fire ignitions from developments, when developments are planned accordingly, such as this project, the fuel availability and fuel continuity decrease, while the probability of fire suppression increases (Fox et al., 2018). This is a result of planned alterations to fuel, increased ignition resistant construction, enhanced fire protection features, higher wildfire risk awareness, and maintenance of fire protection features. The dual benefit of building a fire-hardened development, like the project, is that the same features that protect the development from a wildfire also play a significant role in protecting wildlands and surrounding areas from project-related fires.

3.5.1 Vegetation management

A study in southern Italy found that the ignition potential of an area was significantly influenced by landcover types and human drivers were low or inconsistent (Elia et al., 2019). Urban interfaces with shrubland-dominated vegetation were found to be more fire-prone than those with grasslands or other natural spaces (Elia et al., 2019). The project site is primarily dominated by shrublands, with dispersed non-native grasses areas intermixed throughout. The existing fuels within the areas of disturbance on the site and within FMZ areas will either be completely removed for the development of the structures, roadways, and interior hardscape areas, appropriately thinned within the outer fuel modification zones to create the appropriate separation between fuels, or converted into hardscape/paving or landscaped areas that are modified to reduce fuel densities that are managed and maintained. The fuel conditions will be addressed through various vegetation management techniques, such as fuel modification zones (FMZs). The original intent of FMZs, also known as defensible space, was to protect natural resources from fires in developed areas and have since evolved to protecting communities and structures. In an FMZ, combustible vegetation would be removed and/or modified and partially or totally replaced with more appropriately spaced drought-tolerant, fire-resistant plants. The goal is to provide a managed area where fire spread is not facilitated toward the project or away from the project site into wildland areas. Fuel modification works by redistributing the fire risk on a landscape and altering the interaction between fire, fuels, and weather (Cochrane et al., 2012). FMZs typically target surface fires but can also reduce the likelihood of canopy fires, lower ember cast, and have a shadow effect on the untreated landscape by lowering the probability of burning and the potential fire size (Cochrane et al., 2012). As a result, the risk of a structure being destroyed, whether from a fire from within the development or outside the development, is significantly lower when defensible space is implemented.

However, long-term protection of the development and the surrounding area is dependent on the maintenance of fuel modification as even fire-safe designs can degrade over time. To alleviate this, the project will conduct regular assessments of the FMZs. The assessment of fuel modification zone condition and removal of dead and dying and undesirable species; as well as thinning as necessary to maintain specified plant spacing and fuel densities, shall be completed twice annually, once in early spring, once in late fall, and more often as needed for fire safety, as determined by a LACoFD fire code official during the interim period where FMZ is maintained on- or off-site. The individual homeowners shall be responsible for all fuel modification vegetation management on their lots in compliance with the plan and the LACoFD requirements. The project's HOA and/or Property Manager shall be responsible for all fuel modification/vegetation management for all common areas of the project site, including roadsides clearance and fuel modification zones. The project's HOA and/or Property Manager will assure private homeowner lots comply with the plan initially and on an ongoing basis. This will keep the FMZs and landscaped areas in a highly fire resistive condition free of accumulated flammable debris and plants.

Fuel treatments and defensible space do more than just protect structures. When they are a component of a place-based fire-hardened design, such as this project, they can not only serve to protect structures from wildfire but act

as a buffer for natural areas and surrounding communities. These features will further reduce the potential for wildfire in open space areas and potential impacts on surrounding communities.

3.5.2 Ignition Resistant/Non-combustible Construction

The WUI fire problem is largely structures lacking ignition resistant features (i.e., ember resistant vents, interior sprinklers); therefore, the best mitigation is to reduce the likelihood of building ignition occurring (Zhou, 2013). Structural characteristics play a large role in whether a building burns, which is important in WUI environments as structures also serve as fuel (Gorte, 2011). The benefit of structure-based mitigation is that it not only lowers the on-site risk but also lowers the risk of wildfire across a landscape (Mockrin et al., 2020). In WUI areas, this is because structures are also fuels that can spread a fire into open space. With the incorporation of ignition-resistant construction, the likelihood of structural ignition occurring within the project site is minimized. The project would provide new code compliant, ignition resistive structures, which lowers the threat from on-site fires impacting off-site areas as the structures themselves are very unlikely to act as fuel. While the project includes vent coverings to prevent ember penetration, the Project buildings would also include the installation of an NFPA 13D automatic interior fire sprinkler systems within all 341 age-restricted, detached single-family homes and an NFPA 13 automatic interior fire sprinkler systems within the recreation building. This is crucial in preventing off-site impacts as embers can also be generated by a structure fire and can be blown over the fuel modification into native fuels. Automatic sprinklers can isolate a fire to the area of origin, limit its ability to spread to the rest of the building, and even extinguish a fire before the responding firefighters arrive, thus damping the likelihood of ember production. The installation of interior fire sprinklers also reduce impacts on fire response capacity as the automatic sprinklers will allow firefighters to focus on reducing additional ignitions beyond the point of origin.

Structure design, such as the project's, is crucial in protecting an area against wind-driven fires. The project provides features that not only prevent fire intrusion but prevent structure fires from escaping into off-site areas. This allows the project to not only protect the immediate area but the surrounding environment.

3.5.3 Shelter-in-Place Capability

Sheltering-in-place is the practice of going or remaining indoors during or following an emergency event. This procedure is recommended if there is little time for the public to react to an incident and it is safer for the public to stay indoors for a short time rather than travel outdoors. According to common Emergency Operations Plan language, shelter-in-place is an approach that has been used and is actively contemplated for emergencies, including wildfires. Shelter-in-place advises people to stay secure at their current location.

Consistent with the project's approach, this tactic shall only be used if an evacuation will cause a higher potential for loss of life. Consideration should be given to assigning incident personnel to monitor the safety of citizens remaining in place. The concept of shelter-in-place is an available option in those instances where physical evacuation is impractical. Sheltering-in-place provides a safe haven within the impacted area.

This Fire Protection Plan provides significant evaluation and conclusions regarding the shelter-in-place capability of the project's buildings. Among other things, the project has been designed to include ignition-resistant structures with the use of ignition resistant construction materials, effective defensible space and fuel management zones, ember protection, and other redundant structure, infrastructure, building code, and water supply and flow

requirements established as containing adequate protective features to act as temporary shelters during wildfires. All the on-site structures could be utilized for temporary refuge during a wildfire.

Sheltering-in-place also has many advantages because it can be implemented immediately, allowing people to remain in their familiar surroundings, and providing individuals with everyday necessities such as telephone, radio, television, food, and clothing. However, the amount of time people can stay sheltered-in-place is dependent upon availability of food, water, medical care, utilities, and access to accurate and reliable information. It is not anticipated that any wildfire related shelter-in-place action would require longer than a few hours of on-site refuge.

The decision on whether to evacuate or shelter-in-place is carefully considered with the timing and nature of the incident. Sheltering-in-place is the preferred method of protection for people that are not directly impacted or in the direct path of a hazard. This will reduce congestion and transportation demand on the major transportation routes for those that have been directed to evacuate by police or fire personnel. Like with most new developments that incorporate ignition resistant construction, wide fuel modification zones, ember protection, and fire defensibility throughout, responding fire and law enforcement personnel will be able to direct persons to temporarily refuge on-site in the rare situation where shelter-in-place is determined to be safer than evacuating.

The project buildings will be constructed of ignition resistant construction. Because of the ignition resistant construction and fuel modification zone setbacks, sheltering-in-place is considered to be a safe option if a fast-moving wildfire precludes complete evacuation of the project site. The primary concern is anticipated to be with smoke and air quality rather than exposure to flames and heated air. Measures to safely refuge persons within the buildings and minimize smoke and air quality issues would be enacted in this scenario. For example, when wildfire ignites, it is common for HVAC systems to be turned off.

Project Design Feature: Most of the primary components of the project's layered fire protection system are required by Fire and Building codes, because they have been tested in the lab and in real-time wildfires and found to result in saved structures. They are worth listing because they have been proven effective for minimizing structural vulnerability to wildfire. They also make shelter-in-place possible as an evacuation contingency option when evacuation is not possible.

Even though current Building and Fire Codes require these measures, at one time, many of them were used as mitigation measures for buildings in fire hazard areas, because they were known to reduce structure vulnerability to wildfire. These measures were adopted into the 2007 California Building Code and have been retained and enhanced in code updates since then. The following project features are required for new development in fire hazard areas and would form the basis of the system to provide adequate access by emergency responders and provide the protection necessary to minimize structural ignitions:

- Application of the latest adopted ignition-resistant building codes.
- Exterior wall coverings are to be ignition resistant.
- For structures that achieve the minimum 100 feet of on-site fuel modification, all exterior windows, skylights, and exterior glazed door assemblies shall be constructed of multipaned glazing with a minimum of one tempered pane. All windows shall be UL listed, not of vinyl construction, and shall have a fire-resistant rating of not less than 20 minutes when tested according to NFPA 257/UL 263. **Code-exceeding dual pane dual tempered windows** shall be installed for structures facing the open space and naturally vegetated areas unable to achieve a minimum 100 feet of on-site fuel modification (this area includes the lots in the southeast portion of Planning Area 3), to mitigate for portions of the development. Dual pane

dual tempered windows shall also be UL listed, not of vinyl construction, and shall have a fire-resistant rating of not less than 40 minutes when tested according to NFPA 257/UL 263.

- Ember-resistant vents mesh screening should be between 1/16- and 1/8-inch noncombustible, corrosion resistant material (recommend Vulcan, BrandGuard, O'Hagin, or similar vents [see Appendices G and H]).
- The installation of an NFPA 13D automatic interior fire sprinkler systems within all single-family residential dwellings and an NFPA 13 automatic interior fire sprinkler systems within the recreation center structure.
- Boxed or no eaves or soffits.
- There would be no use of paper-faced insulation or combustible insulation in attics or other ventilated areas.
- There would be no use of plastic, vinyl, or light wood on the exterior.
- Rain gutters and downspouts shall be non-combustible. They would be designed to prevent the accumulation of, embers, leaf litter or debris, which can ignite roof edges, by requiring the installation of non-combustible debris covers/mesh over the top of rain gutters to minimize a common ignition point.
- All doors around the exterior of the structure, excluding the main entrance and sliding glass (sliders) doors, shall be self-closing and conform to the exterior door assembly standards addressed in CBC Chapter 7A, Section 708A.3 – Exterior Door.
- Garage doors shall resist the intrusion of embers by preventing gaps between doors and roof openings at the top, bottom, and sides of doors. Gaps cannot exceed 1/8 inch and shall be controlled by either weather stripping that meets ASTM D638 and ASTM G155, weather stripping shall also have a V-2 or better flammability rating, be constructed so that doors overlap onto jams and headers, or the garage door jams and headers are covered with metal flashing.
- There shall be no combustible awnings, canopies, or similar combustible overhangs.
- No combustible fences to be allowed within 5 feet of structures.
- All chimneys and other vents on heating appliances using liquid fuel (no solid fuel burning appliances), including outdoor fireplaces and permanent barbeques and grills, shall have spark arrestors that comply with the City and LACoFD Code. The code requires that openings would be between 1/16- and 1/8-inch and the screen would have comparable heat and corrosion resistance to 19-gauge galvanized or 24-gauge stainless steel. Arrestors would be visible from the ground.
- Modern infrastructure, access roads, and water delivery system.
- Maintained FMZs.

Notably, interior fire sprinklers, which would be provided in all structures (required by code since 2010), have an extremely high reliability track record (NFPA 2021) of controlling fire in 96% of reported fires, and statistics indicate that fires in structures with sprinklers resulted in 82% lower property damage and 68% lower loss of life (Hall 2013). NFPA 13, 13R, and/or 13D fire sprinklers are designed for structure protection and life safety. For wildland fire defense, should embers succeed in entering a structure, sprinklers provide an additional layer of life safety and structure protection.

Sheltering-In-Place as an Active Emergency Option

Sheltering-in-place or providing temporary refuge when evacuation is considered undesirable is not a new idea. Sheltering-in-place has been a useful tool in the emergency management toolbox since the 1950's. In some wildfire scenarios, temporarily sheltering in a protected structure is safer than evacuating. Huntzinger (2010) states that: "If sheltering in place can provide the community with the same level of protection from an emergency incident as

mass evacuation, this will be the recommended practice to use.” Many civilian deaths have occurred when the population evacuated late and was exposed to wildfire on unprotected roadways (Braun, 2002, CFA 2004). By contrast, fire hardened communities/projects that have implemented similar fire protection, setback, and building standards have fared well in fire events, making them suitable for temporary shelter. Developments constructed in accordance with modern fire-safe development standards also survived the 2003 Simi Fire, the 2008 Freeway Complex Fire, and the 2020 Silverado Fire without a single building lost. Nasiatke (2003) points out that another advantage to sheltering in place in an appropriately protected location is that there would be a substantial reduction in the number of evacuees that would need to be managed, allowing those evacuees at greater risk (i.e., in older, less protected communities) to more quickly evacuate.

3.5.4 Wildfire Risk Awareness Education

The project includes an education awareness program that is a key piece in wildfire prevention in the area (Steffey et al., 2020). This program would provide wildfire information for the community and create greater risk awareness for residents. The wildfire education program would be facilitated by the HOA, property manager, business owners, or similar entity and would disclose the potential wildfire risk and the requirements of this FPP. The educational program would also include information regarding the necessary landscape maintenance and structural-based fire protection features. Having ongoing education included for the project creates a heightened level of wildfire risk awareness and fire protection measures. This benefits both the project development community and the surrounding areas as people would be more aware of the wildfire risk and potential impacts. Further, it decreases the likelihood the project residents, employees, and other users would cause an uncontrolled ignition and they would be aware of what steps to take if they observe an ignition. As such the impact on off-site areas would be further lowered by reducing the probability of ignition.

As described above it is not as simple to say development in areas with high fire hazards will equate to increased wildfire risk. It is possible to develop in these areas when fire protection is incorporated into project design and create a site that is not only hardened against fire but designed to prevent fires. The dual benefit of creating a development that can prevent a fire is that it offers protection to the surrounding communities and the environment. The requirements and recommendations outlined in the FPP have been designed specifically for the proposed construction in the project’s location and can significantly reduce the potential threat to off-site areas.

The Firewise USA program administered by NFPA is a certification program for communities to gain recognition for the fire-wise design and maintenance of their community. Firewise USA began in 2019 with seven sites that were challenged to improve the fire resilience of their communities through a focused approach to active wildfire risk reduction. This is done through a collaborative framework created to empower neighbors to get organized and take action to reduce wildfire risk at a local level. The program has grown to include over 1.5 million residents living in Firewise USA communities (Firewise USA, 2024). The insurance industry, due to Department of Insurance Regulation #REG-2020-00015, is required to recognize the Firewise certification and consider it when it comes to determining if a community is insurable; cuts to insurance premiums have been made based on this certification. Given the established framework of Firewise USA, its direct mention in regulatory language, and its existing adoption by multiple insurance companies, it can be reasonably anticipated that more companies will require the same certification from customers that attempt to pursue discounted policies.

There are several requirements to become a Firewise USA community and multiple living documents must be prepared. Firewise USA communities must have a minimum of 8 dwelling units and a maximum of 2,500, meaning

the proposed Project, in its entirety, would be able to participate in the program (Firewise USA, 2024). In order to be recognized as a Firewise USA community, the following requirements shall be followed by the Belcaro HOA¹³:

1. **Form a board or committee:** Create a board or committee of volunteers to represent the community, made up of residents and partners such as a representative of the local fire department would first need to be formed. A resident leader will need to be identified who will be the program point of contact. The board or committee is responsible for defining the boundaries of the site and determines the number of individual single-family dwelling units within the community or site. As mentioned above, in order to be recognized as a Firewise site, the community must have a minimum of 8 dwelling units and a maximum of 2,500. (Firewise USA, 2024).
2. **Create a Firewise USA portal account:** Create a Firewise USA account and submit an application to your state Firewise USA liaison. (Firewise USA, 2024).
3. **Obtain a wildfire risk assessment:** The board or committee will collaborate with their local wildfire expert or a 3rd-party consultant such as Dudek to complete a community wildfire risk assessment (CWRA). The assessment should be a community-wide view that identifies areas of successful wildfire risk reduction and where improvements could be made. Emphasis should be on the general conditions of homes and related home ignition zones. The CWRA is a living document and would need to be updated at least every five years. (Firewise USA, 2024).
4. **Develop an action plan:** The board or committee will use the CWRA to create a three-year action plan, broken down by year, that identifies and prioritizes actions to reduce ignition to homes. These can include community-wide investments along with suggested homeowner actions and education activities that participants will strive to complete annually, or over a period of multiple years. The action plan document is required to be updated at least every three years. As circumstances change (e.g. completing activities, experiencing a fire or natural disaster, new construction in community, etc.), the action plan may need to be updated more frequently. (Firewise USA, 2024).
5. **Host an educational event:** Host at least one event per year to educate the community about wildfire risk reduction. (Firewise USA, 2024).
6. **Meet the minimum investment:** Every year, neighbors will need to complete educational and risk reduction actions identified in the plan which go towards your site's annual reporting efforts. At a minimum, each site is required to annually invest the equivalent of one (1) volunteer hour per dwelling unit in wildfire risk reduction actions. If your site identifies 100 homes within its boundary, then 100 hours of work or the monetary equivalent, based on the independent sector value of volunteer time, need to be completed for that year. (Firewise USA, 2024).
7. **Submit an annual renewal:** Maintain your Firewise USA status. (Firewise USA, 2024).

In addition to the Firewise certification, the community can hire a qualified individual such as Dudek to assess the community regularly to document compliance with not only the fire code but the insurance industry minimums. Wildfire Risk Assessments have proven valuable in helping communities maintain fire insurance or even apply for

¹³ How to become a Firewise USA site. <https://www.nfpa.org/education-and-research/wildfire/firewise-usa/become-a-firewise-usa-site>

reduced premiums, given that the insurance industry evaluates fire resistant features above and beyond what the fire code requires.

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4 Modeling: Anticipated Fire Behavior for Worst-Case Fire Conditions

4.1 Fire Behavior Modeling

Fire behavior modeling was conducted to document the type and intensity of a fire that would be expected adjacent Following field data collection efforts and available data analysis, fire behavior modeling was conducted to document the type and intensity of the fire that would be expected adjacent to the Project Site, given characteristic site features such as topography, vegetation, and climate/weather during “worst-case” fire conditions (e.g., during Santa Ana winds). For planning purposes, the average worst-case fire behavior, which generally refers to conditions where fires start easily from all causes, spread rapidly, and exhibit extreme erratic behavior, involving low relative humidity, strong winds, and unstable air, leading to long flame lengths and high intensity (refers to the average fire behavior of the 97th percentile), is the most useful information for conservative fuel modification design. Dudek utilized BehavePlus software package version 6 (Andrews, Bevins, and Seli 2008) to analyze potential fire behavior. A discussion of fire behavior modeling is presented in Appendix B, Fire Behavior Modeling.

4.1.1 Fire Behavior Modeling Analysis

An analysis was conducted to evaluate fire behavior variables and to objectively predict flame lengths, intensities, and spread rates for five modeling scenarios¹⁴. These fire scenarios incorporated observed fuel types representing the dominant vegetation representative of the Project Site and adjacent land, in addition to slope gradients, wind, and fuel moisture values. Modeling scenario locations were selected to better understand different fire behavior that may be experienced on or adjacent to the Project Site.

Field data collection and fire behavior modeling was completed by Dudek to document the predicted type and intensity of fire that would be expected on this site given characteristic site features such as topography, vegetation, and weather. Fire behavior modeling is conducted based on the existing conditions. Understanding the anticipated fire behavior on the site pre-construction provides insight into how to best address the risk that the undeveloped areas present. Naturally, the areas that are converted to urban landscapes will result in a reduced fire risk and reduced fire intensity. Areas subject to hardscape and irrigated landscaping post-development can be expected to have flame lengths and intensity well below areas on the periphery of the community, the wildland urban interface.

Vegetation types were derived from a site visit that was conducted on June 25, 2024, by a Dudek Fire Protection Planner. The fuel bed of the modeled area generally consists of shrublands and grasslands of varying fuel load intensities with the fuel loading onsite being lesser than the mountainsides to the east. These fuel types can produce flying embers that may affect the project; however, defenses will be built into the proposed development to prevent ember penetration. The fuel bed of the Project site was characterized into fuel models that are used as inputs in BehavePlus to predict the fire behavior of the Project site. Fire behavior can be predicted largely by analyzing the characteristics of these fuels. Fire behavior is affected by seven principal fuel characteristics: fuel loading, size and shape, compactness, horizontal continuity, vertical arrangement, moisture content, and chemical

¹⁴ Each scenario utilizes a different set of modeling input variables including location, fuel type (vegetation), fuel moisture, weather (wind), topography (slope and aspect), and other related factors.

properties. The seven fuel characteristics help define the 13 standard fire behavior fuel models¹⁵ and the five custom fuel models developed for Southern California¹⁶. In addition, the aforementioned fuel characteristics were utilized in the recent development of 40 new fire behavior fuel models¹⁷ developed for use in BehavePlus modeling efforts. These new models attempt to improve the accuracy of the standard 13 fuel models outside of severe fire season conditions, and to allow for the simulation of fuel treatment prescriptions. Fuel Models in fire behavior are standardized sets of fuel bed characteristics used to predict how wildfires might spread and behave. According to the model classifications, fuel models used in BehavePlus have been classified into four groups, based upon fuel loading (tons/acre), fuel height, and surface to volume ratio. Observation of the fuels in the field (on site) determines which fuel models should be applied in BehavePlus. Further descriptions of the Standard 13 fuel models, five custom Southern California fuel models, and 40 new fuel models are described in the Project’s Appendix B - Fire Behavior Modeling Summary Report. Table 5 provides a description of the existing fuel models observed in the vicinity of the site that were subsequently used in the analysis for this Project. A total of three fire modeling scenarios were completed for the proposed Project area. These modeling scenario locations were selected based on northern, eastern, and southwestern sides of the Project site.

Table 5. Existing Fuel Model Characteristics

Fuel Model Assignment	Vegetation Description	Location	Fuel Bed Depth (Feet)
GR2	Low-load, dry climate grass	Represents the non-native grasses within the Project site.	1.0
GR4	Moderate-load, dry climate grass	Represents the higher load grasslands on the mountainsides to the east of the Project	2.0
GS1	Low-load, dry climate grass-shrub	Represents the sparse grass-shrub vegetation of the Santa Clarita Riverbed.	0.9
GS2	Moderate-load, dry climate grass-shrub	Represents the areas with a higher shrub component within the Project site.	1.5
SH5	High-load, dry climates	Represents the larger shrubs of the mountainsides to the east of the Project site.	6.0

Table 6 summarizes the weather and wind input variables used in the BehavePlus modeling process. Weather and wind input variables were determined using local Remote Automated Weather Station (RAWS) data. Since there is not a RAWS station in close proximity to the Project site, a special interest group was created within Fire Family Plus that creates a weighted average of multiple nearby RAWS stations. The four stations included in the special interest group were Saugus, Newhall Pass, Camp 9, and Acton. The stations were weighted based on their proximity to the Project, elevation, aspect, and relative location to dominant or weather-altering geographic features. The RAWS fuel moisture and wind speed data were processed utilizing the Fire Family Plus software package to determine atypical (97th percentile) and typical (50th percentile) weather conditions. The 97th percentile weather conditions evaluated data from the RAWS between August 1 through November 30 for each year between 2000 and 2023. The 50th

¹⁵ Anderson, Hal E. 1982. Aids to Determining Fuel Models for Estimating Fire Behavior. USDA Forest Service Gen. Tech. Report INT-122. Intermountain Forest and Range Experiment Station, Ogden, UT.
¹⁶ Weise, D.R. and J. Regelbrugge. 1997. Recent chaparral fuel modeling efforts. Prescribed Fire and Effects Research Unit, Riverside Fire Laboratory, Pacific Southwest Research Station. 5p.
¹⁷ Scott, Joe H. and Robert E. Burgan. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. Gen. Tech. Rep. RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

percentile weather conditions evaluated data from the RAWS between June 1 through September 30 for each year between 2000 and 2023. Specifically, the 50th percentile represents the expected baseline fire behavior during less extreme on-shore wind conditions, while the 97th percentile represents the extreme fire danger.

Table 6. Variables Used for Fire Behavior Modeling

Model Variable	Summer Weather (50 th Percentile)	Peak Weather (97 th Percentile)
Fuel Models	GR2, GS2	GR2, GR4, GS2, SH5
1 h fuel moisture	5%	1%
10 h fuel moisture	6%	2%
100 h fuel moisture	10%	5%
Live herbaceous moisture	38%	30%
Live woody moisture	76%	60%
20 ft. wind speed	11 mph (sustained winds)	19 mph (sustained winds); wind gusts of 50 mph
Wind Directions from north (degrees)	225	0 to 90
Wind adjustment factor	0.4	0.4
Slope	10%	1 to 20%

Source: Special interest group consisting of Saugus, Newhall Pass, Camp 9, and Acton RAWS.

Notes:

- 1 Fuel moisture is the moisture content of live and dead vegetation. 1- hour fuel moisture is for vegetation less than 0.25 inches in diameter that react to atmospheric changes within an hour. 10-hour fuel moisture is for vegetation from 0.25 inches to 1 inch that react to atmospheric changes within 10 hours. 100-hour fuel moisture is for vegetation from 1 inch to 3 inches in diameter that react to atmospheric changes within 100 hours.
- 2 20-foot wind speed is the standard height above vegetation for measuring open wind speed.
- 3 The use of 50 MPH wind gusts was determined by the max wind gusts recorded at the RAWS station and weather data from nearby historic wildfires.

4.2 Wildfire Behavior Summary

As mentioned, the BehavePlus fire behavior modeling software package was utilized in evaluating anticipated fire behavior adjacent to the proposed Project site. Three scenarios were completed for the existing project site conditions. The results of the modeling effort included anticipated values for surface fires flame length (feet), rate of spread ((chains per hour and then converted to mph), fireline intensity (Btu/ft/s), and spotting distance (miles). The aforementioned fire behavior variables are an important component in understanding fire risk and fire agency response capabilities. Flame length, the length of the flame of a spreading surface fire within the flaming front, is measured from midway in the active flaming combustion zone to the average tip of the flames (Andrews, Bevins, and Seli 2008). Fireline intensity is a measure of heat output from the flaming front, and also affects the potential for a surface fire to transition to a crown fire. Fire spread rate represents the speed at which the fire progresses through surface fuels and is another important variable in initial attack and fire suppression efforts (Rothermel and Rinehart 1983). Spotting distance is the distance a firebrand or ember can travel down wind and ignite receptive fuel beds. Three fire modeling scenario locations were selected to better understand the different fire behavior that may be experienced on or adjacent the site based on slope and fuel conditions; these fire scenarios are explained in more detail below:

Fire Scenario Locations and Descriptions (Existing Conditions):

- **Scenario 1:** A fall, off-shore fire (97th percentile weather condition) burning through the Sanat Clara Riverbed towards the Project site. A fire is unlikely to occur and spread through this area due to the horizontal discontinuity of fuels. If a fire were to spread, it would be under windy conditions such as this that enables the fire to spread from plant to plant. Given that it is a riverbed, the area is relatively flat with only low-load grass-shrub vegetation. Such a fire could originate from arson, unhoused populations, a vehicle fire along California State Route 14, or from a structure fire from the nearby RV and self-storage.
- **Scenario 2:** A fall, off-shore fire (97th percentile weather condition) burning down the mountainsides to the east of the Project. Such a scenario would likely involve a wildfire which originated elsewhere spreading towards the Project. Such a fire would burn down the moderately steep slopes of the mountainsides through the moderate-load grasses and high-load shrubs towards the Project site. The varied topography of this area may also influence wind speeds leading to micro-variations that could amplify fire behavior.
- **Scenario 3:** A summer, on-shore fire (50th percentile weather condition) burning towards the Project site from the southwest. The vegetation in this area consists of moderate-load grass-shrub vegetation and it is moderately sloped downhill towards the Project site. The fire would likely originate from the low-density residential development in this area either from an equipment, vehicle, or structure fire.

4.3 Fire Behavior Modeling Results

The results presented in Table 7 depict values based on inputs to the BehavePlus software and are not intended to capture changing fire behavior as it moves across a landscape. Changes in slope, weather, or pockets of different fuel types are not accounted for in this analysis. For planning purposes, the averaged worst-case fire behavior is the most useful information for conservative fuel modification design. Model results should be used as a basis for planning only, as actual fire behavior for a given location will be affected by many factors, including unique weather patterns, small-scale topographic variations, or changing vegetation patterns.

As presented in Table 7 and shown in Figure 8, Fire Behavior Map, the greatest fire threat is the eastern side of the property that is exposed to a sizeable expanse of undeveloped, naturally vegetated lands that extend to the San Gabriel Mountains and Angeles National Forest (Scenario 2). There is existing development on all other sides of the Project site and though a fire could possibly approach from the Santa Clarita Riverbed or the lower density residential development to the southwest, the area to the east would be the greatest fire hazard. It should also be noted additional development is being proposed in the area directly east of the proposed Project which would provide an additional buffer between the Belcaro at Sand Canyon development and natural vegetation to the east.

Given the high fuel loads, lack of development, steep slopes, and alignment with strong, Santa Ana winds, a fire moving towards the Project from the east as modeled in Scenario 2 would be the greatest fire threat. Such a fire would likely originate elsewhere within the San Gabriel Mountain Range and could stem from any number of ignition sources. The fire, driven by high winds, would burn downhill through the moderate-load grass and high-load shrub, chaparral fuel beds towards the Project site. Once on said slopes, the fire would exhibit extreme fire behavior (up to 26.2-foot flame lengths during sustained winds and 44.5-foot flame lengths during gusts) and an extreme rate

of spread (2.2 mph during sustained winds) as it burns through the high-load chaparral fuels. Within the moderate-load grass fuel beds, the fire would also exhibit extreme fire behavior (up to 20.0-foot flame lengths during sustained winds and 38.5-foot flame lengths during gusts) and an extreme rate of spread (4.0 mph during sustained winds). Upon nearing the bottom of the slope, the fire would reach the proposed Project site where the fire behavior would be reduced (10.7-foot flame lengths during sustained winds and 18.0-20.4-foot flame lengths during gusts) along with the rate of spread (1.0-2.0 mph during sustained winds and 4.2-6.2 mph during gusts).

While Scenario 1 was modeled under extreme weather conditions exactly like Scenario 2, there is reduced fuel loading in the Santa Clarita Riverbed and onsite relative to the mountains east of the proposed Project site. Within the riverbed, fire could likely only spread under windy conditions such as those modeled to enable spread between plants. Vegetation within the riverbed would produce moderate flame lengths (up to 7.5 feet during sustained winds and up to 14.0 feet during 50 mph gusts) and move at a very high rate of spread (up to 0.8 mph during sustained winds and up to 3.0 mph during 50 mph gusts). Upon exiting the riverbed and onto the proposed Project site, fire behavior would slightly amplify (up to 10.9-foot flame lengths during sustained winds and up to 20.5 feet during 50 mph gusts) with very high to extreme rates of spread (1.0 to 2.1 mph during sustained winds and 4.2 to 6.2 mph during 50 mph gusts).

Unlike Scenarios 1 and 2, Scenario 3 was modeled under average, onshore conditions. Such a fire would approach the proposed Project site from the southwest and would likely originate from an equipment, vehicle, or residential fire within said low-density residential area. The fuels in this area resemble those onsite and thus the resulting fire behavior would be similar between the two areas. The non-native grasslands and sage scrub vegetation would produce moderate flame lengths of 5.0 to 5.4 feet with high rates of spread between 0.3 and 0.5 mph.

When evaluating post-project conditions, it should be noted that the vegetation outside of the proposed Project site would remain the same. As previously mentioned, the area to the east is also being proposed for development and should it be built, it would provide an additional buffer between the proposed Project and offsite fuels. The portion of the Project site that would change, the landscaping and fuel modification zones were modeled again to display the reduced fuels around the planned community (Table 8). Fuel Modification Zones (FMZs) are designed to provide vegetation buffers that gradually reduce fire intensity and flame lengths from advancing fire by strategically placing thinning zones, restricted vegetation zones, and irrigated zones adjacent to each other on the perimeter of the WUI exposed structures. Additional details on the Project's FMZs is discussed further in section 6.5 of this FPP. A fire burning through the fuel modification zone (post-project conditions) during an extreme weather event (Scenario 1), would reduce in intensity as it progressed through the distinct zones. Within the furthest zone, Zone C, there would be moderate to very high flame lengths (7.4 feet under sustained winds and 14.0 feet under 50 mph gusts) and very high to extreme rates of spread (0.7 mph under sustained winds and 3.0 mph during 50 mph gusts). Within Zone B, there would be moderate flame lengths up to 4.0 feet and a very high spread rate of 0.7 mph. By the time the fire reached Zone A, there would only be low flame lengths of 2.1 to 3.0 feet and a moderate rate of spread of 0.1 to 0.2 mph.

A fire burning within the fuel modification zone of the proposed project under the extreme conditions of Scenario 1 could be compared to one burning under average, on-shore weather conditions as modeled in Scenario 2. Upon reaching Zone C, the fire would exhibit low flame lengths of 3.6 feet and a moderate rate of spread of 0.2 mph. Within Zone C, flame lengths would drop to 2.1 feet while the rate of spread would be similar. If the fire were to reach Zone A, there would be only 1.1-foot flame lengths and a very low rate of spread of less than 0.1 mph. The reduced fire behavior within the up to 200-foot-wide fuel modification zone, the inclusion of a 5-foot non-combustible Zone 0 around all structures, the ignition resistance provided by California Building Code Chapter 7A

standards, and additional features outlined in the FPP would reduce the fire hazard associated with this community when compared to the existing conditions.

Table 7: RAWs BehavePlus Fire Behavior Model Results – Existing Conditions

Fuel Model	Flame Length ¹ (feet)	Spread Rate ¹ (mph ²)	Fireline Intensity ¹ (Btu/ft/s)	Spot Fire ¹ (miles)
Scenario 1: 1% slope; Fall off-shore extreme (97th percentile), 19 mph winds, 50 mph gusts from north				
Low-load grasses (GR2)	10.9 (18.0)	2.1 (6.2)	1,591 (1,591)	0.5 (1.3)
Low-load grass-shrub (GS1)	7.5 (14.0)	0.8 (3.0)	1,919 (1,919)	0.4 (1.1)
Moderate-load grass-shrub (GS2)	10.8 (20.5)	1.0 (4.2)	3,113 (3,113)	0.5 (1.4)
Scenario 2: 20% slope; Fall off-shore extreme (97th percentile), 19 mph winds, 50 mph gusts from east				
Low-load grasses (GR2)	10.7 (18.0)	2.0 (6.2)	1,591 (1,591)	0.5 (1.3)
Moderate-load grasses (GR4)	20.0 (38.5)	4.0 (16.6)	3,095 (3,095)	0.7 (2.2)
Moderate-load grass-shrub (GS2)	10.7 (20.4)	1.0 (4.2)	3,113 (3,113)	0.5 (1.4)
High-load shrubs (SH5)	26.2 (44.5)	2.2 (6.7)	7,202 (7,202)	0.9 (2.4)
Scenario 3: 10% slope; Summer on-shore average (50th percentile), 11 mph winds from southwest				
Low-load grasses (GR2)	5.0	0.5	1,135	0.2
Moderate-load grass-shrub (GS2)	5.3	0.3	2,314	0.2

Note:

1. Wind-driven surface fire.
2. MPH=miles per hour
3. Outputs in parenthesis represent peak gusts of 50 mph.

Table 8: RAWs BehavePlus Fire Behavior Model Results – Post-Project Conditions

Fuel Model	Flame Length ¹ (feet)	Spread Rate ¹ (mph ²)	Fireline Intensity ¹ (Btu/ft/s)	Spot Fire ¹ (miles)
Scenario 1: 20% slope; Fall off-shore extreme (97th percentile), 19 mph winds, 50 mph gusts from east				
FMZ Zone A: Setback Zone	2.1 (3.0)	0.1 (0.2)	1,286 (1,286)	0.2 (0.4)
FMZ Zone B: Irrigated Zone	4.0 (4.0)	0.7 (0.7)	602 (602)	0.2 (0.5)
FMZ Zone C: Thinning Zone	7.4 (14.0)	0.7 (3.0)	1,919 (1,919)	0.4 (1.1)
Scenario 2: 10% slope; Summer on-shore average (50th percentile), 11 mph winds from southwest				
FMZ Zone A: Setback Zone	1.1	<0.1	973	0.1
FMZ Zone B: Irrigated Zone	2.1	0.2	426	0.1
FMZ Zone C: Thinning Zone	3.6	0.2	1,423	0.2

Note:

1. Wind-driven surface fire.
2. MPH=miles per hour
3. Outputs in parenthesis represent peak gusts of 50 mph.

4.4 Project Area Fire Risk Assessment

Wildland fires are a common natural hazard in California with a long and extensive history. Southern California landscapes include a diverse range of plant communities, including vast tracts of shrublands and grasslands, like those found on and adjacent to the Project Site. Wildfire in this Mediterranean-type ecosystem ultimately affects the structure and functions of vegetation communities and will continue to have a substantial and recurring role

(Rochester et al. 2010). Supporting this are the facts that 1) native landscapes, from forests to grasslands, become highly flammable each fall, and 2) the climate of southern California has been characterized by fire climatologists as the worst fire climate in the United States (Keeley 2004) with high winds (Santa Ana) occurring during autumn after a six-month drought period each year. Based on this research, the anticipated growing population expanding into WUI areas, and the regions' fire history, it can be anticipated that periodic wildfire may continue to start on, burn onto, or spot into the site. The most common type of fire anticipated in the vicinity of the Project Area is a wind-driven fire from the north/northeast or east/southeast, moving through the chaparral and sage scrub on the adjacent lands.

With the conversion of the landscape to hardscape and ignition-resistant development, wildfires may still encroach upon and drop embers on the Project Site but would not be expected to burn through the Site due to the decrease in available urban fuels. Studies indicate that even with older developments that lacked the fire protection features provided as part of the Project, wildfires declined steadily over time (Syphard, et. al., 2007 and 2013) and further, the acreage burned remained relatively constant, even though the number of ignitions temporarily increased. This is due to the conversion of landscapes to ignition resistant, maintained areas, more human monitoring areas resulting in early fire detection and discouragement of arson, and fast response from the fire suppression resources that are located within these developing areas.

Therefore, it will be important that the latest fire protection technologies, developed through intensive research and real-world wildfire observations and findings by fire professionals, for both ignition resistant construction and for creating defensible space in the ever-expanding WUI areas, are implemented and enforced. The Project, once developed, would not facilitate wildfire spread and would reduce projected flame lengths to levels that would be manageable by firefighting resources for protecting the site's structures, especially given the ignition resistance of the structures and the planned ongoing maintenance of the entire site landscape.

The Project would implement the latest fire protection measures, including fuel modification along the perimeter edges of the development. In addition, the up to 200-foot-wide FMZ widths for the site would be about eight times wider than the longest calculated flame length conditions for portions of the proposed developed area that abut chamise chaparral and sage scrub plant communities.

Given the climatic, vegetative, topographic characteristics, and local fire history of the area, the Project Site, once developed, is expected to be continually subject to periodic wildfires that may start on, burn onto, or spot into the site. While there is the potential for off-site wildfire encroaching on, or showering embers on the Project Site is considered moderate, but the risk of ignition from such encroachments or ember showers is considered low based on the type of construction and fire protection features, including the 200-foot-wide FMZ that will be provided for the structures.

While it is true that humans are the cause of most fires in California, there is no data available that links increases in wildfires with the development of ignition-resistant communities. The Project would include a robust fire protection system, as detailed in the Project's FPP and discussed in Section 5 Buildings, Infrastructure, and Defensible Space, and Section 8 Summary of Primary Code Features, Primary Code-Exceeding Features, and Recommended Project Design Features. This same robust fire protection system provides protections from on-site fire spreading to off-site vegetation. Accidental fires within the landscape or structures in the Project would have limited ability to spread. The landscape throughout the Project and on its perimeter would be highly maintained and much of it irrigated, which further reduces its ignition potential. Structures would be highly ignition resistant on the exterior and the interiors will be protected with automatic sprinkler systems, which have a very high success rate for confining fires or extinguishing them. Although

power outages can occur without notice, the interior fire sprinkler system within the residential structures are designed to be heat-activated and do not rely on electricity for their primary function. The design of an automatic interior fire sprinkler system contains heat-sensitive materials that break or melt when exposed to high heat temperatures from a fire, releasing water (DynaFire, 2025). The Project will be a fire-adapted community with a strong resident outreach program that raises fire awareness among its residents.

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Table 1. Existing Fuel Model Characteristics

Fuel Model Assignment	Vegetation Description	Location	Fuel Bed Depth (Feet)
GR2	Low-load, dry climate grass	Represents the non-native grasses within the Project site.	1.0
GR4	Moderate-load, dry climate grass	Represents the higher load grasslands on the mountainsides to the east of the Project	2.0
GS1	Low-load, dry climate grass-shrub	Represents the sparse grass-shrub vegetation of the Santa Clara Riverbed.	0.9
GS2	Moderate-load, dry climate grass-shrub	Represents the areas with a higher shrub component within the Project site.	1.5
SH5	High-load, dry climates	Represents the larger shrubs of the mountainsides to the east of the Project site.	6.0

Table 2: Variables Used for Fire Behavior Modeling

Model Variable	Summer Weather (50 th Percentile)	Peak Weather (97 th Percentile)
Fuel Models	GR2, GS2	GR2, GR4, GS2, SH5
1 h fuel moisture	5%	1%
10 h fuel moisture	6%	2%
100 h fuel moisture	10%	5%
Live herbaceous moisture	38%	30%
Live woody moisture	76%	60%
20 ft. wind speed	11 mph (sustained winds)	19 mph (sustained winds); wind gusts of 50 mph
Wind Directions from north (degrees)	225	0 to 90
Wind adjustment factor	0.4	0.4
Slope	10%	1 to 20%

Table 3: RAWS BehavePlus Fire Behavior Model Results – Existing Conditions

Fuel Model	Flame Length ¹ (feet)	Spread Rate ¹ (mph ²)	Fireline Intensity ¹ (Btu/ft/s)	Spot Fire ¹ (miles)
Scenario 1: 1% slope; Fall off-shore extreme (97th percentile), 19 mph winds, 50 mph gusts from north				
Low-load grasses (GR2)	10.9 (18.0)	2.1 (6.2)	1,591 (1,591)	0.5 (1.3)
Low-load grass-shrub (GS1)	7.5 (14.0)	0.8 (3.0)	1,919 (1,919)	0.4 (1.1)
Moderate-load grass-shrub (GS2)	10.8 (20.5)	1.0 (4.2)	3,113 (3,113)	0.5 (1.4)
Scenario 2: 20% slope; Fall off-shore extreme (97th percentile), 19 mph winds, 50 mph gusts from east				
Low-load grasses (GR2)	10.7 (18.0)	2.0 (6.2)	1,591 (1,591)	0.5 (1.3)
Moderate-load grasses (GR4)	20.0 (38.5)	4.0 (16.6)	3,095 (3,095)	0.7 (2.2)
Moderate-load grass-shrub (GS2)	10.7 (20.4)	1.0 (4.2)	3,113 (3,113)	0.5 (1.4)
High-load shrubs (SH5)	26.2 (44.5)	2.2 (6.7)	7,202 (7,202)	0.9 (2.4)
Scenario 3: 10% slope; Summer on-shore average (50th percentile), 11 mph winds from southwest				
Low-load grasses (GR2)	5.0	0.5	1,135	0.2
Moderate-load grass-shrub (GS2)	5.3	0.3	2,314	0.2

Note:
 1. Wind-driven surface fire.
 2. MPH=miles per hour
 3. Outputs in parenthesis represent peak gusts of 50 mph.

Table 4: RAWS BehavePlus Fire Behavior Model Results – Post-Project Conditions

Fuel Model	Flame Length ¹ (feet)	Spread Rate ¹ (mph ²)	Fireline Intensity ¹ (Btu/ft/s)	Spot Fire ¹ (miles)
Scenario 1: 20% slope; Fall off-shore extreme (97th percentile), 19 mph winds, 50 mph gusts from east				
FMZ Zone A: Setback Zone	2.1 (3.0)	0.1 (0.2)	1,286 (1,286)	0.2 (0.4)
FMZ Zone B: Irrigated Zone	4.0 (4.0)	0.7 (0.7)	602 (602)	0.2 (0.5)
FMZ Zone C: Thinning Zone	7.4 (14.0)	0.7 (3.0)	1,919 (1,919)	0.4 (1.1)
Scenario 2: 10% slope; Summer on-shore average (50th percentile), 11 mph winds from southwest				
FMZ Zone A: Setback Zone	1.1	<0.1	973	0.1
FMZ Zone B: Irrigated Zone	2.1	0.2	426	0.1
FMZ Zone C: Thinning Zone	3.6	0.2	1,423	0.2

Note:
 1. Wind-driven surface fire.
 2. MPH=miles per hour
 3. Outputs in parenthesis represent peak gusts of 50 mph.

 Project Boundary



SOURCE: GOOGLE EARTH AERIAL IMAGERY SERVICE

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5 Emergency Response and Service

The following sections analyze the Project in terms of current LACoFD Fire Service capabilities and resources to provide Fire Protection and Emergency Services. The analysis that follows examines the ability of the existing LACoFD fire stations to adequately serve the Project Site. Response times were evaluated using Project build-out conditions. It was assumed that phased construction would include access roads to the newly constructed buildings and that the shortest access route to those structures would be utilized.

5.1 Emergency Response and Fire Facilities

The Project is located within the LACoFD jurisdictional response area, which includes the Santa Clarita Valley where the project would be situated. Regionally, LACoFD provides fire, emergency medical, and rescue services from 176 stations spanning 2,311 square miles consisting of 60 district cities and all unincorporated communities with approximately 1,295,894 housing units and 3,961,285 residents (LACoFD, 2024). The Project Site lies within the Northern Operations Bureau, Division 3. Fire Station 132 would provide an initial response to the Project; however, Stations 123, 107, 150, and 128 are available to provide a secondary response to the Project, if needed. The location of the closest fire stations to the Project site can be found using the interactive Station Locator Map found on the LACoFD’s website.¹⁸ These existing stations were analyzed herein due to their proximity to the Project Site. Table 9 provides a summary of the LACoFD fire and medical delivery system for Fire Stations 132, 123, 107, 150, and 128.

Table 9. Closest Responding LACoFD Fire Stations Summary

Station	Location	Equipment
Station 132	29310 Sand Canyon Rd, Canyon Country, CA 91387	Engine 132 Engine 4132 Patrol 132 Engine 532
Station 123	26321 Sand Canyon Rd, Santa Clarita, CA 91387	Engine 123 Patrol 123 Engine 5123
Station 107	18239 Soledad Canyon Rd, Canyon Country, CA 91387	Engine 107 Squad 107 Squad 5107
Station 150	19190 Golden Valley Rd, Canyon Country, CA 91387	Engine 150 Haz Mat 150 Utility 22 Engine 5150 Command 1
Station 128	28450 Whites Canyon Rd, Santa Clarita, CA 91351	Engine 128 Patrol 128 WT128 Patrol 5128

¹⁸ LACoFD’s Station locator Map: <https://locator.lacounty.gov/fire/Location/3045197/los-angeles-county-fire-department--station-132>

5.2 Emergency Response Travel Time Coverage

Within the area’s emergency services system, fire and emergency medical services are also provided by other LACoFD Fire Stations. Generally, each agency is responsible for structural fire protection and wildland fire protection within their area of responsibility. However, mutual aid agreements enable non-lead fire agencies to respond to fire emergencies outside their district boundaries. In the Project area, fire agencies cooperate under existing regional and statewide master mutual aid agreements. These include the Los Angeles County Operational Area Mutual Aid Plan, the California Fire Master Mutual Aid Agreement, California Master Cooperative Wildland Fire Management and Stafford Act Response Agreement, California Fire Assistance Agreement, and Public Resources Code 4129.

While additional resources outside of the Los Angeles County Fire Department could respond to an emergency at the Project via existing mutual aid agreements, none are closer than the LACoFD stations listed above in Table 9. The nearest, non-LACoFD stations include Ventura County Fire Station 28 in Piru, California approximately 26 miles to the west, Los Angeles Fire Department Station 91 south of Newhall Pass approximately 15 miles to the south, and the United States Forest Service Bear Divide Fire Station approximately 7 miles to the south. These distances are a straight-line map distance and would not be representative of road travel distance to the Project. Given that the LACoFD stations listed in Table 9 are closer than any mutual-aid resources, a non-LACoFD response would only be anticipated in the unlikely event of a large wildfire, conflagration, or similarly substantial event that necessitates a sizeable emergency response.

The County of Los Angeles prepares an annual document that summarizes performance measures for all departments. Within the performance measures for the Fire Department, are conformance to response times that vary by land classification. Those response time standards are summarized in Table 10 below.

Table 10. LACoFD Response Time Standards by Land Classification

<i>Land Classification</i>	<i>Classification Description</i>	<i>Response Time</i>
URBAN	Dense business populations, high-rise structures, no wildland interface	less than 5 minutes
SUBURBAN	Dense residential population, some wildland interface	less than 8 minutes
RURAL	Sparser population, few structures, greater wildland interface	less than 12 minutes

Source: County of Los Angeles 2023-2024 Performance Measures.

In an effort to understand fire department response capabilities, Dudek conducted an analysis of the travel-time response coverage from the closest, existing station (Fire Station 132). The response time analysis was conducted using travel distances that were derived from Google Road data and Project development plan data. Travel times were calculated applying the distance at speed limit formula ($T=(D/S) * 60$, where T=time, D=distance in miles, and S=speed in MPH) as well as the nationally recognized Verisk Public Protection Classification Program’s Response Time Standard formula ($T=0.65 + 1.7 D$, where T= time and D = distance) for comparison. The Verisk response travel time formula discounts speed for intersections, vehicle deceleration, and acceleration, and does not include turnout time. Tables 11 and 12 present tabular results of the emergency response time analysis using the Speed Limit formula and the Verisk formula, respectively.

Table 11. Proposed Project Emergency Response Analysis using Speed Limit Formula

LACoFD Station Nos.	Travel Distance to Project Entrance	Travel Time to Project Entrance ¹	Maximum Travel Distance	Maximum Travel Time ²	Total Response Time ³
132	2.5	4 minutes 17 seconds	3.1	5 minutes 19 seconds	7 minutes 19 seconds
123	3.2	5 minutes 29 seconds	3.9	6 minutes 41 seconds	8 minutes 41 seconds
107	3.5	6 minutes	4.1	7 minutes 2 seconds	9 minutes 2 seconds
150	5	8 minutes 34 seconds	5.6	9 minutes 36 seconds	11 minutes 36 seconds
128	6.9	11 minutes 50 seconds	7.5	12 minutes 51 seconds	14 minutes 51 seconds

Notes:

1. Assumes travel distance and time to the proposed Project entrance nearest the respective station, and application of the distance at speed limit formula ($T=(D/S) * 60$, where T=time, D=distance in miles, and S=speed in MPH), a 35 mph travel speed, and does not include turnout time.
2. Assumes travel distance and time to the furthest point within the proposed Project development from the respective station, and application of the distance at speed limit formula ($T=(D/S) * 60$, where T=time, D=distance in miles, and S=speed in MPH), a 35 mph travel speed, and does not include turnout time.
3. Emergency response time target thresholds include travel time to furthest point within the proposed Project development from fire station, and application of the speed limit formula ($T=(D/S) * 60$, where T=time, D=distance in miles, and S=speed in MPH), a 35 mph travel speed along with dispatch and turnout time, which can add an additional three minutes to travel time

Table 12. Emergency Response Analysis using Verisk Formula

LACoFD Station Nos.	Travel Distance to Project (miles)	Travel Time to Project Entrance	Maximum Travel Distance ¹ (miles)	Maximum Travel Time ²	Total Response Time ²
132	2.5	4 minutes 54 seconds	3.1	5 minutes 55 seconds	7 minutes 55 seconds
123	3.2	6 minutes 5 seconds	3.9	7 minutes 17 seconds	9 minutes 17 seconds
107	3.5	6 minutes 36 seconds	4.1	7 minutes 37 seconds	12 minutes 37 seconds
150	5	9 minutes 9 seconds	5.6	10 minutes 10 seconds	12 minutes 10 seconds
128	6.9	12 minutes 23 seconds	7.5	13 minutes 24 seconds	15 minutes 24 seconds

Notes:

- ¹ Assumes travel distance and time to the furthest point within the Project site from the fire station, and application of the ISO formula, $T=0.65+1.7(\text{Distance})$, a 35 mph travel speed, and does not include turnout time.
- ² Emergency response time target thresholds include travel time to the furthest point within the Project Site from a fire station, and application of the ISO formula, $T=0.65+1.7(\text{Distance})$, a 35 mph travel speed along with dispatch and turnout time, which can add two minutes to travel time.

It is assumed that the Project will be classified as "Suburban", with an 8.0-minute first-in fire engine response time. Emergency response time target thresholds include travel time along with dispatch and turnout time, which can add two minutes to travel time. LACoFD Fire Station 32 at 29310 Sand Canyon Rd, Canyon Country, California, would provide an initial response as the closest existing fire station. As indicated in Tables 11 and 12, the response from Station 32 to the Belcaro at Sand Canyon Project Site conforms to the response time standard of eight (8) minutes for suburban areas (LACoFD 2023-2024). Specifically, total response time, including call and turnout time, from Station 132 is calculated at roughly 7 minutes and 19 seconds to the furthest lot within the proposed development as calculated with the Speed Limit Formula and 7 minutes and 55 seconds as calculated with the Verisk Formula. The second engine to the site from Station 123 is estimated to arrive to the farthest extents of the Project within approximately 8 minutes and 41 seconds as calculated with the Speed Limit Formula and 9 minutes and 7 seconds as calculated with the Verisk Formula. All response calculations are based on an average response speed of 35 mph, consistent with nationally recognized National Fire Protection Association (NFPA) 1710.

5.3 Estimated Calls and Demand for Service

Emergency call volumes related to typical projects, such as new residential and commercial developments, can be reliably estimated based on the historical per-capita call volume from a particular fire jurisdiction. The LACoFD documented 449,364 total incidents for 2023 generated by a County-wide service area total population of approximately 3,961,285 persons in 60 cities and all unincorporated communities within Los Angeles County (LACoFD 2024). The County's per capita annual call volume is approximately 110 calls per 1,000 persons. The resulting per capita call volume is 0.11.

The Project includes 341 age-restricted single-family lots with an average unit occupancy of 3.05 people per single-family dwelling unit for the City of Santa Clarita. However, it should be noted that with this being an age-restricted community the majority of the units will have two residents, thus it can be calculated that the development will include a population of approximately 682 people ($2.0 \times 341 \text{ DU} = 682$), with a maximum total population of approximately 1,041 people ($3.05 \times 341 \text{ DU} = 1,041$). Using Los Angeles County Fire's estimated per capita call volume of 0.11 (110 annual calls per 1,000 population), the Belcaro at Sand Canyon Project's estimated population between 682 and 1,041 residents would generate a minimum of 75 calls (approximately 6 calls per month) and up to 115 calls per year (approximately 9 to 10 calls per month). The type of calls expected would primarily be medical-related as is the case with most jurisdictions, including LACoFD where 73.8% of total calls in 2023 were medical-related (LACoFD 2024). The estimated incident call volume at buildout from the Project is based on a conservative estimate of the maximum potential number of persons on-site at any given time (considered a "worst-case" scenario).

The Belcaro at Sand Canyon Project is an active-adult, 55+ community. Belcaro will not include, and does not propose, any assisted living components. As such, delays in evacuation are not anticipated as a result of the fact the project will be restricted to residents age 55+. As an active adult community, the majority of residents, like any community, are expected to be physically capable of self-evacuation and own their own automobiles. Further, the Project provides options for evacuation or on-site sheltering. As with any residential community, residents of Belcaro will be able to self-evacuate, as well as receive evacuation assistance through the HOA, City, and volunteer programs that serve residents with mobility concerns. Further, an ongoing educational campaign to raise awareness and prepare individuals in the event an evacuation is necessary would be available. Specifically, the following Project features and measures will assist all residents with evacuation:

- Education from HOA, a fire coordinator position for the overall site

- Layered and redundant programs for evacuation, including:
 - An HOA carpool program;
 - City/County Older Adults program;
 - Volunteers/non-profit programs.

5.3.1 Response Capability Impact Assessment

The available firefighting and emergency medical resources in the vicinity of the Project Site include an assortment of fire apparatus and equipment considered fully capable of responding to the type of fires and emergency medical calls potentially occurring within the Project Site. In 2023 Station 132, the primary responding station for the Project, responded to a total of 2,213 incidents with an approximate call volume of 6 calls a day (LACoFD 2023).

Based on this assessment, the existing fire protection within the service area appears to be adequate for the existing development/land use. Therefore, the addition of approximately 75 to 115 calls per year is considered to be an achievable addition to Station 132's annual call volume of 2,213 calls per year (an approximate 5% increase. A busy suburban fire station would run 10 or more calls per day. An average station runs about 5 calls per day. The level of service demand for the Belcaro at Sand Canyon Project Site slightly raises overall call volume but is not anticipated to impact the existing fire station to a point that they cannot meet the demand. The addition of approximately between 75 and 115 calls per year (approximately 6 to 9 calls per month or less than one call a day) will likely be lower as it is based on the average occupancy rate and calls per capita data used in this estimate and assumes the entire population is always onsite. Therefore, the Project is not expected to have a significant impact on LACoFD services.

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6 Fire Safety Requirements- Infrastructure, Building Ignition Resistance, and Defensible Space

6.1 Applicable Codes/Existing Regulations

As described in more detail in section 1.2, this FPP demonstrates that the Project would comply with applicable portions of Title 32 of the Los Angeles County Code, as amended, which adopts by reference the 2022 edition of the California Fire Code (CFC) with Supplements. Title 32 is hereafter referred to as the Los Angeles County Fire Code (2023 or current edition) or “Fire Code”. The Project also shall comply with Chapter 7A of the 2022 California Building Code (CBC) with Supplements; the 2022 California Residential Code, Section 237; and the 2024 Edition of the International Fire Code as adopted by the County. The Project would also be subject to the provisions of section 4291 of the Public Resources Code regarding brush clearance standards around structures and the Los Angeles County Fire Department guidelines for Fuel Modification Plans. Should changes to the codes occur between completion of this document and the initiation of construction, the more stringent requirements shall apply.

Chapter 7-A of the CBC addresses exterior structural ignition resistance and ember penetration into homes, a leading cause of structure loss from wildfires (California Building Standards Commission 2022). Thus, code compliance is an important component of the requirements of this WPSP, given the Project’s wildland-urban interface (WUI) location and the entirety of the Project Site lies within an area considered an LRA VHFHSZ, as designated by CAL FIRE - OSFM. Furthermore, the Open Space area located north of the northern property boundary within the Santa Clarita River watershed is also designated as an LRA VHFHSZ, as shown on Figure 3, Fire Hazard Severity Zone Map. Fire hazard designations are based on topography, vegetation, and weather, among other factors with more hazardous sites, including steep terrain, unmaintained fuels/vegetation, and WUI locations. Projects situated in VHFHSZ require fire hazard analysis and the application of fire protection measures to create defensible communities within these WUI locations.

As described in this FPP, the Project would meet applicable code requirements for building in these higher fire hazard areas or meet the intent of the code through the application of site-specific fire protection measures. These codes have been developed through decades of wildfire structure save and loss evaluations to determine why buildings were lost to fire or why they survived. The resulting fire codes now focus on mitigating former structural vulnerabilities through construction techniques and materials so that the buildings are resistant to ignitions from direct flames, heat, and embers, as indicated in the 2022 California Building Code (Chapter 7-A, Section 701A Scope, Purpose, and Application) (California Building Standards Commission 2022).

The following summaries highlight important fire protection features. All underground utilities, hydrants, water mains, curbs, gutters, and sidewalks will be installed, and the drive surface shall be approved prior to combustibles being brought on site.

6.2 Fire Apparatus Access Roads

6.2.1 Access Roads

The Project would involve the construction of new age-restricted single-family residential structures, and roadways, and would generate new trips to and from the Project Site. Project Site access, including road widths and connectivity, will be consistent with the State Minimum Fire Safe Regulations, County's roadway standards (Title 21), the 2022 CFC Section 503, and will include:

- The Project Site's primary routes are accessed through a series of internal neighborhood roadways, which connect with the primary ingress/egress roads that intersect off-site primary and major transportation routes.

A secondary access road on the south end of the Project Site is proposed to extend the southern access from Oak Springs Canyon Road down to Robinson Ranch Road. This access road will serve as an access road by the community, as well as first responders. First Responders deemed to need access by the County shall have access to the road and include but are not limited to the County Sheriff, California Highway Patrol, LACoFD, Public Works, and EMS services. The southern access road would comply with the SMFSR and as well as all applicable LACoFD and Los Angeles County Fire Code requirements regarding sizing, condition, maintenance, and secured access. The southern access road would extend vehicular access from the Project south to Robinson Ranch Road, and would physically link to an existing, improved public road that connects back to Sand Canyon Road to the west. The road would consist of a private minimum 20-foot-wide paved road. The road would be maintained by the Project's HOA. Prior to the issuance of an occupancy permit for construction both access routes shall be graded and surfaced with a material able to support the imposed loads of fire apparatus and vehicles. The road width shall be unobstructed and shall be no less than 20 feet in width with an unobstructed vertical clearance to the sky, except for where there are protected oak trees, then it's a minimum vertical clearance of at least 13 feet 6 inches.

- Interior circulation streets include all roadways that are considered common or primary roadways for traffic flow through the site and fire department access serving all proposed residential and commercial structures. Any dead-end streets serving new buildings or dwellings that are longer than 150 feet shall have approved provisions for fire apparatus turnaround.
- Fire apparatus roads shall have a minimum unobstructed width of not less than 20 feet, exclusive of shoulders. All interior residential streets will be designed to accommodate a minimum of 75,000-lb. and shall be surfaced to provide all-weather driving capabilities fire apparatus load. Fire apparatus access roads shall not exceed 15 percent in grades.
- Fire apparatus access roads shall not be obstructed in any manner, including parking of vehicles or use of traffic calming devices, including but not limited to speed bumps or speed humps. The widths and clearances in Sections 503.2.1 and 503.2.2 shall be maintained at all times.
- Private and public streets for each phase shall meet all project-approved fire code requirements and/or mitigated exceptions for maximum allowable dead-end distance, paving, and fuel management prior to combustibles being brought to the site.

- The vertical clearance of vegetation (lowest-hanging tree limbs), along roadways, will be maintained a minimum 20-foot-wide path that is clear to the sky.
- Where a fire apparatus road consists of a divided roadway, the width shall be not less than 15 feet for residential use and 20 feet for commercial/industrial uses.
- Any roads that have traffic lights shall have approved traffic pre-emption devices (Opticom) compatible with devices on the fire apparatus.
- Roadways and/or driveways will provide fire department access within 150 feet of all portions of the exterior walls of the first floor of each structure.

Provide approved signs or other approved notices or markings that include the words “NO PARKING - FIRE LANE” shall be provided for Fire Apparatus Access Roads. Signs shall have a minimum dimension of 12 inches wide by 18 inches high and have red letters on a white reflective background. Signs shall be provided for fire apparatus access roads, to clearly indicate the entrance to such road, or prohibit the obstruction thereof and at intervals, as required by the Fire Inspector. A no-parking designation shall meet the requirements of California Vehicle Code Section 22500.1 and be approved by the fire code official.2-63.

- Access roads shall be completed and provide all-weather access prior to the issuance of building permits and prior to the occurrence of combustible construction.
- The developer will provide information illustrating the new roads, in a format acceptable to the County Fire for updating Fire Department response maps.

A minimum 5-foot-wide approved firefighter access walkway leading from the Fire Department Access Road to all required openings in the building's exterior walls shall be provided for firefighting and rescue purposes.

6.2.2 Maximum Dead-End Road (cul-de-sac) Length

Dead End roads will comply with the adopted Los Angeles County Fire Code and Title 21 of the County Code including:

- Cul-de-sacs and fire apparatus turnarounds will meet requirements and County Fire cul-de-sac length restrictions (County Code Section 21.24.190) as follows:
 - 500 feet in length, when serving land zoned for industrial or commercial use.
 - 700 feet in length, when serving land zoned for residential uses having a density of more than four dwelling units per net acre.
 - 1,000 feet in length, when serving land zoned for residential uses having a density of four or fewer dwelling units per net acre.
 - End of cul-de-sac streets and fire apparatus turnarounds for dead-end alleys will meet the requirements of County Fire cul-de-sac length restrictions and County Code Section 21.24.180

6.2.3 Gates

Gates on private roads are permitted but subject to Fire Code requirements and standards. Gates shall be equipped with conforming sensors for detecting emergency vehicle strobe lights from any direction of approach if required. All entrance gates will be equipped with a key switch, which overrides all command functions and opens the gate. Gate activation devices will be equipped with a battery backup or manual mechanical disconnect in case of power failure. In addition, the gates would comply with AB 2911 which requires additional standards for comprehensive site, and risk reduction requires roads to be unobstructed if being relied on for secondary access. A gate shall be installed along the secondary access road and will be supplied with backup power and open upon the approach of a vehicle whether via pressor sensors or infrared sensors. The gate shall comply with the minimum requirements set forth in this section per Title 32 Section 503.6 and CFC Section 503.6. Any gates within the Project site will be:

- Gates shall be equipped with conforming sensors for detecting emergency vehicle “opticom” strobe lights from any direction of approach if required.
- All entrance gates will be equipped with a key switch, which overrides all command functions and opens the gate.
- Gate activation devices will be equipped with a battery backup or manual mechanical disconnect in case of power failure.
- Further, gates will be:
 - Where a single gate is provided, the gate width shall not be less than 20 feet, clear-to-sky, with all gate hardware is clear of the access way..
 - Gates shall be swinging or sliding type
 - Construction of gates shall be of materials that allow manual operation by one person.
 - Maintained in operative condition at all times and replaced/repaired when defective
 - Electric gates shall be equipped with a means of opening the gate by fire department personnel for emergency access. Emergency opening devices shall be approved by the fire code official.
 - Methods of locking shall be submitted for approval by the fire code official. All locking devices shall comply with the County of Los Angeles Fire Department Regulation 5, Compliance for Installation of Emergency Access Devices.
 - Electric Gates shall be listed in accordance with UL 325
 - Gates intended for automatic operation shall be designed, constructed, and installed in accordance with ASTM F2200
 - Inclusive of provisions for manual operation from both sides by one person, if power fails. Gates will have the capability of manual activation from the development side or a vehicle (including a vehicle detection loop).
 - An approved key box, listed in accordance with UL 1037, shall be provided as required by Fire Code 506. The location of each key box shall be determined by the Fire Inspector.
 - Where a Fire Apparatus Road consists of a divided roadway, the gate width shall be not less than 15 feet for residential uses and 20 feet for commercial/industrial uses
 - Provide a minimum 32-foot turning radius beyond the keypad, prior to the gate entrance at a minimum width of 20' for turnaround purposes.

6.2.3.1 Recommended Gate Design Feature

The Project includes primary access road from the north as well as a full access roadway from the south. The southern access road entrance is proposed to be gated. To comply with requirements for unobstructed access, the Project would equip the southern access road gate with code-required fire department access features (i.e., Knox remote opening system) and is recommended to also include an additional remote operating system of the latest technology to the approval of LACoFD that will enable the gate to be monitored and opened via internet protocol or cellular access during an emergency or wildfire situation.

6.2.4 Road Width and Circulation

Internal circulation would be from a series of internal streets that travel in both directions and terminate at cul-de-sacs. On-site roads will be constructed to current Los Angeles County Fire Apparatus Access Code standards and 2022 CFC. Approved fire apparatus access roads shall be provided for every facility, building or portion of a building hereafter constructed or moved into or within the County of Los Angeles jurisdiction. The fire apparatus access road shall comply with the requirements of section 503 of Title 32 – Fire Code, and shall extend to within 150 feet of all portions of the facility and all portions of the exterior walls of the first story of the building as measured by an approved route around the exterior of the building or facility (Section 503.1.1). Fire apparatus roads where a hydrant is not located shall have a minimum unobstructed width of not less than 20 feet, exclusive of shoulders, except for approved security gates in accordance with Section 503.6, a minimum turning radius of 32 feet, and an unobstructed vertical clearance clear to the sky to allow aerial ladder truck operation. A minimum vertical clearance of 13 feet 6 inches may be allowed for protected tree species adjacent to access roads. Any applicable tree-trimming permit from the appropriate agency is required. The dimensions of the approved Fire Apparatus Access Roads shall be maintained as originally approved by the fire code official.

Fire access roadways designed to allow parking shall provide a minimum clear width of not less than 28 feet for parking on one side and a clear width of not less than 36 feet for parking on both sides. The interior residential access roads will be designed to accommodate a minimum of a 75,000-pound (lb.) fire apparatus load and shall be surfaced to provide all-weather driving capabilities.

6.2.5 Dead-End Roads

Dead-end fire apparatus access roads that exceed 150 feet shall have an approved turnaround (County Code Section 503.2.5). Eight (8) dead-end roads within the Project Site provide access to the residential lots. Each dead-end road terminates with a cul-de-sac. Cul-de-sacs shall not be more than 700-feet in length when serving a residential density of more than four dwelling units per net acres and shall not be more than 1000 feet in length when serving a residential density of four or less dwelling units per net acre (Title 21 Section 21.24.190). The cul-de-sacs would comply with Section 503.2.5 of the Fire Code and provide a minimum turning radius of 32 feet and an unobstructed width of 26 feet unless otherwise determined by LACoFD.

6.2.6 Grade

The Project complies with the Los Angeles County grade requirements. Fire apparatus access roads shall not exceed 15 percent in grade.

6.2.7 Surface

All fire apparatus access and vehicle roadways shall be asphalt or concrete and designed and constructed in accordance with County Public Works standards and be designed to accommodate a minimum of a 75,000-pound fire apparatus load and shall be surfaced to provide all-weather driving capabilities.

6.2.8 Vertical Clearance

Fire apparatus access roads shall have an unobstructed width of not less than 20 feet, no less than 26-feet where hydrants are provided, exclusive of shoulders, and except for approved security gates in accordance with Section 503.6 of the Fire Code, and an unobstructed vertical clearance clear to the sky to allow aerial ladder truck operation. The fire access road shall have an unobstructed vertical clearance of 20 feet.

- Exception: A minimum vertical clearance of 13 feet 6 inches may be allowed for protected tree species adjacent to access roads. Any applicable tree-trimming permit from the appropriate agency is required.

6.2.9 Premises Identification

Identification of roads and structures will comply with Fire Code as follows:

- Approved building address numbers, building numbers or approved building identification shall be provided and maintained to be plainly visible and legible from the street fronting the property. Numbers shall be 4 inches in height, 1/2 -inch stroke, and located 6 to 8 feet above grade. Numbers will contrast with the background.
- Multiple structures located off common driveways or roadways will include posting addresses on structures and the entrance to individual driveways/roads or at the entrance to the common driveway/ road for faster emergency response.
- Multiple residential and commercial buildings having entrances to individual units not visible from the street or road shall have unit numbers displayed in groups for all units within each structure. Such numbers may be grouped on the wall of the structure or mounted on a post independent of the structure and shall be positioned to be plainly visible from the street or road as required by Fire Code 505.3 and in accordance with Fire Code 505.1.
- Streets will have street names posted on non-combustible street signposts. Letters/numbers will be per County standards.

Premise identification will be installed, along with street signs, and building numbers, prior to the occupancy of structures.

6.2.10 Ongoing Infrastructure Maintenance

Project Owner/Project's HOA shall be responsible for long term funding and maintenance of fuel modification zones.

6.2.11 Pre-Construction Requirements

Per Los Angeles County Fire Code, 4908.1, A fuel modification plan shall be submitted and have preliminary approval prior to any subdivision of land; or, have final approval prior to the issuance of a permit for any permanent structure

used for habitation; where, such structure or subdivision is located within areas designated as a Fire Hazard Severity Zone within SRAs or VHFHSZs within the Local Responsibility areas, applicable Fire Hazard Zone maps, and Appendix M of this code at the time of application. An on-site inspection must be conducted by the personnel of the Forestry Division of the Fire Department and final approval of the fuel modification plan issued by the Forestry Division prior to a certificate of occupancy being granted by the official building code. Construction activities would also comply with Chapter 33 of the CFC, Fire Safety During Construction and Demolition, and with the Modified Project's Construction Fire Protection Plan (CFPP).

Prior to bringing lumber or combustible materials onto the Project site, improvements within the active development area shall be in place, including utilities, operable fire hydrants, an approved, temporary roadway surface, and construction phase fuel modification zones established. These features will be approved by the fire department or their designee prior to combustibles being brought on-site.

A preconstruction meeting with the Los Angeles County Fire Prevention Unit is advised, prior to start of underground installation.

6.3 Ignition Resistant Construction and Fire Protection Systems

In WUI areas, homes can be considered fuel as well as an ignition point for wildfires. The WUI fire problem is structural; therefore, the best mitigation is to reduce the likelihood of building ignition occurring. (Zhou, 2013). Structural characteristics play a large role in whether or not a building burns, which is important in WUI environments as ill-prepared structures may also serve as fuel (Gorte, 2011). Preventing the ignition of structures can result in the reduction of fire spread in surrounding WUI areas (Maranghides & Mell, 2012). The benefit of structure-based mitigation is that it not only lowers the onsite risk but also lowers the risk of wildfire across a landscape (Mockrin et al., 2020).

The proposed structures will be built utilizing the most current construction methods intended to mitigate wildfire exposure, required by LACoFD, at the time of construction. Construction methods intended to mitigate wildfire exposure will comply with the wildfire protection building construction requirements contained in the Los Angeles County Building Code including the following:

1. CBC and Los Angeles County Building Code, Chapter 7A
2. Los Angeles County Residential Code, Section R327
3. Los Angeles County Referenced Standards Code, Chapter 12-7A

Construction practices respond to the requirements of the County Fire Code Title 32 and the Los Angeles County Building Code (Title 26, Chapter 7A), "Construction Methods for Exterior Wildfire Exposure." These requirements include the ignition resistant requirements found in Chapter 12-7A of the Los Angeles County Referenced Standards Code. A key component to addressing the wildfire problem is to address the structural ignition (Zhou, 2013). Addressing structural ignition potential is an effective mitigation strategy for preventing wildfires and increasing WUI ignition resistance (Zhou, 2013). Research has found that structural characteristics, especially roofing, play a significant role in reducing a structure's vulnerability to fire and the likelihood of burning (Gorte, 2011; Knapp et al., 2021; Kolden & Henson, 2019; Manzello et al., 2011; Syphard et al., 2017; Zhou, 2013). Further, reducing a structure's likelihood of ignitions reduces the risk for the individual homeowners and the risk associated with fire

spreading to other homes or wildland areas (Mockrin et al., 2020). While these standards will provide a high level of protection to structures in this development and should reduce or eliminate the need to order evacuations, there is no guarantee of assurance that compliance with these standards will prevent damage or destruction of structures by fire in all cases.

There are two primary concerns for structure ignition: 1) radiant and/or convective heat and 2) burning embers (NFPA 1144 2008, Ventura County Fire Protection District 2011, IBHS 2008, and others). Burning embers have been a focus of building code updates for at least the last decade, and new structures in the Wildland Urban Interface (WUI) built to these codes have proven to be very ignition resistant. Likewise, radiant and convective heat impacts on structures have been minimized through Chapter 7A exterior fire ratings for walls, windows, and doors.

Additionally, provisions for modified fuel areas separating wildland fuels from structures have reduced the number of fuel-related structure losses. As such, most of the primary components of the layered fire protection system provided by the Project are required by the LACoFD but are worth listing because they have been proven effective for minimizing structural vulnerability to wildfire and, with the inclusion of required interior sprinklers (required in the 2022 Building/Fire Code update), of extinguishing interior fires, should embers succeed in entering a structure. Even though these measures are now required by the latest Building and Fire Codes, at one time, they were used as mitigation measures for buildings in WUI areas, because they were known to reduce structure vulnerability to wildfire. These measures performed so well, that they were adopted into the code.

The 7A Materials and Construction Methods for Exterior Wildfire Exposure (CBC) chapter detail the ignition resistant requirements for the following key components of building safely in wildland-urban interface and fire hazard severity zones. Each of the critical exterior building features summarized below has been addressed within Chapter 7A to minimize the potential for structural ignition from wildfire exposure as well as from airborne embers.

6.3.1 Roofing Assemblies

Roofing shall comply with Chapter 7A and Chapter 15 of the CBC. Roof assemblies shall be a Class A rating in accordance with ASTM E108 or UL790. Where the roof allows a space between the roof covering and roof decking the space shall be constructed to prevent the intrusion of embers, or is installed over a combustible deck, be fire stopped with a 72-inch cap sheet meeting the ASTM D3909 Standard Specification for “Asphalt Rolled Roofing Surfaces with Mineral Granules”, shall be installed over the roof deck. Bird stops are to be used at the eaves, and hip and ridge caps will be mudded in to prevent the intrusion of embers. Roof valley flashing shall be no less than 0.019 inches No. 26 gauge galvanized sheet corrosion-resistant metal installed over no less than one layer of minimum 72 lb. mineral surfaced nonperforated cap sheet compliant with ASTM D3909, at least 36 inches wide running the full length of the valley. Gutters shall be provided with means to prevent the accumulation of embers.

Wood shake shingles and wood shakes are prohibited in any Fire Hazard Severity Zone regardless of classification per LACBC Section 705A.2.

6.3.2 Vents and Openings

Any vent openings, enclosed eaves soffit spaces, enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters, and underfloor ventilation shall comply with Section 1203 and Section 706A.1 through 706A.3 of the CBC and Section 706A of the LACBC. All vents and openings shall be fully covered with Wildland Flame and Ember Resistant vents approved and listed by the California State Fire Marshal or WUI vents

listed in ASTM E2886. This also applies to any gable ends, ridge ends, crawl spaces, foundations, and all other cents that mount onto a vertical wall. Vents shall not be installed on the underside of eaves or cornices unless they are WUI vents as described above.

6.3.3 Exterior Wall Covering

Exteriors walls shall comply with Section 707A.3 of the CBC and be either noncombustible or ignition-resistant. This applies to exterior wall coverings, exterior wall assembly, exposed undersides or eaves or soffits, undersides of porch ceilings, the underside of floor projections, and exterior underfloor areas.

6.3.4 Open Roof Eaves

Any exposed roof deck material on the underside of open roof eaves shall either be noncombustible, ignition resistant, one layer of 5/8 inch thick Type X gypsum, or 1-hour fire resistive exterior wall assembly designed for exteriors fire exposure using gypsum panel and sheeting in accordance with CBC Section 707A.4.

6.3.5 Closed Roof Eaves and Soffits

Enclosed eaves and soffits shall comply with CBC Section 707A.5. The exposed underside of enclosed eaves or soffits shall be protected by either noncombustible material, ignition-resistant material, one layer of 5/8 inch Type X gypsum sheeting, 1-hour fire restive exteriors wall assembly, assemblies that meet the performance criteria in Section 707A.10 or assemble that meet the performance criteria in State Fire Marshall (SFM) Standard 12-7A-3.

6.3.6 Floor Projections and Underfloor Protection

The underside of floor projections must comply with Section 707A.7 of the CBC. The exposed underside of a cantilevered floor projection, where a floor assembly extends over an exterior wall, must be protected by noncombustible materials, ignition-resistant materials, one layer of 5/8 in Type X gypsum, 1-hour fire resistive exterior wall assembly that meets the criteria in Section 707A.10, or meets performance criteria in SFM Standard 12-7A-3. The underfloor area of an elevated or overhanging building shall be enclosed in accordance with CBC Section 707A.8.

6.3.7 Underfloor Appendices

When required by County Fire, the underside of overhanging appendages shall be enclosed per CBC Section 707A.9. Or the underside of the exposed underfloor shall consist of noncombustible material, ignition-resistant material, one layer of 5/8 inch Type X gypsum, 1-hour fire resistive exterior wall assembly, or meets the performance criteria in SFM Standard 12-7A-3 or ASTM E2957.

6.3.8 Windows, Skylights, and Doors

Assemblies shall meet one of the following requirements:

- Be constructed of multiplane glazing with a minimum of one tempered pane meeting the requirements of Section 2406 Safety Glazing.

- Be constructed of glass block units.
- Have a fire-resistive rating of no less than 20 minutes per National Fire Protection Association (NFPA) 257.
- Be tested to meet the performance requirements of SFM Standard 12-7A-2.

Skylights shall be protected by a non-combustible mesh screen with openings of no more than 1/8 inches. Wall assemblies behind structural glass veneers shall comply with Section 707A.3 of the CBC.

6.3.9 Exterior Doors

Exterior doors shall be constructed as follows:

- Noncombustible material
- Ignition-resistant construction
- A solid wood core that has stiles and rails no less than 1 3/8-inch-thick and panels no less than 1 ¼ inch thick.
- Fire-resistance rating of no less than 20 minutes per NFPA 252
- Surface or cladding that meets the performance criteria of CBC Section 707A.3.1 when tested per ASTM E2707 or SFM Standard 12-7A-1.

Garage doors shall resist the intrusion of embers by preventing gaps between doors and roof openings at the top, bottom, and sides of doors. Gaps cannot exceed 1/8 inch and shall be controlled by either weather stripping that meets ASTM D638 and ASTM G155, weather stripping shall also have a V-2 or better flammability rating, be constructed so that doors overlap onto jams and headers, or the garage door jams and headers are covered with metal flashing.

6.3.10 Decking

Any deck, porch, balcony, or stairs within 10 feet of a building shall comply with CBC Section 709A. The walking surface shall either comply with Section 709A.4 when tested per ASTM E2632 and ASTM E2726, ignition-resistant material, material that meets the criteria of SMF Standard 12-7A-4 and SFM Standard 12-7A-5, noncombustible material, any material that meets SFM Standard 12-7A-4A when attaches to exterior walls that are noncombustible or ignition-resistant or any material that meets Section 709A.5 and is attached to an exterior wall that is noncombustible or ignition-resistant.

6.3.11 Accessory Structures

Accessory structures are applied to buildings covered by LACBC Section 710A.3, Exception 1 as well as any building that requires a permit including but not limited to trellises, arbors, patio covers, gazebos, and similar structures within less than 3 feet of the building or otherwise determined by County Fire. Buildings that are less than 120 square feet in floor area and are more than 30 feet but less than 50 feet from structures shall be noncombustible or ignition-resistant per CBC Section 704A.2. No requirements shall apply to an accessory building or miscellaneous structures when located at least 50 feet from an applicable building. Applicable accessory buildings and attached miscellaneous structures, or detached miscellaneous structures that are installed at a distance of fewer than 3 feet from an applicable building, shall comply with LACBC Section 710A. Structures that

meet the requirements of an accessory or miscellaneous structures shall be noncombustible or ignition resistant per CBC Section 704A.2.

6.4 Fire Protection Systems

The following infrastructure components are made in order to comply with the Los Angeles County requirements, the 2022 California Fire Code, LACoFD's Fire Code Standards, and nationally accepted fire protection standards, as well as additional requirements to assist in providing reasonable on-site fire protection.

6.4.1 Water Supply

The Project will be consistent with County Title 20, Section 20.16.060 for fire flow and fire hydrant requirements within a VHFHSZ. The Project would include the provisions of utilities.

The minimum fire flow and fire hydrant requirements shall be determined by the fire chief or fire marshal and be based upon 20 pounds per square inch (p.s.i.) residual operating pressure remaining from the street main from which the fire flow is being measured at the time of measurement. The minimum fire flow may be adjusted as determined by the fire chief or fire marshal based on local conditions, exposure, and/or congestion, and construction of buildings. Building permits shall be accompanied by evidence indicating to County Fire a reliable water supply and a certificate from County fire that there is sufficient water supply for fire protection. The water supply for the Project shall be consistent with approved types of water supply such as reservoirs, pressure tanks, elevated tanks, water mains, or other fixed systems capable of providing required fire flow per Title 32 Section 507.2. Any water tanks and associated structures shall be installed and maintained in accordance with NFPA 22 and County Fire.

In addition, County Fire helicopters can obtain water for dropping on wildland fires from Castaic Lake to the north or from numerous ponds that are located throughout nearby golf courses.

The Project would meet all water and water pressure requirements for fire flow.

6.4.2 Fire Hydrants

Fire hydrants shall be provided at intersections and along fire access road and adjacent to public streets as determined by LACoFD Fire Chief or Fire Marshal and current fire code requirements to meet operational needs (Section C102.1). The minimum number of fire hydrants available to a building, complex or subdivision shall not be less than that determined by the spacing requirements in Sections C105 and C106 when applied to fire apparatus access roads and perimeter public streets from which fire operations could be conducted (Section C103.1). For one- and two-family dwellings, and Group R-3 buildings, fire hydrants shall be spaced no more than 600 feet apart. For properties with more than one dwelling unit per acre, no portion of lot frontage should be more than 450 feet away, via fire apparatus access, from a public hydrant. For properties less than one dwelling unit per acre, no portion of a fire apparatus access roadway shall be farther than 750 feet away, via fire apparatus access, from a properly spaced public hydrant that meets the required fire-flow (Section C105.2). When cul-de-sac depth exceeds 450 feet (residential), hydrants shall be required at mid-block. Additional hydrants will be required if hydrant spacing exceeds specified distances in Sections C105.2 and C105.3 (Section C105.4). Vehicular access to hydrants will be provided and maintained throughout construction. Fire hydrants shall be installed, tested, and accepted prior to construction.

Fire hydrants will be consistent with applicable County Design Standards. All fire hydrants shall measure 6"x 4"x 2-1/2" brass or bronze, conforming to current AWWA standard C503 or approved equal, and shall be installed in accordance with the County of Los Angeles Fire Code. Fire hydrants will be placed within four feet by four feet by four inches concrete base. A 4-foot clear space shall be maintained around the circumference of fire hydrants. Reflective blue dot hydrant markers shall be installed in the street to indicate the location of the hydrant. Crash posts will be provided where needed in on-site areas where vehicles could strike fire hydrants or fire department connections. Fire hydrants within VHFHSZ shall be constructed with four feet by four inches concrete base. Prior to the issuance of building permits, the appropriate number of fire hydrants and their specific locations will be approved by LACoFD.

6.4.3 Automatic Fire Sprinklers

All structures, of any occupancy type, will be protected by an automatic, interior fire sprinkler system. All automatic internal fire sprinklers would comply with County Fire and National Fire Protection Association (NFPA) 13, 13D, or 13R installation requirements as required based on structure type, use, and size. This is crucial in preventing off-site impacts as embers can also be generated by a structure fire and can be blown over the fuel modification into native fuels. Automatic sprinklers can isolate a fire to the point of origin, limit its ability to spread to the rest of the building, and even extinguish a fire before the responding firefighters arrive, thus damping the likelihood of ember production (NFPA, 2021). Automatic sprinklers have an extremely high success rate in controlling or suppressing interior structure fires (NFPA, 2021). This also reduces impacts on fire response capacity as the automatic sprinklers will allow firefighters to focus on reducing additional ignitions beyond the point of origin. The Project is inclusive of both protection measures including components to resist ignitions from wildland fuels, and the built environment.

6.5 Defensible Space and Vegetation Management

6.5.1 Defensible Space and Fuel Modification Zone (FMZ) Requirements

An important component of a fire protection system for the Project is the provision for fire-resistant landscapes and modified vegetation buffers. FMZs are designed to provide vegetation buffers that gradually reduce fire intensity and flame lengths from advancing fire by strategically placing thinning zones, restricted vegetation zones, and irrigated zones adjacent to each other on the perimeter of the WUI exposed structures.

The Project will be exposed to naturally vegetated open space areas surrounding the site. Based on the modeled extreme weather flame lengths for the Project Site, wildfire flame lengths are projected to be approximately 10 to 26 feet high in areas of Development Footprint-adjacent grassland, coastal scrub, and chaparral fuels. The fire behavior modeling system used to predict these flame lengths was not intended to determine sufficient FMZ widths, but it does provide the average predicted length of the flames, which is a key element for determining "defensible space" distances for providing firefighters with room to work and minimizing structure ignition. For the Belcaro at Sand Canyon Project Site, the FMZ widths between the naturally vegetated open space areas and the property lot lines are proposed to be a minimum of 100 feet and up to 200 feet or the property boundary, whichever is greater, approximately 4 times the modeled flame lengths based on the fuel type represented adjacent to the development footprint. The FMZs will be constructed from the structure outward toward undeveloped areas. Figure 9 illustrates the FMZ Plan proposed for the Belcaro at Sand Canyon Project Site, including a minimum 30-foot-wide irrigated,

setback area Zone A, a minimum 70-foot-wide irrigated area Zone B, and an additional up to 100-foot-wide thinning area Zone C. A 5-foot-wide ember-resistant Zone O would also be included around all structures. Further, fuel modification will also be included within 10 feet of all fire apparatus access roads and a vertical clearance of at least 13 feet and 6 inches would be maintained as well.

6.5.1.1 Los Angeles County Fuel Modification Zone Standards

An FMZ is a strip of land where combustible vegetation has been removed and/or modified and partially or completely replaced with more adequately spaced, drought-tolerant, fire-resistant plants in order to provide a reasonable level of protection to structures from wildland fire. The purpose of the section is to document LACoFD's standards and make them available for reference. Los Angeles County Fire Code (Title 32, Fire, Section 4907) is consistent with the 2022 California Fire Code (Section 4907 – Defensible Space), Government Code 51175 – 51189, and Public Resources Code 4291, which require that fuel modification zones be provided around every building that is designed primarily for human habitation or use within a VHFHSZ. A typical landscape/fuel modification installation per the County's Fire Code consists of a 30-foot-wide Zone A and a 70-foot-wide Zone B for a total of 100¹⁹ feet in width. An additional 100-foot-wide Zone C may be required for the areas adjacent to natural-vegetated, open space areas. The majority of the Proposed Project aligns with LACoFD requirements and will consist of a 30-foot-wide Zone A and a 70-foot-wide Zone B (both Zones A and B will be irrigated) and a 100-foot thinning Zone C. The southwest portion of the development is adjacent to a CDFW jurisdictional stream/channel and in order to reduce direct impacts to these areas the project includes reduced fuel modification zone areas. This portion of the development achieves a minimum 30 feet and up to approximately 70 feet of fully irrigated on-site fuel modification that will be maintained to Zone A standards. The lots in the southwest portion of the development which are adjacent to the low-fuel CDFW jurisdictional streambed/channel provides an opportunity to construct a non-combustible, six-foot tall, heat-deflecting wall (lower 1 to 2 feet block wall and upper 4 to 5 feet dual pane, one pane tempered glass glazing) to provide additional deflection for these lots to compensate for the reduced fuel modification zones. A Fuel Modification Plan shall be reviewed and approved by the Forestry Division of the LACoFD for consistency with defensible space and fire safety guidelines. Figure 9 conceptually displays FMZs for the Project Site. Based on the conceptual Project site plan, the building has more than adequate on-site defensible space which consists of asphalt and concrete roadways, parking stalls, loading zones, and irrigated landscaping.

To ensure long-term identification and maintenance, a fuel modification area shall be identified by a permanent zone marker meeting the approval of LACoFD. All markers will be located along the perimeter of the fuel modification area at a minimum of 500 feet apart or at any direction change of the fuel modification zone boundary; for areas that traverse through environmentally sensitive areas, FMZ markers will be placed outside of these sensitive areas. FMZs will be maintained on at least an annual basis or more often as needed to maintain the fuel modification buffer function.

An on-site inspection will be conducted by staff of the Forestry Division of the LACoFD upon completion of landscape installation and before a certificate of occupancy is granted by the County's building code official.

¹⁹ In accordance with section 325.2.1 of the Los Angeles County Fire Code, Clearance of Brush and Vegetation Growth "Extra Hazard", it may be determined by the fire official that some sites pose an extra hazard. In such cases, Fuel Modification Zones may exceed 100 feet but not exceed 200 feet from structures. Based on modeled fire behavior, it was determined that 200-foot FMZs would provide adequate defensible space for the Project.

6.5.1.2 Project Fuel Modification Zone Treatments

Zone 0 Ember Resistant Zone (ERZ) – 0 to 5 feet from the structure

The ERZ, per PRC 4291, is designed to keep fire or embers from igniting materials that can spread to structures. It includes the area under and around all attached decks and requires more stringent wildfire fuel reduction. In 2020, the concept of the ERZ was added to PRC 4291 to designate a more intense fuel reduction area immediately adjacent to homes and/or structures to reduce the likelihood of ember-based home ignition. However, the requirement for an ERZ under PRC 4291 will not take effect for new structures until the Board of Forestry releases updated regulations and guidance documents. Although not currently required, CALFIRE’s website recommends the following guidance for the ERZ, and in anticipation of the regulation going into effect, the ERZ has been included in the Project. Per PRC 4291, the ERZ is measured from building, structures, decks, etc. outward 5 feet (horizontal distance) and includes the following:

1. Hardscape, such as gravel, pavers, concrete, and other non-combustible materials are permitted within this zone.
2. The use of combustible bark or mulch is prohibited.
3. This zone shall be free of all dead and dying weeds, grass, plant, shrubs, trees, branches, and vegetative debris.
4. Combustible items within this zone, including on decks, should be limited.
5. Any firewood or lumber should be relocated within Zone B.
6. Fencing, gates, and arbors attached to homes or structures should be made with non-combustible materials.
7. Garbage and recycling containers should not be kept within this zone. They should be kept a minimum 5 feet from structures, windows, and vents, and stored in the garage, a non-combustible bin enclosure or shed, or behind a non-combustible fence.
8. Create separation between trees, shrubs, and items that could catch fire, such as patio furniture, wood piles, swing sets, etc.

Zone A: Setback Zone – from structure outward to a minimum of 30 feet

Approved plan description: Extends 30 feet beyond the edge of any combustible structure, accessory structure, appendage, or projection. Irrigation by automatic or manual systems shall be provided for landscaping to maintain healthy vegetation.

1. Irrigated by the automatic or manual system to maintain healthy vegetation and fire resistance
2. Landscaping and vegetation in this zone shall consist primarily of green lawns, ground covers (not exceeding 6 inches in height), and spaced shrubs by at least 10 feet.

3. Plants in Zone A shall be inherently highly fire-resistant and spaced appropriately. Plants shall be on the approved fuel modification plant list (Appendix C)
4. Trees are not recommended for Zone A unless they are dwarf varieties or mature trees of small stature.
5. Prohibited plant species (Appendix D) shall not be within 30 feet or more of the structures.
6. Vines and climbing plants shall not be allowed on any structure.
7. In all cases, the overall characteristics of the landscape provide adequate defensible space in a fire environment.

Zone B: Irrigated Zone – from the outer edge of Zone A to 100 feet from a structure

Approved plan description: Extends from the outermost edge of Zone A to 100 feet from a structure or as noted on the plan. Automatic or manual irrigation systems are required for this zone unless it consists entirely of native plants.

1. Zone B plant selection should consist primarily of irrigated green lawns, ground covers not exceeding six inches in height (except as approved by LACoFD), and adequately spaced shrubs by at least 10 feet.
2. Ground covers shall be maintained to not exceed 6 inches. If they are located on a slope, 12-inches is acceptable within 50-feet of structures and 18 inches is acceptable beyond 50 feet.
3. Annual grasses and weeds shall not exceed a height of 3 inches.
4. Vegetation may consist of modified existing native plants, adequately spaced ornamental shrubs trees, or both.
5. Target species (Appendix D) are not allowed within 30 feet or more of combustible structures and may require removal if existing on-site. If necessary, the distance may be extended to 50 feet.
6. Irrigation shall be provided to maintain healthy vegetation by automatic or manual systems. If this zone consists entirely of native plants, then irrigation systems are not required.
7. Trees found in Appendix C can be planted, if they are Zone B appropriate, far enough from structures, spaced approximately, and do not overhang any structures at maturity.
8. In all cases, the overall characteristics of the landscape provide adequate defensible space in a fire environment.

Zone C: Native Brush Thinning Zone – from the outer edge of Zone B to 200 feet from the structure

Approved plan description: Extends from the outermost edge of Zone B up to 200 feet from the structure.

1. Required thinning and clearance will be determined upon inspection and required clearance may be increased to the maximum allowed by LACoFD.
2. Irrigation systems are not required if the zone entirely consists of native plants.
3. Vegetation may consist of modified existing native plants, adequately spaced ornamental shrubs, trees, or both.
4. In all cases, the overall characteristics of the landscape provide adequate defensible space in a fire environment.
5. Plants in Zone C shall be spaced appropriately and existing native vegetation shall be modified by thinning and removal of species constituting fire risks such as but not limited to chamise, sage, sagebrush, and buckwheat.
6. Annual grasses and weeds shall not exceed a height of 3 inches.
7. General spacing for existing native shrubs or groups is 15 feet between canopies. Native plants may be thinned by reducing the amounts as the distance from the development increases.

8. General spacing for existing native trees or groups of trees is 30 feet between canopies. This may be increased or decreased depending on the slope, arrangement of trees, and the species of the trees.

Zone C is considered a thinning zone and is any FMZ greater than 100 feet from structures. When provided, either by conditions of development, voluntary by the property owner, or required by the LACoFD, this zone is more of a progressive thinning zone to lessen the spread of fire as it approaches the primary FMZ adjacent to structures. The amount of fuel reduction and removal should take into consideration the type and density of fuels, aspects, topography, weather patterns, and fire history. In no case shall Zone C be less than 100 feet wide.

6.5.1.2.1 Fire Access Road Zone/Roadway Clearance

Approved plan description: Extends a minimum of 10 feet from the edge of any public or private roadway that may be used as access for fire-fighting apparatus or resources. Clear and remove flammable growth for a minimum of 10 feet on each side of the access roads. (Fire Code 325.10) Additional clearance beyond 10 feet may be required upon inspection. Required on all areas of the Project.

1. Required clearance extends a minimum of 10 feet from the edge of any public or private roadway as well as an unobstructed vertical clearance of 13-feet and 6 inches.
2. Landscaping and native plants shall be appropriately spaced and maintained.
3. Trees found in Appendix C can be planted, if they are provided up to 13 feet and 6 inches of vertical clearance from Fire Department accesses.

Roadside fuel modification for the Project consists of maintaining ornamental landscapes, including trees, clear of dead and dying plant materials. Per section 325.10 of the County Fire Code, LACoFD may require additional removal and clearance of flammable vegetation or combustible growth along roadsides. Vegetation clearance would be a minimum of 10 feet on each side of the roadway whether public or private road. The minimum clearance of 10 feet may be increased if the fire code official determines additional distance is required to provide reasonable fire safety. Any landscaping along roads would be comprised of fire-resistive drought-tolerant species and be regularly maintained by the HOA.

6.5.1.2.2 Special Fuel Management Issues

On the Project Site, tree planting in the fuel modification zones and along roadways is acceptable, as long as they meet the following restrictions as described below and in the County’s Fire Code and the LACoFD’s Guide to Defensible Space and Fuel Modification Zones spacing requirements:

- For streetscape planting, trees should be planted 10 feet from the edge of the curb to the center of the tree trunk. Care should be given to the type of tree selected so that it will not encroach into the roadway, or produce a closed canopy effect.
- Crowns of trees located within defensible space shall maintain a minimum horizontal clearance of 15 feet for a single tree. Mature trees shall be pruned to remove limbs one-third the height of six feet, whichever is less, above the ground surface adjacent to the trees.
- Deadwood and litter shall be regularly removed from trees.
- Ornamental trees shall be limited to groupings of 2–3 trees with canopies for each grouping separated horizontally.

6.5.1.2.3 Specific Landscaping Requirements

The following requirements are provided for HOA-maintained fuel modification zones. All landscaping shall be maintained by the HOA or other approved entity.

Plants used in the fuel modification areas or landscapes will include drought-tolerant, fire-resistive trees, shrubs, and groundcovers. The planting list and spacing will be reviewed and approved by LACoFD, included on submitted landscape plans. The plantings will be consistent with LACoFD's Suggested Plant Reference Guide (refer to Appendix C). The suggested plant reference guide intends to provide examples of plants that are less prone to ignite or spread flames to other vegetation and combustible structures during a wildfire. Additional Plants can be added to the landscape plant material palette with approval from LACoFD.

6.5.1.2.4 Pre-Construction Requirements

Per Los Angeles County Fire Code, 4906.2, A fuel modification plan shall be submitted and have preliminary approval prior to any subdivision of land; or, have final approval prior to the issuance of a permit for any permanent structure used for habitation; where, such structure or subdivision is located within areas designated as a FHSZ within SRAs or VHFHSZs within the Local Responsibility areas, applicable Fire Hazard Zone maps, and code at the time of application. An on-site inspection must be conducted by the personnel of the Forestry Division of the Fire Department and final approval of the fuel modification plan issued by the Forestry Division prior to a certificate of occupancy being granted by the building code official.

6.5.1.2.5 Undesirable Plants

Certain plants are considered to be undesirable in the landscape due to characteristics that make them highly flammable. These characteristics can be physical (structures promote ignition or combustible) or chemical (volatile chemicals increase flammability or combustion characteristics). The plants included in the FMZ Undesirable Plan List (refer to Appendix D) are unacceptable from a fire safety standpoint and shall not be planted or allowed to establish opportunistically within the FMZs or landscape areas.

6.5.2 Fuel Modification Area Vegetation Maintenance Requirement

Per the approved fuel modification plan the Project is required to maintain fuel modification zones on at least an annual basis and more often as required in perpetuity. All fuel modification area vegetation management within the FMZs shall be completed annually prior to inspections each year and more often as needed for fire safety, as determined by the LACoFD.

The individual homeowners shall be responsible for all fuel modification vegetation management on their lots in compliance with the plan and the LACoFD requirements. The Project HOA or other approved entity, shall be responsible for all fuel modification vegetation management for all common areas of the Project Site, including roadsides clearance and fuel modification zones. The Project HOA or other approved entity will assure private homeowner lots comply with the plan initially and on an ongoing basis. Chapter 7A requirements for ongoing maintenance of fire-resistive building materials and fire sprinkler systems will be included in the CC&Rs and Deed encumbrances for each lot. Additionally, the Project HOA or other approved entity shall be responsible for

ensuring long-term funding and ongoing compliance with all provisions of the FPP, including vegetation planting, fuel modification on the perimeter, and maintenance requirements on all common areas and roadsides.

Routine maintenance shall be performed regularly in all zones per the requirements below and outlines in the Fuel Modification Guide:

- Removal or thinning of undesirable combustible vegetation and removal of dead or dying landscaping
- Pruning and thinning to reduce overall fuel load and continuity of fuels
- Fuel loads shall be reduced by pruning lower branches of trees and tree-form shrubs to 1/3 of their height, or 8 feet from the lowest hanging branch. Trees with understory plants should be limbed up to at least three times the height of the underlying vegetations or up to 40 feet.
- Accumulated plant litter and deadwood shall be removed. Debris and trimming produced by thinning should be removed from the site or chipped and evenly dispersed to a maximum depth of 6 inches.
- All invasive species and their parts should be removed from the site
- Manual and automatic irrigation systems shall be maintained for operational integrity and programming. Effectiveness should be regularly evaluated.
- Compliance with the Fire Code is a year-round responsibility. Enforcement will occur following an inspection by the fire department
- All future plantings shall be in accordance with LACoFD Fuel Modification Guidelines and approved prior to installation.

Long-term maintenance of FMZs and Defensible Space is an important component for the long-term fire safety of the Project. Long-term maintenance obligations will be as follows:

- All future plantings shall be in accordance with LACoFD Fuel modification Guidelines.
- All lots will be required to submit plans to the LACoFD Fuel Modification Unit prior to landscaping being installed and must be identified in the CC&Rs
- Changing landscaping in common areas or individual lots will be reviewed by the LACoFD Fuel Modification Unit and approved prior to installation.
- Walls may be required on lots based on the location of structure and proximity to slope and be determined upon final tract submittal or individual lot review

Project HOA or other approved entity Maintenance Responsibilities:

- The Project HOA or other approved entity will maintain the access roads, including a minimum of 10 feet of clearance on each side of the road(s) within the Development Footprint adjacent to open space areas.
- The Project HOA or other approved entity will be required to annually maintain the FMZs (or as needed).
- The Project HOA or other approved entity will maintain all common areas, including trees planted along roadways and in other areas throughout Project.

Resident/Homeowner Maintenance Responsibilities:

- Maintenance of vegetation on individual property lots.

6.5.3 Annual Fuel Modification Zone Compliance Inspection

To confirm that the Project's FMZs and landscape areas are being maintained according to the FPP and the LACoFD's fuel modification guidelines, the Project's HOA or other approved entity would obtain an FMZ inspection and report from Dudek or a qualified LACoFD-approved 3rd party inspector in May/June of each year certifying that vegetation management activities throughout the Project Site have been performed. If the FMZ areas are not compliant, the Project HOA or other approved entity will have a specified period to correct any noted issues so that a re-inspection can occur and certification can be achieved. Annual inspection fees are subject to the current Fire Department Fee Schedule.

6.5.4 Construction Phase Vegetation Management

Vegetation management requirements shall be implemented at commencement and throughout the construction phase. Vegetation management for the Project area shall be performed pursuant to the FPP and LACoFD requirements on all building locations prior to the start of work and prior to any import of combustible construction materials. Adequate fuel breaks shall be created around all grading, site work, and other construction activities in areas where there is flammable vegetation. Combustible materials will not be brought on-site without prior fire department approval.

In addition to the requirements outlined above, the Project will comply with the following important risk-reducing vegetation management guidelines:

- All-new power lines shall be installed underground for fire safety purposes. Temporary construction power lines may be allowed in areas that have been cleared of combustible vegetation.
- Caution must be used not to cause erosion or ground (including slope) instability or water runoff due to vegetation removal, vegetation management, maintenance, landscaping, or irrigation.

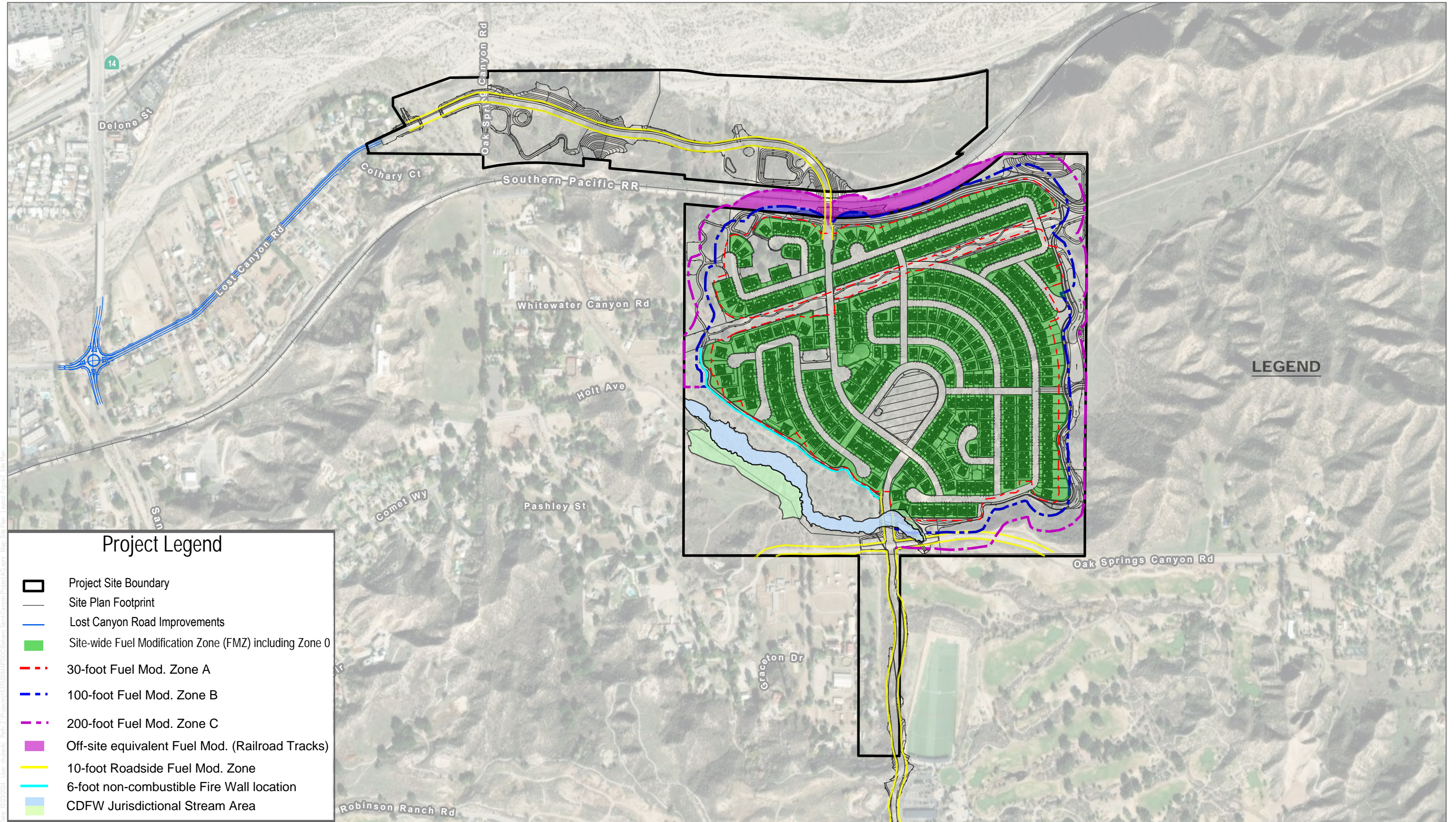
6.6 Requirements for Activities in a Hazardous Fire Area

The Project will comply with County Fire requirements for activities per Section 326 Activities in Wildfire Risk Areas of Title 32:

1. Permits shall be required for the following similar activities: recreational activities such as but not limited to rifle ranges, carnivals, public assembly events, fireworks, open burning, stands for cooking, or other activities which could provide an ignition source.
2. The following but not limited to fire protection facilities/conditions shall be required to maintain fire safety during activities:
 - a. Adequate water supply
 - b. Firebreaks
 - c. No smoking signs
 - d. Removal of dry grass and weeds along roadways, parking areas, or other areas accessible to the public/participants of the activity

- e. Fire watch or fireguards when the activity is taking place
 - f. Adequate access and parking facilities to prevent congestion, permit adequate egress for evacuation, and permit movement of fire apparatus equipment
 - g. Restriction of activities during periods of high fire hazard weather conditions
 - h. Fencing
 - i. Other conditions, limitations, or provisions to maintain reasonable fire safety
3. Any portion of public or private land in a wildfire risk area may be closed to the public by the fire code official at the request of the owners when in the opinion of the fire official the closure is necessary to prevent fires.
 4. No person shall use or operate in, upon, or within a wildfire risk area any tractors, construction equipment, machinery, or any steam, oil, or gasoline operated stationary or mobile equipment unless said equipment is provided with a qualified device or spark arrestor.
 5. Any chimney to a fireplace, incinerator, or heating appliance that uses a solid or liquid fuel within a wildfire risk area shall be maintained with a spark arrestor with heavy wire mesh or other non-combustible material with no more than ½ inch openings.
 6. No person shall operate or use an open flame device within a wildfire risk area.
 7. No person except for a public officer shall drive or park a motorcycle, motor scooter, or motor vehicle upon any fire road or firebreak, obstruct the entrance to a fire road or firebreak, or install or maintain radio or television aerials or any other obstruction on a fire road or fire break that is less than 16 feet above said fire road or fire break.

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LEGEND

Project Legend

- Project Site Boundary
- Site Plan Footprint
- Lost Canyon Road Improvements
- Site-wide Fuel Modification Zone (FMZ) including Zone 0
- 30-foot Fuel Mod. Zone A
- 100-foot Fuel Mod. Zone B
- 200-foot Fuel Mod. Zone C
- Off-site equivalent Fuel Mod. (Railroad Tracks)
- 10-foot Roadside Fuel Mod. Zone
- 6-foot non-combustible Fire Wall location
- CDFW Jurisdictional Stream Area

SOURCE: Esri World Imagery 2022; Alliance Land Planning & Engineering 2024



FIGURE 9

Draft Fuel Modification Zone Map
 Belcaro at Sand Canyon Project Fire Protection Plan

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7 Justification for Reduced Fuel Modification Zones

As presented in this FPP, the majority of the FMZs provided for the proposed Belcaro at Sand Canyon Project are consistent with the LACoFD defensible space standards, however, the southwest portion of the development is adjacent to a CDFW jurisdictional stream/channel and in order to reduce direct impacts to these areas the project includes reduced fuel modification zone areas. The lots in the southwest portion of the development which are adjacent to the low-fuel CDFW jurisdictional streambed/channel provides an opportunity to construct a non-combustible, six-foot tall, heat-deflecting wall (lower 1 to 2 feet block wall and upper 4 to 5 feet dual pane, one pane tempered glass glazing) to provide additional deflection for these lots to compensate for the reduced fuel modification zones not standard FMZs.

An important component of a fire protection system for this Project is the provision for ignition-resistant construction and modified vegetation buffers. The structure ignition resistance standards detailed in the 2022 California Fire Code and Chapter 7A of the 2022 California Building code will enable the new residential structures to withstand the type of wildfire that may occur in the fuels outside the development footprint. Fuel modification zone requirements, including a minimum up to 100 feet of fully irrigated landscapes with drought-tolerant, fire resistive plantings (Zones 1 and 2) and an additional up to 100-foot zone (Zone 3), will provide a reasonable level of wildfire protection to the ignition resistant structure. Additionally, undesirable, highly flammable plant species shall not be planted in fuel modification zones. For the lots in the southwest portion of the development that are unable to achieve the full up to 200-foot-wide FMZ, the construction of a 6-foot fire view wall along the rear property boundary of the lots in the southwest portion of the development will function as heat-deflecting wall and stop the progression of a ground fire from advancing into the rear yards of these lots. Also, yearly fuel modification maintenance shall be required for all lots by the Project's HOA/or other approved entity and each individual property owner. The community's HOA/or other approved entity as well as individual property owners, shall be responsible for obtaining an FMZ inspection and report from a qualified LACoFD-approved 3rd party inspector in May of each year. Dudek has found that the code-exceeding mitigation measure provided have been used for many other similar successful projects and demonstrate that they meet or exceed the code required 200-foot-wide fuel modification zone. Fire behavior modeling, as previously presented, was used to predict flame lengths and was not intended to determine sufficient fuel modification zone widths. However, the results of the fire modeling provide important fire behavior projections, which is key supporting information for determining buffer widths that would minimize structure ignition and provide "defensible space" for firefighters. With that said, it is anticipated that the proposed structures will be able to withstand the short duration, low to moderate intensity fire and ember shower that is projected from off-site, adjacent fuels based on several factors, as discussed below.

7.1 Structure Ignition

There are two primary concerns for structure ignition: 1) radiant and/or convective heat and 2) burning embers (NFPA 1144 2008, IBHS 2008, and others). Burning embers have been a focus of building code updates for at least the last decade, and new structures in the WUI built to these codes have proven to be very ignition resistant. Likewise, radiant and convective heat impacts on structures have been minimized through the Chapter 7A exterior fire ratings for walls, windows and doors. Additionally, provisions for modified fuel areas separating wildland fuels from structures have reduced the number of fuel-related structure losses. As such, most of the

primary components of the layered fire protection system provided for the Project are required by the County and State codes but are worth listing because they have been proven effective for minimizing structural vulnerability to wildfire and, with the inclusion of required interior sprinklers (required in the 2013 Building/Fire Code update), of extinguishing interior fires, should embers succeed in entering a structure. Even though these measures are now required by the latest Building and Fire Codes, at one time, they were used as mitigation measures for buildings in WUI areas, because they were known to reduce structure vulnerability to wildfire. These measures performed so well, they were adopted into the code. The following project features are required for this new development in WUI areas and form the basis of the system of protection necessary to minimize structural ignitions as well as providing adequate access by emergency responders:

1. Application of Chapter 7A, ignition resistant building requirements
2. Minimum 1-hour rated exterior walls and doors
3. Multi- pane glazing with a minimum of one tempered pane, fire-resistance rating of not less than 20 minutes when tested according to NFPA 257, or be tested to meet the performance requirements of State Fire Marshal Standard 12-7A-2. For lots unable to achieve the full 100 feet of FMZs (Lots 1 through 5, 7 and 8) dual pane dual tempered glass windows will be installed on the exposed sides of the new residential structures. Dual pane, one pane tempered glass has been shown during testing and in after fire assessments to significantly decrease the risk of breakage and ember entry into structures. Therefore, requiring code-exceeding dual pane, both panes tempered is anticipated to be an important safety measure that provides enhanced structure protection and provides mitigation for reduced fuel modification zones and limited setbacks from adjacent structures. *The window upgrade also exceeds the requirements of Chapter 7A of the CBC and providing additional protection for the structure's most vulnerable, exterior side.*
4. Ember resistant vents (recommend BrandGuard or similar vents)
5. Automatic, interior fire sprinkler system to code for occupancy type.

7.2 Fuel Separation

As experienced in numerous wildfires, including the most recent fire storms in San Diego County (2003 and 2007), homes in the WUI are potential fuel. The distance between the wildland fire that is consuming wildland fuel and the home (“urban fuel”) is the primary factor for structure ignition (not including burning embers). The closer a fire is to a structure, the higher the level of heat exposure (Cohen 2000). However, studies indicate that given certain assumptions (e.g., 10 meters of low fuel landscape, no open windows), wildfire does not spread to homes unless the fuel and heat requirements (of the home) are sufficient for ignition and continued combustion (Cohen 1995, Alexander et al. 1998). Construction materials and methods can prevent or minimize ignitions. Similar case studies indicate that with nonflammable roofs and vegetation modification from 10 to 18 meters (roughly 32 to 60 feet) in southern California fires, 85% to 95% of the homes survived (Howard et al. 1973, Foote and Gilless 1996). Similarly, San Diego County after fire assessments indicate strongly that the building codes are working in preventing home loss: of 15,000 structures within the 2003 fire perimeter, 17% (1,050) were damaged or destroyed. However, of the 400 structures built to the 2001 codes (the most recent at the time), only 4% (16) were damaged or destroyed. Further, of the 8,300 homes that were within the 2007 fire perimeter, 17% were damaged or destroyed. A much smaller percentage (3%) of the 789 homes that were built to 2001 codes were impacted and an even smaller percentage (2%) of the 1,218 structures built to the 2004 Codes were impacted (IBHS 2008). Damage to the

structures built to the latest codes is likely from flammable landscape plantings or objects next to structures or open windows or doors (Hunter 2008).

These results support Cohen's (2000) findings that if a community's homes have a sufficiently low home ignitability, the community can survive exposure to wildfire without major fire destruction. This provides the option of mitigating the wildland fire threat to homes/structures at the residential location without extensive wildland fuel reduction. Cohen's (1995) studies suggest, as a rule-of-thumb, larger flame lengths and widths require wider fuel modification zones to reduce structure ignition. For example, valid SIAM results indicate that a 20-foot-high flame has minimal radiant heat to ignite a structure (bare wood) beyond 33 feet (horizontal distance). Whereas, a 70-foot-high flame requires about 130 feet of clearance to prevent structure ignitions from radiant heat (Cohen and Butler 1996). This study utilized bare wood, which is more combustible than the ignition resistant exterior walls for structures built today. Obstacles, including steep terrain and non-combustible fire walls can block or deflect all or part of the radiation and heat, thus making narrower fuel modification distances possible. Fires in ravines, chutes, coves, v-drainages, and steep-sided canyons can, under specific conditions, result in an upward draft, similar to a fireplace chimney. Chimneys on the landscape are created when air is drawn in from lower elevations, creating strong upslope drafts. The result can be acceleration of radiant and convective heat as well as actual fire spread, similar to opening the damper in a fireplace chimney. Areas where the terrain includes a restriction or narrowing can result in this type of acceleration. The terrain features adjacent the Project site include flat areas with little to no examples of these "chimneys" that are not expected to significantly alter fire behavior.

7.3 Heat Deflecting Walls

The southwest portion of the development is adjacent to a CDFW jurisdictional stream/channel and in order to reduce direct impacts to these areas the project includes reduced fuel modification zone areas. The lots in the southwest portion of the development which are adjacent to the low-fuel CDFW jurisdictional streambed/channel provides an opportunity to construct a non-combustible, six-foot tall, heat-deflecting wall (lower 1 to 2 feet block wall and upper 4 to 5 feet dual pane, one pane tempered glazing or a six-foot high CMU block wall) to provide additional deflection for these lots to compensate for the reduced fuel modification zones. Walls like these have proven to deflect heat and airborne embers on numerous wildfires in San Diego, Orange, Los Angeles, Ventura, and Santa Barbara County. Rancho Santa Fe Fire Protection District, Laguna Beach Fire Department, Orange County Fire Authority, and others utilize these walls as Alternative methods based on observed performance during wildfires. This has led to these agencies approving use of non-combustible landscape walls as mitigations for reduced fuel modification zones and reduced setbacks at top of slope. These walls are consistent with NFPA 1144 Standard for Reducing Structure Ignition Hazards from Wildland Fire – 2008 Edition, Section 5.1.3.3 and A.5.1.3.3 and International Urban Wildland Interface Code (ICC 2012). NFPA 1144, A.5.1.3.3 states: "Noncombustible walls and barriers are effective for deflecting radiant heat and windblown embers from structures." These walls and barriers are usually constructed of noncombustible materials (concrete block, bricks, stone, stucco) or earth with emergency access openings built around a development where 30 feet (9 meters) of defensible space is not available.

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8 Additional Factors for Reducing Potential Wildfire Risks Associated with the Project's Introduction of New Development

Research indicates that while humans can drive wildfire ignition risk in the WUI, comprehensive actions can be taken to mitigate such risks to less than significant levels (Elia et al., 2019). When fire protection is implemented at the parcel level and leverages ignition resistant building materials, infrastructure improvements, increased response capacity, and incorporates landscape design FMZs, the wildfire risk can be reduced not only within the proposed development but in the surrounding environment as well (Newman et al., 2013). The following section summarizes factors for determining wildfire risk from new development and potential opportunities to mitigate such risks.

Research has indicated that increased human activity in WUI areas can result in an increased likelihood of ignition (Keeley & Syphard, 2018; Syphard, Clayton, et al., 2007; Syphard & Keeley, 2015). As such, residential development within fire-prone areas is commonly characterized as the principal driver of wildfire risk (Keeley & Syphard, 2018; Syphard, Clayton, et al., 2007; Syphard & Keeley, 2015). However, as humans can drive wildfire risk they can in turn reduce it by household level or parcel level decisions, such as home siting, building materials, and landscape design that can reduce risk in the WUI environment (Newman et al., 2013). These decisions can take the form of reducing fire ignition risks by converting fire-prone areas to ignition-resistant, maintaining ground covers, constructing ignition-resistant homes and hardscapes, and increasing the development setback from the wildland-urban interface (Newman et al., 2013). This change occurs through the strategic implementation of fire protection measures that result in planned alterations to fuel, increased ignition resistant construction, enhanced fire protection features, higher wildfire risk awareness, and maintenance of fire protection features. When developments are planned accordingly, the fuel availability and fuel continuity decrease, while the probability of fire suppression increases (Fox et al., 2018).

The dual benefit of building a fire-hardened development is that the same features that protect the development from a wildfire also play a significant role in protecting wildlands and surrounding areas from Project-related fires through ignition reduction.

8.1 Reducing Wildfire Risks Associated with Introducing Ignition Sources and increasing Human Activities in the WUI

As previously mentioned, in southern California humans play a major role in ignitions by influencing the timing and spatial pattern of fires (Keeley & Syphard, 2018). As a result, humans account for more than 95% of ignitions in the region (Keeley & Syphard, 2018). The relationship between human activities and natural dynamics has contributed to altering fire regimes (Syphard et al., 2007). One alteration is that urban development increases the risk of repeated fires on the landscape (Syphard, Clarke, et al., 2007). As humans move into landscapes with

patterns of ignitions change as well (Syphard, Clarke, et al., 2007). However, the number of ignitions and the area burned varies by an ignition source (Syphard & Keeley, 2015). Overall, human-caused ignitions peaked in 1980 and have since dropped likely due to increased efficiencies in fire prevention, changes in infrastructure, a decline in smoking, neighborhood watch program, penalties for arsonists, and new developmental rules (Keeley & Syphard, 2018). However, while the number of ignitions has decreased the area burned has not changed, indicating while fires are fewer, they are larger in magnitude (Keeley & Syphard, 2018). The relationship between ignitions and human development is complex. While human-caused ignitions increase as populations and development expand into the WUI this increase reaches a peak and then declines at the point at which development or impervious surfaces (hardscape) outweigh the wildland fuels (Keeley & Syphard, 2018).

By analyzing all wildfire ignitions included in the CAL FIRE Fire and Resource Assessment Program (FRAP) database dating back over 100 years it was found that in the case of one Southern California county (San Diego County), equipment-caused fires were by far the most numerous (Syphard & Keeley, 2015). These ignitions accounted for most of the area burned, followed closely by the area burned by power line fires (Syphard & Keeley, 2015). This pattern is consistent beyond San Diego County and is applicable in Los Angeles County. In Los Angeles County a common source of wildfire ignition stems from human activities such as smoking, playing with fire, and powerlines (Keeley & Syphard, 2018). Ignitions are classified as equipment caused resulted from exhaust or sparks from power saws or other equipment with gas or electric motors, such as lawnmowers, trimmers, or tractors. In San Diego County and Los Angeles County, ignitions were more likely to occur close to roads and structures, and intermediate structure densities (Syphard & Keeley, 2015). Powerline-based ignitions that have caused or contributed to recent fires, such as the Camp Fire in 2018, have demonstrated how the presence of powerlines (particularly the lower height distribution lines) can result in significant wildfire ignitions. Part of the challenge is that as humans push into WUI areas powerlines are often located in areas where access is difficult creating challenges for firefighting tactics (Syphard & Keeley, 2015). Research has indicated that important factors in structure loss are the coincidence of human-caused ignitions with severe weather and the location and pattern of housing development (Schwartz & Syphard, 2021). However, it is important to note that often these themes are researched in isolation with small proportions studying two more themes limiting our understanding of the interactions and dependencies (Price et al., 2021).

Given the number and intensity of wildfires in recent years, there has been an increasing focus on wildfires and reducing the size of wildfires (Syphard et al., 2014). However, addressing wildfires in the WUI with fuels reduction and prescribed burning is often faced with challenges related to private property constrictions (Schwartz & Syphard, 2021). Studies have shown that land-use decision-making, defensible space, homeowner preparation, and ignition prevention can complement traditional management in reducing wildfires and addressing fuels management (Schwartz & Syphard, 2021; Syphard et al., 2017). Further, given the importance of the WUI and often the lack of capacity for large-scale fuels reduction creating safer spaces within the WUI is critical (Schwartz & Syphard, 2021). Because most fires are caused by humans, ignition reduction is a powerful management strategy (Syphard & Keeley, 2015). Given that we are moving into a more hazardous wildfire future land-use planning and ignition prevention represent the most effective long-term solutions while traditional management and fuel breaks still play a role in addressing the coincidence of human-caused ignitions and severe fire weather (Schwartz & Syphard, 2021; Syphard et al., 2017).

To minimize the negative effects, the Project has designed multi-scaled fire protection features to address the existing fire hazard, reduce ignition probability, and lower the fire risk for the Project and the surrounding area. As discussed above, one of the most effective solutions to wildfire problems in the WUI is to address the wildfire hazard through land-use planning and ignition prevention. The Project would result in the conversion of readily ignitable

fuels, such as grass and scrub fuels, to irrigated/thinned landscaping and development. Notably, the Project minimizes ignition risk by incorporating a minimum of 100 feet and up to 200-foot-wide FMZs around the entire project perimeter, which will provide defensible space and reduce fire intensity and flame lengths in the event of ignition occurring. These FMZs, which are based on County Fire requirements and confirmed with site-specific modeling, will be implemented by knowledgeable professionals, inspected by third-party inspectors, and maintained in perpetuity by the Project HOA or other approved entity. Additionally, other fuel modification/landscaping requirements like the Project's roadway fuel modification zones, stormwater basin vegetation management, and the prohibition of certain highly flammable plants will further reduce the risk of fire ignition and spread despite the introduction of additional humans in the area. Critically, the structures in the Project will also be built in accordance with the most state-of-the-art, ignition-resistant construction standards and building codes required by the County and the State, including Chapter 7A of the Los Angeles County Building Code (Title 26, Chapter 7A), which requires that the buildings are resistant to ignitions from direct flames, heat, and embers. Other structural requirements include fire-resistant roofing, vent covering and opening limitations, noncombustible or ignition-resistant exterior walls, ignition-resistant eaves, and porch ceilings, insulated windows and exterior doors, and other measures that have proven to substantially reduce the risk of building ignition and fire spread. Finally, a key component of reducing the chances of fire ignition and spread involves educating residents to have a high fire risk awareness. In this respect, the Project includes as mitigation a robust education awareness program that will provide residents with wildfire safety information and create greater risk awareness for occupants and their employees. Through this program, residents will learn about necessary landscape maintenance, activities in a wildfire risk area, preventing wildfires, structural-based fire protection features, and wildfire evacuation information.

As evidenced by these measures and the other measures described in Section 6, the Project has outlined steps in which it will implement ignition reduction from common anthropogenic ignition sources, leverage its capacity for implementing fuels reduction including defensible space, and consider both onsite and offsite wildfire risk. Still, there are other project-specific anthropogenic fire risks that are worthy of being highlighted for the purposes of this FPP. These include powerlines, vehicles, and machinery. Each is discussed below.

8.1.1 Powerlines

Common ignition sources in southern California are related to powerlines and many destructive fires across the State have been caused by powerlines (Keeley & Syphard, 2018). However, this risk can be mitigated by burying powerlines. The Project will underground all project-related distribution power lines on the Project site.

8.1.2 Vehicles

A potential source of vegetation ignitions in the Project area is the existing SR-14 and other roads used by Project residents and occupants. The Project provides roadside fuel modification via the removal of flammable vegetation and provisions for landscaping along roads it controls. The Project includes provisions for creating increased separation from potential roadside ignition sources and potential fuel. These efforts reduce or minimize the ability of a vehicle-related spark, catalytic converter failure, or another ignition source to ignite and spread fire from the roadsides into unmaintained fuels. As such, the Project is not expected to significantly increase the already known fire risk associated the preexisting roads. The onsite roadways would comply with all fire department access requirements and be adjacent to fuel modification. Further, the Interior roadways are also not expected to result in significant vehicle ignitions due to roadside FMZs that would minimize receptive fuel beds for sparks or hot metal from vehicles. Therefore, even if ignition were to occur within the Project, it is highly unlikely it would be sustained

or spread beyond the Project site due to the hardened landscapes, hardscape, and adjacent fuel modifications areas.

8.1.3 Machinery

The use of equipment in WUI areas is another common source of modern-day human-caused ignitions. This is due to heated machinery, sparks, hot fluids, or exhaust igniting vegetation. Potential ignitions due to equipment use can occur during construction activities or ongoing operational risk.

8.1.3.1 Construction Activities

Construction activities associated with the Project would introduce potential ignition sources to the Project site. However, the Project would comply with County Fire requirements for activities in hazardous fire areas and the CFC. Spark arrestors would be required on all equipment with a solid or liquid fuel motor used on the Project Site. The Project would also comply with Section 326.12.1 of the Fire Code which prohibits the use or operation of any tractor, construction equipment, engine, machinery, or any steam, oil, or gasoline-operated stationery or mobile equipment, from which a spark or fire may originate unless such equipment is provided with a qualified device that has been approved by the state fire marshal and that will prevent the escape of fire or sparks. Further construction activities would comply with Chapter 33 of the CFC Fire Safety During Construction and Demolition. Per Section 3304 the Project would take precautions against ignitions such as but not limited to prohibiting smoking except in approved areas, preventing the accumulation of and removing combustible debris, implementing fire watch personnel where required by the fire code official, having approved water supply onsite, and maintaining vehicle access for firefighting to all construction and demolition area. Additionally, the project would prepare a Construction Fire Protection Plan (CFPP) that will address fire safety practices to reduce the possibility of fire during construction activities. However, due to the existing vegetation conditions, there is a potential for a significant fire hazard due to construction activities. As such, additional construction Design Features would be implemented by the Project to lower the potential fire hazard below the level of significance. This would require that prior to combustible materials being brought on-site utilities, access roads, and fuel modification zones would be first established. The design features, CFPP, and regulatory requirements would reduce the risk of wildfire ignition and spread from the Project during construction activities.

8.1.3.2 Operational Activities

Operational activities associated with maintenance or use of the Project site also have the potential to introduce ignitions to the area. The operational activities would also be required to comply with the CFC spark arrestor requirements, Chapter 33 Fire Safety During Construction and Demolition for any post-development construction, maintenance, or renovations, and other applicable codes and requirements based on the activity type. Operational activities would also comply with County Fire requirements for activities in fire hazard areas as described above. FMZs and landscaping within the Project site would require ongoing maintenance. These common area landscapes and perimeter FMZs would be managed and maintained by the HOA or other approved entity through a qualified contractor. The contractor would be required to meet fire safety requirements regarding equipment, the timing of maintenance, and fire suppression capabilities. This type of maintenance program is far safer and more controlled than if each homeowner provided their own maintenance of FMZ areas. Additionally, maintaining the FMZs and landscaping accordingly would allow them to continue their function purpose of reducing potential ignition and fire spread both from fire onsite or offsite in origin. Further, even if the equipment were to cause a fire it is unlikely it

would spread offsite due to the adjacent FMZs and ignition resistant landscape. A robust wildfire education program would provide residents and occupants with ongoing education regarding wildfire. The education program would be implemented by the HOA or other approved entity and have a layered approach to wildfire awareness that includes both passive and active features. The educational program would cover a wide range of information such as residential evacuation planning, defensible space guidelines, how to maintain fire protection features, activities in a fire risk area, and more, all provided in easy-to-understand, graphically based materials. This would education regarding safe activities in wildfire risk areas, including the appropriate use of machinery, during red flag warning days, restrictions on the use of machinery in the Project area would be implemented. This requirement, in conjunction with the Project Design and regulation compliance, will significantly reduce potential ignitions both in the Project area and limit the potential impact on the surrounding area.

8.1.4 Project Design Features Addressing Fire Risk Associated with increasing Human Activities in the WUI

8.1.4.1 Vegetation Management

The fuel conditions immediately adjacent to the Project will also be addressed through FMZs. The existing hazardous fuel, mostly shrub fuels, on the Project site and within FMZ areas would be converted into hardscape and or to reduce fuel densities that are managed and maintained. In an FMZ, combustible vegetation would be removed and/or partially or totally replaced with more appropriately spaced drought-tolerant, fire-resistant plants including an irrigated zone. This would provide a managed area where fire spread is not facilitated toward the Project or away from the Project into wildland areas by redistributing the fire risk on a landscape and altering the interaction between fire, fuels, and weather (Cochrane et al., 2012). FMZs would also reduce the likelihood of canopy fires, lower ember cast, and have a shadow effect on the untreated landscape by reducing the probability of burning and the potential fire size (Cochrane et al., 2012). As such, the Project would lower ignition potential in the area by reducing and altering the available fuel-scape to a less flammable managed condition not conducive to fire spread and increasing the probability of fire suppression if ignition occurs (Fox et al., 2018). Further, the Project benefits from an historic grazing program that addresses larger scale landscape fuel conditions. As a result, the risk of a structure being destroyed, whether from a fire from within the development or outside the development, is significantly lower when defensible space is implemented. Studies have also indicated that treatments in close proximity to residential buildings provide greater protection (Syphard et al., 2014). Accordingly, the Project will provide an ERZ which is a 5-foot-wide non-combustible zone around all structures to address the potential for ember-caused ignitions next to structures.

The Project's FMZs and fuels management will serve to create defensible space around the structures. Defensible space adjacent to structures also functions to limit the spread of fire from the built environment into off-site vegetation (Warziniack et al., 2019). The FMZ areas and historic grazing areas function as fuel breaks which are crucial in reducing fire risk and facilitating effective fire prevention (Wang et al., 2021) The irrigated zone acts as a green barrier that uses specific vegetation growth, such as high-internal moisture, fire-resistive species, to reduce fire spread (Wang et al., 2021). The high internal moisture and spacing between plant groups make it more difficult for ignition to occur and fires to spread from plant to plant. This affects fire behavior by reducing flame lengths, slowing spread rates, and lowering fire intensity. If a fire from a structure or vehicle spread to the irrigated zone, the fire-resistive species in this zone would be less likely to ignite and reduce the likelihood of the fire spreading off-site (Wang et al., 2021). The use of irrigated areas to reduce wildfire impacts can achieve wildfire mitigation and offer wildfire protection in fire-prone areas beyond the Project site (Wang et al., 2021). Further fuel treatments also

have an ecological benefit by reducing the potential fire severity which can result in high post-fire litter cover, higher herbaceous plant cover, higher biodiversity, and lower levels of invasive pests, benefiting adjacent open space areas (Safford et al., 2009b). The benefits of defensible space and FMZs are not solely limited to the built environment. Positioning the low plant density, irrigated zone directly adjacent to the development pad, and implementing defensible space provides a significant buffer between structures and open space areas. These techniques aid in preventing ignitions in the built environment but also across the larger landscape.

However, long-term protection of the development and the surrounding area is dependent on the maintenance of fuel modification as even fire-safe designs can degrade over time. To alleviate this concern, the Project will conduct annual assessments of the FMZs and the Project HOA or other approved entity will be responsible for the long-term funding of fire protection features. During this maintenance, dead and dying material and undesirable plants will be removed. Thinning will also be conducted as necessary to maintain plant spacing and fuel densities. This will keep the FMZs and landscaped areas in a highly fire-resistive condition free of accumulated flammable debris and plants.

These features will further reduce the potential for wildfire in open space areas and potential impacts on surrounding communities.

8.1.4.2 Ignition Resistant Construction

With the incorporation of ignition-resistant construction, the likelihood of structural ignition occurring within the Project area is minimized. Ignition-resistant construction is critical in preventing building ignitions from windblown embers. The Project will comply with Chapter 7A of the Los Angeles County Building Code (Title 26, Chapter 7A), “Construction Methods for Exterior Wildfire Exposure” so that the buildings are resistant to ignitions from direct flames, heat, and embers. The Project, based on its location and ember potential, is required to include the latest ignition and ember resistant construction materials and methods for roof assemblies, walls, vents, windows, and appendages, as mandated by the County Fire and the County’s Fire and Building Codes (e.g., Chapter 7A). The structure design is crucial against wind-driven fires and newer homes are more likely to survive. Dual paned windows were significant in protecting against thermal exposure. (Syphard et al., 2017). This lowers the threat of onsite fires impacting offsite areas as the structures themselves are very unlikely to act as fuel which will minimize the potential for home-to-home ignitions, reducing the likelihood of an onsite fire spreading within the community or toward open space. Additionally, the adjacent fuel modification will aid in isolating onsite structure fires or accidental ignitions to the Project area should they occur.

Structure design, such as the those throughout the Project, is crucial in protecting an area against wind-driven fires. The Project provides features that not only prevent fire intrusion but prevent structures fires from escaping into offsite areas. This allows the Project to not only protect the immediate area but the surrounding environment.

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9 Recommended Wildfire Education Program and Early Evacuation

9.1 Recommended Wildfire Education Program

The Project residents and occupants would be provided with ongoing education regarding wildfire, and the FPP's requirements. The educational information would support the fire safety and evacuation features/plans designed for the community. Informational handouts, community website pages, mailers, fire-safe council participation, inspections, and seasonal reminders are some methods that would be used to disseminate wildfire and relocation awareness information. Materials would be provided in multiple languages and formats to ensure that all residents and visitors to the area have access to the Wildfire Education Program. LACoFD would review and approve all wildfire educational material/programs before printing and distribution.

The Belcaro at Sand Canyon Wildfire Education Program's goal is to provide targeted outreach to residents living in a fire risk area in order to foster a community that has fire adaptive capacity. The educational program would cover a wide range of information such as residential evacuation planning, defensible space guidelines, how to maintain fire protection features, activities in a fire risk area, and more, all provided in easy-to-understand, graphically based materials. The educational program will be based on a layered approach to wildfire awareness that includes both passive and active features. The program will be ongoing in order to maintain high wildfire awareness even as the community grows and evolves. Program features are as follows:

1. **Bi-annual email and mailers:** Residents and occupants will be provided with bi-annual emails and mailers in April and in August. They will include information such as reminders about annual defensible space inspections, how to prepare for wildfire season, evacuation information, and how to prevent wildfires. There will also be links to various resources on where to get trusted information such as LACoFD, 211 LA County, and Ready LA County.
2. **Website:** There will be a dedicated community website with more detailed information and resources about wildfire awareness and prevention. The website will serve as a centralized resource for the fire education program and include information from the FPP. The website will also have fire watch and red flag warning alerts, as well as information on restrictions during fire weather conditions. Residents will also be able to use the website to sign up for an annual residential defensible space inspection from the HOA Fire Committee.
3. **Community workshops and webinars:** Two times a year there will be either in-person or virtual community workshops. The goal of the workshops will be to cover various fire topics more in-depth. For example, this could include having an LACoFD representative come to meet the community, a workshop on how to make a go-bag, a workshop on how to make a residential evacuation plan, or how to maintain the fuel modification zones, including 5-foot Ember Resistant Zone 0.
4. **New resident packet:** All residents and new residents in the future will also be presented with a wildfire awareness and safety package upon purchase or rental of a home. Within the package will be a memory stick with the evacuation plan, a list of fire protection features, information on the regional fire hazard, prohibited activities in fire risk areas, how to build a go-bag, and a list of agencies and resources for receiving trusted information.

5. **Emergency alert campaign:** Residents and homeowners will be encouraged to sign up for Alert LA County. Alert LA County is the mass notification system for emergency alerts, weather alerts, health notifications, building alerts, and other updates from County, State, and Federal agencies. The campaign will occur annually and encourage residents to sign up for Alert LA County. Reminders will also be sent out in the bi-annual mailers and emails, on the community website, in the workshops, and in the new resident package.
6. **Fire watch groups:** Within the community, there will also be volunteer fire watch groups. These will be residents or businesses who volunteer to participate in a fire watch group for the community. During red flag warning days, this group will be responsible for reminding residents of fire-safe practices and restrictions. During red flag warning days, the fire watch group will also maintain vigilance of potential fires and will be trained on procedures for alerting LACoFD in the event of a fire.
7. **HOA fire safety committee:** The fire safety committee will be responsible for overseeing the maintenance of community-wide fire protection features. Residents will be able to report fire hazards or hazardous fuel conditions to the HOA committee for remediation. The committee will be responsible for the coordination of the 3rd party FMZ inspections and the volunteer residential defensible space inspections. The committee will also be responsible for the creation and distribution of the educational program for the Project. The committee will serve as a communication link between LACoFD and the community.

Additionally, as described above, the Firewise USA program administered by NFPA is a certification program for communities to gain recognition for the fire-wise design and maintenance of their community. Firewise USA began in 2019 with seven sites that were challenged to improve the fire resilience of their communities through a focused approach to active wildfire risk reduction. This is done through a collaborative framework created to empower neighbors to get organized and take action to reduce wildfire risk at a local level. The program has grown to include over 1.5 million residents living in Firewise USA communities (Firewise USA, 2024). The insurance industry, due to Department of Insurance Regulation #REG-2020-00015, is required to recognize the Firewise certification and consider it when it comes to determining if a community is insurable; cuts to insurance premiums have been made based on this certification. Given the established framework of Firewise USA, its direct mention in regulatory language, and its existing adoption by multiple insurance companies, it can be reasonably anticipated that more companies will require the same certification from customers that attempt to pursue discounted policies.

There are several requirements to become a Firewise USA community and multiple living documents must be prepared. Firewise USA communities must have a minimum of 8 dwelling units and a maximum of 2,500, meaning the proposed Project, in its entirety, would be able to participate in the program (Firewise USA, 2024). In order to be recognized as a Firewise USA community, the following requirements shall be followed by the Belcaro HOA:

1. **Form a board or committee:** Create a board or committee of volunteers to represent the community, made up of residents and partners such as a representative of the local fire department would first need to be formed. A resident leader will need to be identified who will be the program point of contact. The board or committee is responsible for defining the boundaries of the site and determining the number of individual single-family dwelling units within the community or site. As mentioned above, in order to be recognized as a Firewise site, the community must have a minimum of 8 dwelling units and a maximum of 2,500. (Firewise USA, 2024).
2. **Create a Firewise USA portal account:** Create a Firewise USA account and submit an application to your state Firewise USA liaison. (Firewise USA, 2024).

3. **Obtain a wildfire risk assessment:** The board or committee will collaborate with their local wildfire expert or a 3rd-party consultant such as Dudek to complete a community wildfire risk assessment (CWRA). The assessment should be a community-wide view that identifies areas of successful wildfire risk reduction and where improvements could be made. Emphasis should be on the general conditions of homes and related home ignition zones. The CWRA is a living document and would need to be updated at least every five years. (Firewise USA, 2024).
4. **Develop an action plan:** The board or committee will use the CWRA to create a three-year action plan, broken down by year, that identifies and prioritizes actions to reduce ignition to homes. These can include community-wide investments along with suggested homeowner actions and education activities that participants will strive to complete annually, or over a period of multiple years. The action plan document is required to be updated at least every three years. As circumstances change (e.g. completing activities, experiencing a fire or natural disaster, new construction in community, etc.), the action plan may need to be updated more frequently. (Firewise USA, 2024).
5. **Host an educational event:** Host at least one event per year to educate the community about wildfire risk reduction. (Firewise USA, 2024).
6. **Meet the minimum investment:** Every year, neighbors will need to complete educational and risk reduction actions identified in the plan which go towards your site's annual reporting efforts. At a minimum, each site is required to annually invest the equivalent of one (1) volunteer hour per dwelling unit in wildfire risk reduction actions. If your site identifies 100 homes within its boundary, then 100 hours of work or the monetary equivalent, based on the independent sector value of volunteer time, need to be completed for that year. (Firewise USA, 2024).
7. **Submit an annual renewal:** Maintain your Firewise USA status. (Firewise USA, 2024).

In addition to the Firewise certification, the community can hire a qualified individual such as Dudek to assess the community regularly to document compliance with not only the fire code but the insurance industry minimums. Wildfire Risk Assessments have proven valuable in helping communities maintain fire insurance or even apply for reduced premiums, given that the insurance industry evaluates fire resistant features above and beyond what the fire code requires.

9.2 "Ready, Set, Go!"

Early evacuation for any type of wildfire emergency at the Project Site is the preferred method of providing for occupant safety, consistent with LACoFD's current approach within the County of Los Angeles. As such, the Belcaro at Sand Canyon Project would formally adopt, practice, and implement a "Ready, Set, Go!" approach to evacuation.

The "Ready, Set, Go!" concept is widely known and encouraged by the State of California and most fire agencies. Pre-planning for emergencies, including wildfire emergencies, focuses on being prepared, having a well-defined plan, minimizing the potential for errors, maintaining the Project site's fire protection systems, and implementing a conservative (evacuate as early as possible) approach to evacuation during periods of fire weather extremes. The Project's HOA or other approved entity will coordinate with the LACoFD to hold an annual fire safety and evacuation preparedness informational meeting. Representatives of LACoFD will be invited to attend, and important fire and evacuation information will be reviewed. One focus of these meetings and the Project's annual message will be on

the importance of each resident to prepare and be familiar with their own “Ready, Set, Go!” evacuation plan. The Project will also include temporary refuge areas for firefighters, occupants, and nearby residents to shelter should LACoFD or law enforcement determine this a safer approach than evacuations. However, temporary refuge areas are not to replace the principles of Read! Set! Go! But rather provide an additional option to aid in the safe evacuation of the Project site.

Additionally, community readiness is an important aspect of emergency preparedness. The Belcaro at Sand Canyon HOA or other approved entity is encouraged to form a volunteer Community Emergency Response Team (CERT) through the LACoFD CERT program. Further, the Project’s HOA or other approved entity will organize annual evacuation public outreach; engage directly with organizations such as the California Fire Safe Council.

Note that large-scale evacuations during a wildfire or other emergencies are managed by agencies including the Los Angeles County Office of Emergency Management (OEM) Department, law enforcement, and fire agencies. Emergencies are often fluid events and on-scene emergency personnel provide key information and direction regarding evacuations.

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10 Conclusion

The requirements and recommendations set forth in this FPP meet fire safety, building design elements, infrastructure, fuel management/modification, and landscaping recommendations of the applicable codes. The recommendations provided in the FPP have also been designed specifically for the proposed construction of structures within areas designated as VHFHSZ. When properly implemented on an ongoing basis, the fire protection strategies proposed in this FPP should significantly reduce the potential fire threat to vegetation on the community and its structures, as well as assist LACoFD in responding to emergencies within the Project site. The fire protection system provided for the Project Site includes redundant layering of code-compliant, fire-resistant construction materials, and methods that have been shown through post-fire damage assessments to reduce the risk of structural ignition. Additionally, modern infrastructure would be provided, and all structures are required to include interior, automatic fire sprinklers consistent with the County's regulatory standards. Further, the proposed fuel modification on perimeter edges adjacent to the open space areas would provide a buffer between fuels in the open space and structures within the Project site.

Note that this is a conceptual plan, which provides enough detail for LACoFD approval. Detailed plans, such as improvement plans and building permits, demonstrating compliance with the concepts in the FPP and with County Fire Code requirements, would be submitted to LACoFD at the time they are developed.

Fire is a dynamic and somewhat unpredictable occurrence and as such, this FPP does not guarantee that a fire will not occur or will not result in injury, loss of life, or loss of property. There are no warranties, expressed or implied, regarding the suitability or effectiveness of the recommendations and requirements in this FPP, under all circumstances.

The Project's developers, contractors, engineers, and architects are responsible for the proper implementation of the concepts and requirements set forth in the FPP. Homeowners and property managers are also responsible for maintaining their structures and lots, including fuel modification and landscape, as required by this FPP, the LACoFD, and as required by the County Fire Code. Alternative methods of compliance with this FPP can be submitted to the fire authority for consideration.

It will be extremely important for all homeowners, property managers, and occupants to comply with the recommendations and requirements described and required by the FPP on their property. The responsibility to maintain the fuel modification and fire protection features required for the Project site lies with the homeowners. The HOA or similar entity would be responsible for ongoing education and maintenance of the common areas, and the LACoFD would enforce the vegetation management requirements detailed in this FPP. Such requirements would be made part of deed encumbrances and CC&Rs for each lot, as appropriate.

It is recommended that the homeowners or other occupants who may reside within the Belcaro at Sand Canyon Project adopt a conservative approach to fire safety. The approach must include maintaining the landscape and structural components according to the appropriate standards and embracing a "Ready, Set, Go" stance on evacuation.

The Project is not to be considered a shelter-in-place development. However, the fire agencies and/or law enforcement officials may, during an emergency, as they would for any new development providing the layers of fire protection as the project, determine that it is safer to temporarily refuge residents on-site. When an evacuation is ordered, it will occur according to pre-established evacuation decision points or as soon as notice to evacuate is

received, which may vary depending on many environmental and other factors. It is important for anyone living within the WUI to educate themselves on practices that will improve safety.

The goal of the fire protection features, both required and those offered above and beyond the Codes, provided for the Project is to provide the structures with the ability to survive a wildland fire with little intervention from firefighting forces. Preventing ignition to structures results in a reduction of the exposure of firefighters and residents to hazards that threaten personal safety. It will also reduce property damage and losses. Mitigating ignition hazards and fire spread potential reduces the threat to structures and can help the fire department optimize the deployment of personnel and apparatus during a wildfire. The analysis in this FPP provides support and justifications for acceptance of the proposed fuel modification zones for the proposed Belcaro at Sand Canyon Project development footprint based on the site-specific fire environment.

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Appendix A

Representative Site Photograph Log



Photograph 1: Overview photograph of the portion of the Santa Clara Riverbed northwest of the Project site. Photograph taken from the northwestern corner of the Project site, looking northwest.



Photograph 2: Overview photograph of the Santa Clara Riverbed north of the Project site. Photograph taken from the northwestern corner of the Project site, looking northeast.



Photograph 3: Overview photograph of the vegetation on the western side of the portion of the Project site north of the railroad. Photograph taken from the western side of the northern portion of the Project site, looking east.



Photograph 4: Overview photograph of the vegetation on the small hills in the portion of the Project site north of the railroad. Photograph taken from just north of the railroad facing northeast.



Photograph 5: Overview photograph of the vegetation along the railroad where there is a cut through the existing small hills. Photograph taken from the railroad looking east-northeast



Photograph 6: Overview photograph of the vegetation along the railroad on the western side of the Project. Photograph taken from along the railroad near the hills facing west-northwest.



Photograph 7: Overview photograph of the eastern side of the portion of the Project site that is north of the railroad. Photograph taken from this northeastern area, facing northeast.



Photograph 8: Overview photograph of the area to the north of the portion of the Project site north of the railroad, along the Santa Clara Riverbed. Photograph taken from the eastern side of this portion of the Project site facing northwest.



Photograph 9: Overview photograph of the portion of the Project site south of the railroad. Photograph taken from the central area of the northern side of this southern portion looking south-southeast.



Photograph 10: Overview photograph of the railroad east of the Project site. Photograph taken near the central portion of the northern side of the southern portion of the Project site facing northeast.



Photograph 11: Overview photograph of the mountains to the east of the Project site with part of the Project site in the foreground. Photograph taken near the central portion of the northern side of the southern portion of the Project site facing southeast.



Photograph 12: Overview photograph of the western side of the portion of the Project site south of the railroad. Photograph taken near the central portion of the northern side of the southern portion of the Project site facing southwest.



Photograph 13: Overview photograph of typical surface fuels within the Project site. Photograph taken near the central portion of the northern side of the southern portion of the Project site facing south.



Photograph 14: Overview photograph of Oak Springs Canyon Road. Photograph taken from the southwestern corner of the Project site facing east.



Photograph 15: Overview photograph of Oak Springs Canyon Road east of the Project site. Photograph taken from Oak Springs Canyon road facing east.



Photograph 16: Overview photograph of the Project site. Photograph taken from the southeastern corner of the site along Oak Springs Canyon Road facing northwest.

Appendix B

BehavePlus Fire Behavior Analysis

FIRE BEHAVIOR MODELING SUMMARY BELCARO AT SAND CANYON PROJECT, SANTA CLARITA, CALIFORNIA

1 BehavePlus Fire Behavior Modeling History

Fire behavior modeling has been used by researchers for approximately 50+ years to predict how a fire will move through a given landscape (Linn 2003). The models have had varied complexities and applications throughout the years. One model has become the most widely used as the industry standard for predicting fire behavior on a given landscape. That model, known as “BEHAVE”, was developed by the U. S. Government (USDA Forest Service, Rocky Mountain Research Station) and has been in use since 1984. Since that time, it has undergone continued research, improvements, and refinement. The current version, BehavePlus 6.0, includes the latest updates incorporating years of research and testing. Numerous studies have been completed testing the validity of the fire behavior models’ ability to predict fire behavior given site specific inputs. One of the most successful ways the model has been improved has been through post-wildfire modeling (Brown 1972, Lawson 1972, Sneeuwjagt and Frandsen 1977, Andrews 1980, Brown 1982, Rothermel and Rinehart 1983, Bushey 1985, McAlpine and Xanthopoulos 1989, Marsden-Smedley and Catchpole 1995, Grabner, et. al. 1997, Alexander 1998, Grabner et al. 2001, Arca et al. 2005). In this type of study, Behave is used to model fire behavior based on pre-fire conditions in an area that recently burned. Real-world fire behavior, documented during the wildfire, can then be compared to the prediction results of Behave and refinements to the fuel models incorporated, retested, and so on.

Fire behavior modeling conducted on this site includes a relatively high-level of detail and analysis which results in reasonably accurate representations of how wildfire may move through available fuels on and adjacent to the property. Fire behavior calculations are based on site-specific fuel characteristics supported by fire science research that analyzes heat transfer related to specific fire behavior. To objectively predict flame lengths, spread rates, and fireline intensities, this analysis incorporated predominant fuel characteristics, slope percentages, and representative fuel models observed on site. The BehavePlus fire behavior modeling system was used to analyze anticipated fire behavior within and adjacent to key areas just outside of the proposed project site. Predicting wildland fire behavior is not an exact science. As such, the movement of a fire will likely never be fully predictable, especially considering the variations in weather and the limits of weather forecasting. Nevertheless, practiced, and experienced judgment, coupled with a validated fire behavior modeling system, results in useful and accurate fire prevention planning information. To be used effectively, the basic assumptions and limitations of BehavePlus must be understood.

- First, it must be realized that the fire model describes fire behavior only in the flaming front. The primary driving force in the predictive calculations is dead fuels less than one-quarter inch in diameter. These are the fine fuels that carry fire. Fuels greater than one inch have little effect while fuels greater than three inches have no effect on fire behavior.
- Second, the model bases calculations and descriptions on a wildfire spreading through surface fuels that are within six feet of the ground and contiguous to the ground. Surface fuels are often classified as grass, brush, litter, or slash.
- Third, the software assumes that weather and topography are uniform. However, because wildfires almost always burn under non-uniform conditions, length of projection period and choice of fuel model must be carefully considered to obtain useful predictions.

- Fourth, the BehavePlus fire behavior computer modeling system was not intended for determining sufficient fuel modification zone/defensible space widths. However, it does provide the average length of the flames, which is a key element for determining “defensible space” distances for minimizing structure ignition.

Although BehavePlus has some limitations, it can still provide valuable fire behavior predictions which can be used as a tool in the decision-making process. In order to make reliable estimates of fire behavior, one must understand the relationship of fuels to the fire environment and be able to recognize the variations in these fuels. Natural fuels are made up of the various components of vegetation, both live and dead, that occur on a site. The type and quantity will depend upon the soil, climate, geographic features, and the fire history of the site. The major fuel groups of grass, shrub, trees, and slash are defined by their constituent types and quantities of litter and duff layers, dead woody material, grasses and forbs, shrubs, regeneration, and trees. Fire behavior can be predicted largely by analyzing the characteristics of these fuels. Fire behavior is affected by seven principal fuel characteristics: fuel loading, size and shape, compactness, horizontal continuity, vertical arrangement, moisture content, and chemical properties.

The seven fuel characteristics help define the 13 standard fire behavior fuel models¹ and the five custom fuel models developed for Southern California². According to the model classifications, fuel models used in BehavePlus have been classified into four groups, based upon fuel loading (tons/acre), fuel height, and surface to volume ratio. Observation of the fuels in the field (on site) determines which fuel models should be applied in BehavePlus. The following describes the distribution of fuel models among general vegetation types for the standard 13 fuel models and the custom Southern California fuel models:

- Grasses Fuel Models 1 through 3
- Brush Fuel Models 4 through 7, SCAL 14 through 18
- Timber Fuel Models 8 through 10
- Logging Slash Fuel Models 11 through 13

In addition, the aforementioned fuel characteristics were utilized in the recent development of 40 new fire behavior fuel models³ developed for use in BehavePlus modeling efforts. These new models attempt to improve the accuracy of the standard 13 fuel models outside of severe fire season conditions, and to allow for the simulation of fuel treatment prescriptions. The following describes the distribution of fuel models among general vegetation types for the new 40 fuel models:

- Grass Models GR1 through GR9
- Grass-shrub Models GS1 through GS4

¹ Anderson, Hal E. 1982. Aids to Determining Fuel Models for Estimating Fire Behavior. USDA Forest Service Gen. Tech. Report INT-122. Intermountain Forest and Range Experiment Station, Ogden, UT.
² Weise, D.R. and J. Regelbrugge. 1997. Recent chaparral fuel modeling efforts. Prescribed Fire and Effects Research Unit, Riverside Fire Laboratory, Pacific Southwest Research Station. 5p.
³ Scott, Joe H. and Robert E. Burgan. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. Gen. Tech. Rep. RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

- Shrub Models SH1 through SH9
- Timber-understory Models TU1 through TU5
- Timber litter Models TL1 through TL9
- Slash blowdown Models SB1 through SB4

BehavePlus software was used in the development of this Fire Behavior Analysis for the Belcaro at Sand Canyon (Proposed Project) in order to evaluate potential fire behavior for the Project site. Existing site conditions were evaluated, and local weather data was incorporated into the BehavePlus modeling runs.

2 Fuel Models

Dudek utilized the BehavePlus software package to analyze fire behavior potential for the proposed Project site in Santa Clarita, California. Refer to the project's *Fire Behavior Modeling Map* exhibit for the fire modeling scenario locations. As is customary for this type of analysis, three fire scenarios were evaluated for the existing conditions, including one summer, onshore weather condition and two extreme fall, offshore weather conditions. An additional two scenarios were performed for post-project conditions (one extreme fall, offshore weather condition, and one summer, onshore weather condition). The proposed Project site is currently undeveloped with existing, low density residential development to the southwest, the Santa Clara River and California State Route 14 to the north, a golf course to the south, and the San Gabriel Mountains to the east where an additional development is being planned. The Golf course to the south provides an ideal buffer as it is well maintained and irrigated. The Santa Clara River to the north is also unlikely to support fire spread due to the horizontal discontinuity of fuels. Thus, the greatest hazards are an ignition within the wildland-urban intermix to the southwest spreading through the moderate-load grass-shrub vegetation towards the Project or a wildfire approaching from the east spreading through the moderate load grasses and high load shrubs of the mountains towards the Project. However, the Project would have a 200-foot wide fuel modification zone around the entirety of the development that would stop the spread of surface fire or reduce it to an intensity that enables fire suppression forces to intervene and protect any structures from being damaged. With that said, fuels and terrain within and adjacent to the Project could produce flying embers that may affect the home and surrounding community; however, defenses will be built into the new structure to prevent ember penetration and to extinguish fires that may result from ember penetration (requirements of Chapter 7A of the California Building Code).

The BehavePlus software requires site-specific variables for surface fire spread analysis, including fuel type, fuel moisture, wind speed, and slope data. The output variables used in this analysis include surface fires' flame length (feet), rate of spread (mph), fireline intensity (Btu/ft/s), and spotting distance (miles). The following provides a description of the input variables used in processing the BehavePlus models for the proposed Project site. In addition, data sources are cited and any assumptions made during the modeling process are described.

2.1 Vegetation (Fuels)

To support the fire behavior modeling efforts conducted for the proposed Project, the different vegetation types observed within the Project area and are adjacent to/surrounding the proposed Project site were classified into the aforementioned numeric fuel models. As is customary for this type of analysis, the terrain and fuels within and adjacent to the project areas were used for determining flame lengths and fire spread. It is these fuels that would

have the potential to affect the proposed Project’s structures from a radiant and convective heat perspective as well as from direct flame impingement.

Vegetation types were derived from a site visit that was conducted on June 25, 2024, by a Dudek Fire Protection Planner. The fuel bed of the modeled area generally consists of shrublands and grasslands of varying fuel load intensities with the fuel loading onsite being lesser than the mountainsides to the east. These fuel types can produce flying embers that may affect the project; however, defenses will be built into the proposed development to prevent ember penetration. Table 1 provides a description of the existing fuel models observed in the vicinity of the site that were subsequently used in the analysis for this Project. A total of three fire modeling scenarios were completed for the proposed Project area. These modeling scenario locations were selected based on northern, eastern, and southwestern sides of the Project site.

Table 1. Existing Fuel Model Characteristics

Fuel Model Assignment	Vegetation Description	Location	Fuel Bed Depth (Feet)
GR2	Low-load, dry climate grass	Represents the non-native grasses within the Project site.	1.0
GR4	Moderate-load, dry climate grass	Represents the higher load grasslands on the mountainsides to the east of the Project	2.0
GS1	Low-load, dry climate grass-shrub	Represents the sparse grass-shrub vegetation of the Santa Clara Riverbed.	0.9
GS2	Moderate-load, dry climate grass-shrub	Represents the areas with a higher shrub component within the Project site.	1.5
SH5	High-load, dry climates	Represents the larger shrubs of the mountainsides to the east of the Project site.	6.0

2.2 Topography

Slope is a measure of angle in degrees from horizontal and can be presented in units of degrees or percent. Slope is important in fire behavior analysis as it affects the exposure of fuel beds. Additionally, fire burning uphill spreads faster than those burning on flat terrain or downhill as uphill vegetation is pre-heated and dried in advance of the flaming front, resulting in faster ignition rates. Elevations on the site range from approximately 1,565 feet amsl to 1,720 feet amsl. On-site slopes vary from 0-15% across most of the site and up to 30% along the hillsides. Slopes within the San Gabriel mountains to the east are up to approximately 75% though the modeled area had an average slope of 20%.

2.3 Weather Analysis

Historical weather data for the Laguna Beach region was utilized in determining appropriate fire behavior modeling inputs for the Project area. Average (50th percentile) and Extreme (97th percentile) moisture values were derived from Remote Automated Weather Stations (RAWS) and utilized in the fire behavior modeling efforts conducted in support of this report. Since there is not a RAWS station in close proximity to the Project site, a special interest group was created within Fire Family Plus that creates a weighted average of multiple nearby RAWS stations. The

four stations included in the special interest group were Saugus, Newhall Pass, Camp 9, and Acton. The stations were weighted based on their proximity to the Project, elevation, aspect, and relative location to dominant or weather-altering geographic features. Data from fire seasons dating back to 2000 and up through 2023 were included in the analysis.

RAWS fuel moisture and wind speed data were processed utilizing the Fire Family Plus software package to determine atypical (97th percentile) and typical (50th percentile) weather conditions. Data from the RAWS were evaluated from August 1 through November 30 for each year between 2000 and 2023 for 97th percentile weather conditions and from June 1 through September 30 for 50th percentile weather conditions.

Following analysis in Fire Family Plus, fuel moisture information was incorporated into the Initial Fuel Moisture file used as an input in BehavePlus. Wind speed data resulting from the Fire Family Plus analysis was also determined. Initial wind direction and wind speed values for the BehavePlus runs were manually entered during the data input phase. The input wind speed and direction is roughly an average surface wind at 20 feet above the vegetation over the analysis area. Table 2 summarizes the wind and weather input variables used in the Fire BehavePlus modeling efforts.

Table 2: Variables Used for Fire Behavior Modeling

Model Variable	Summer Weather (50 th Percentile)	Peak Weather (97 th Percentile)
Fuel Models	GR2, GS2	GR2, GR4, GS2, SH5
1 h fuel moisture	5%	1%
10 h fuel moisture	6%	2%
100 h fuel moisture	10%	5%
Live herbaceous moisture	38%	30%
Live woody moisture	76%	60%
20 ft. wind speed	11 mph (sustained winds)	19 mph (sustained winds); wind gusts of 50 mph
Wind Directions from north (degrees)	225	0 to 90
Wind adjustment factor	0.4	0.4
Slope	10%	1 to 20%

3 Fire Behavior Modeling Efforts

As mentioned, the BehavePlus fire behavior modeling software package was utilized in evaluating anticipated fire behavior adjacent to the proposed Project site. Three focused were completed for the existing project site conditions. The results of the modeling effort included anticipated values for surface fires flame length (feet), rate of spread (mph), fireline intensity (Btu/ft/s), and spotting distance (miles). The aforementioned fire behavior variables are an important component in understanding fire risk and fire agency response capabilities. Flame length, the length of the flame of a spreading surface fire within the flaming front, is measured from midway in the active flaming combustion zone to the average tip of the flames (Andrews, Bevins, and Seli 2008). Fireline intensity is a measure of heat output from the flaming front, and also affects the potential for a surface fire to transition to a crown fire. Fire spread rate represents the speed at which the fire progresses through surface fuels and is another

important variable in initial attack and fire suppression efforts (Rothermel and Rinehart 1983). Spotting distance is the distance a firebrand or ember can travel down wind and ignite receptive fuel beds. Three fire modeling scenario locations were selected to better understand the different fire behavior that may be experienced on or adjacent the site based on slope and fuel conditions; these fire scenarios are explained in more detail below:

Fire Scenario Locations and Descriptions (Existing Conditions):

- **Scenario 1:** A fall, off-shore fire (97th percentile weather condition) burning through the Sanat Clara Riverbed towards the Project site. A fire is unlikely to occur spread through this area due to the horizontal discontinuity of fuels. If a fire were to spread, it would be under windy conditions such as this that enables the fire to spread from plant to plant. Given that it is a riverbed, the area is relatively flat with only low-load grass-shrub vegetation. Such a fire could originate from arson, unhooded populations, a vehicle fire along California State Route 14, or from a structure fire from the nearby RV and self-storage.
- **Scenario 2:** A fall, off-shore fire (97th percentile weather condition) burning down the mountainsides to the east of the Project. Such a scenario would likely involve a wildfire which originated elsewhere spreading towards the Project. Such a fire would burn down the moderately steep slopes of the mountainsides through the moderate-load grasses and high-load shrubs towards the Project site. The varied topography of this area may also influence wind speeds leading to micro-variations that could amplify fire behavior.
- **Scenario 3:** A summer, on-shore fire (50th percentile weather condition) burning towards the Project site from the southwest. The vegetation in this area consists of moderate-load grass-shrub vegetation and it is moderately sloped downhill towards the Project site. The fire would likely originate from the low-density residential development in this area either from an equipment, vehicle, or structure fire.

4 Fire Behavior Modeling Results

The results presented in Table 3 depict values based on inputs to the BehavePlus software and are not intended to capture changing fire behavior as it moves across a landscape. Changes in slope, weather, or pockets of different fuel types are not accounted for in this analysis. For planning purposes, the averaged worst-case fire behavior is the most useful information for conservative fuel modification design. Model results should be used as a basis for planning only, as actual fire behavior for a given location will be affected by many factors, including unique weather patterns, small-scale topographic variations, or changing vegetation patterns.

As presented in Table 3, the greatest fire threat is the eastern side of the property that is exposed to a sizeable expanse of undeveloped, naturally vegetated lands that extend to the San Gabriel Mountains and Angeles National Forest (Scenario 2).. There is existing development on all other sides of the Project site and though a fire could possibly approach from the Santa Clara Riverbed or the lower density residential development to the southwest, the area to the east would be the greatest fire hazard. It should also be noted additional development is separately being proposed in the area directly east of the proposed Project which would provide an additional buffer between the Belcaro at Sand Canyon development and natural vegetation to the east.

Given the high fuel loads, lack of development, steep slopes, and alignment with strong, Santa Ana winds, a fire moving towards the Project from the east as modeled in Scenario 2 would be the greatest fire threat. Such a fire would likely originate elsewhere within the San Gabriel Mountain Range and could stem from any number of ignition sources. The fire, driven by high winds, would burn downhill through the moderate-load grass and high-load shrub, chaparral fuel beds towards the Project site. Once on said slopes, the fire would exhibit extreme fire behavior (up to 26.2-foot flame lengths during sustained winds and 44.5-foot flame lengths during gusts) and an extreme rate of spread (2.2 mph during sustained winds) as it burns through the high-load chaparral fuels. Within the moderate-load grass fuel beds, the fire would also exhibit extreme fire behavior (up to 20.0-foot flame lengths during sustained winds and 38.5-foot flame lengths during gusts) and an extreme rate of spread (4.0 mph during sustained winds). Upon nearing the bottom of the slope, the fire would reach the proposed Project site where the fire behavior would be reduced (10.7-foot flame lengths during sustained winds and 18.0-20.4-foot flame lengths during gusts) along with the rate of spread (1.0-2.0 mph during sustained winds and 4.2-6.2 mph during gusts).

While Scenario 1 was modeled under extreme weather conditions exactly like Scenario 2, there is reduced fuel loading in the Santa Clara Riverbed and onsite relative to the mountains east of the proposed Project site. Within the riverbed, fire could likely only spread under windy conditions such as those modeled to enable spread between plants. Vegetation within the riverbed would produce moderate flame lengths (up to 7.5 feet during sustained winds and up to 14.0 feet during 50 mph gusts) and move at a very high rate of spread (up to 0.8 mph during sustained winds and up to 3.0 mph during 50 mph gusts). Upon exiting the riverbed and onto the proposed Project site, fire behavior would slightly amplify (up to 10.9-foot flame lengths during sustained winds and up to 20.5 feet during 50 mph gusts) with very high to extreme rates of spread (1.0 to 2.1 mph during sustained winds and 4.2 to 6.2 mph during 50 mph gusts).

Unlike Scenarios 1 and 2, Scenario 3 was modeled under average, onshore conditions. Such a fire would approach the proposed Project site from the southwest and would likely originate from an equipment, vehicular, or residential fire within said low-density residential area. The fuels in this area resemble those onsite and thus the resulting fire behavior would be similar between the two areas. The non-native grasslands and sage scrub vegetation would produce moderate flame lengths of 5.0 to 5.4 feet with high rates of spread between 0.3 and 0.5 mph.

When evaluating post-project conditions, it should be noted that the vegetation outside of the proposed Project site would remain the same. As previously mentioned, the area to the east is also being proposed for development and should it be built, it would provide an additional buffer between the proposed Project and offsite fuels. The portion of the project that would change, the landscaping and fuel modification zone of the proposed Project, was modeled again to display the reduced fuels around the planned community (Table 4). A fire burning through the fuel modification zone (post-project conditions) during an extreme weather event (Scenario 1), would reduce in intensity as it progressed through the distinct zones. Within the furthest zone, Zone C, there would be moderate to very to high flame lengths (7.4 feet under sustained winds and 14.0 feet under 50 mph gusts) and very high to extreme rates of spread (0.7 mph under sustained winds and 3.0 mph during 50 mph gusts). Within Zone B, there would be moderate flame lengths up to 4.0 feet and a very high spread rate of 0.7 mph. By the time the fire reached Zone A, there would only be low flame lengths of 2.1 to 3.0 feet and a moderate rate of spread of 0.1 to 0.2 mph.

A fire burning within the fuel modification zone of the proposed project under the extreme conditions of Scenario 1 could be compared to one burning under average, on-shore weather conditions as modeled in Scenario 2. Upon reaching Zone C, the fire would exhibit low flame lengths of 3.6 feet and a moderate rate of spread of 0.2 mph. Within Zone C, flame lengths would drop to 2.1 feet while the rate of spread would be similar. If the fire were to reach Zone A, there would be only 1.1-foot flame lengths and a very low rate of spread of less than 0.1 mph. The

reduced fire behavior within the 200-foot-wide fuel modification zone, the inclusion of a 5-foot non-combustible Zone 0 around all structures, the ignition resistance provided by California Building Code Chapter 7A standards, and additional features outlined in the FPP would reduce the fire hazard associated with this community when compared to the existing conditions.

Table 3: RAWS BehavePlus Fire Behavior Model Results – Existing Conditions

Fuel Model	Flame Length ¹ (feet)	Spread Rate ¹ (mph ²)	Fireline Intensity ¹ (Btu/ft/s)	Spot Fire ¹ (miles)
Scenario 1: 1% slope; Fall off-shore extreme (97th percentile), 19 mph winds, 50 mph gusts from north				
Low-load grasses (GR2)	10.9 (18.0)	2.1 (6.2)	1,591 (1,591)	0.5 (1.3)
Low-load grass-shrub (GS1)	7.5 (14.0)	0.8 (3.0)	1,919 (1,919)	0.4 (1.1)
Moderate-load grass-shrub (GS2)	10.8 (20.5)	1.0 (4.2)	3,113 (3,113)	0.5 (1.4)
Scenario 2: 20% slope; Fall off-shore extreme (97th percentile), 19 mph winds, 50 mph gusts from east				
Low-load grasses (GR2)	10.7 (18.0)	2.0 (6.2)	1,591 (1,591)	0.5 (1.3)
Moderate-load grasses (GR4)	20.0 (38.5)	4.0 (16.6)	3,095 (3,095)	0.7 (2.2)
Moderate-load grass-shrub (GS2)	10.7 (20.4)	1.0 (4.2)	3,113 (3,113)	0.5 (1.4)
High-load shrubs (SH5)	26.2 (44.5)	2.2 (6.7)	7,202 (7,202)	0.9 (2.4)
Scenario 3: 10% slope; Summer on-shore average (50th percentile), 11 mph winds from southwest				
Low-load grasses (GR2)	5.0	0.5	1,135	0.2
Moderate-load grass-shrub (GS2)	5.3	0.3	2,314	0.2

Note:

1. Wind-driven surface fire.
2. MPH=miles per hour
3. Outputs in parenthesis represent peak gusts of 50 mph.

Table 4: RAWS BehavePlus Fire Behavior Model Results – Post-Project Conditions

Fuel Model	Flame Length ¹ (feet)	Spread Rate ¹ (mph ²)	Fireline Intensity ¹ (Btu/ft/s)	Spot Fire ¹ (miles)
Scenario 1: 20% slope; Fall off-shore extreme (97th percentile), 19 mph winds, 50 mph gusts from east				
FMZ Zone A: Setback Zone	2.1 (3.0)	0.1 (0.2)	1,286 (1,286)	0.2 (0.4)
FMZ Zone B: Irrigated Zone	4.0 (4.0)	0.7 (0.7)	602 (602)	0.2 (0.5)
FMZ Zone C: Thinning Zone	7.4 (14.0)	0.7 (3.0)	1,919 (1,919)	0.4 (1.1)
Scenario 2: 10% slope; Summer on-shore average (50th percentile), 11 mph winds from southwest				
FMZ Zone A: Setback Zone	1.1	<0.1	973	0.1
FMZ Zone B: Irrigated Zone	2.1	0.2	426	0.1
FMZ Zone C: Thinning Zone	3.6	0.2	1,423	0.2

Note:

1. Wind-driven surface fire.
2. MPH=miles per hour
3. Outputs in parenthesis represent peak gusts of 50 mph.

The following describes the fire behavior variables (Heisch and Andrews 2010) as presented in Tables 3 and 4:

Surface Fire:

- **Flame Length (feet):** The flame length of a spreading surface fire within the flaming front is measured from midway in the active flaming combustion zone to the average tip of the flames.

- **Fireline Intensity (Btu/ft/s):** Fireline intensity is the heat energy release per unit time from a one-foot wide section of the fuel bed extending from the front to the rear of the flaming zone. Fireline intensity is a function of rate of spread and heat per unit area, and is directly related to flame length. Fireline intensity and the flame length are related to the heat felt by a person standing next to the flames.
- **Surface Rate of Spread (mph):** Surface rate of spread is the "speed" the fire travels through the surface fuels. Surface fuels include the litter, grass, brush and other dead and live vegetation within about 6 feet of the ground.

Crown Fire:

- **Transition to Crown Fire:** Indicates whether conditions for transition from surface to crown fire are likely. Calculation depends on the transition ratio. If the transition ratio is greater than or equal to 1, then transition to crown fire is Yes. If the transition ratio is less than 1, then transition to crown fire is No.
- **Crown Fire Rate of Spread (mph):** The forward spread rate of a crown fire. It is the overall spread for a sustained run over several hours. The spread rate includes the effects of spotting. It is calculated from 20-ft wind speed and surface fuel moisture values. It does not consider a description of the overstory.

Fire Type:

Fire type is one of the following four types: surface (understory fire), torching (passive crown fire; surface fire with occasional torching trees), conditional crown (active crown fire possible if the fire transitions to the overstory), and crowning (active crown fire; fire spreading through the overstory crowns). Dependent on the variables: transition to crown fire and active crown fire

The information in Table 4 presents an interpretation of the fire intensity outputs in the context of fire suppression efforts. The results of fire behavior modeling efforts are presented in Table 3. Identification of modeling run locations is presented graphically in Figure 6, Fire Behavior Analysis Map.

Table 4: Fire Suppression Interpretation

Flame Length (ft)	Fireline Intensity (Btu/ft/s)	Interpretations
Under 4 feet	Under 100 BTU/ft/s	Fires can generally be attacked at the head or flanks by persons using hand tools. Hand line should hold the fire.
4 to 8 feet	100-500 BTU/ft/s	Fires are too intense for direct attack on the head by persons using hand tools. Hand line cannot be relied on to hold the fire. Equipment such as dozers, pumpers, and retardant aircraft can be effective.
8 to 11 feet	500-1000 BTU/ft/s	Fires may present serious control problems – torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective.
Over 11 feet	Over 1000 BTU/ft/s	Crowning, spotting, and major fire runs are probable. Control efforts at head of fire are ineffective.

Appendix C

LACoFD Acceptable Plant List

Fuel Modification Plant Selection Guidelines

Selecting and locating plants for a Fuel Modification Landscape plan is best done by first focusing on the density and arrangement of plants in relation to structures as a primary consideration. Second, but no less important is choosing zone appropriate plant species based on plant characteristics such as moisture content, resin/pitch and the production of dead litter from leaves, bark, seed pods etc. Avoid creating fuel ladders both vertically and horizontally throughout all zones (see basic fire behavior section below).

The following guidelines are intended to simplify this approach through zone specific compositions up to the property boundary.

5' Ember/Ignition resistant zone

- All efforts shall be made to eliminate any combustible materials including plants, organic mulches, patio furniture etc. This zone has been found to be the most important area to address during planning and future maintenance.

Zone A (30' from the edge of any qualifying structure)

- Zone A should be planted with the least density (limited use of large woody plants) and plant selections should consist of small herbaceous or succulent plants less than 2'-3' in height or regularly irrigated and mowed lawns.
- It is best not to use woody trees, shrubs, subshrubs, perennials or masses of un-mowed grasses over 12" tall within 10 feet of the structure; especially in front of windows, which are weak points in a structure.
- Occasional accents of woody plants can be used sparingly to soften hard edges of structures if the selections are widely spaced and zone appropriate.
- Consider locating hardscape features such as walkways, patios, driveways, sport courts etc. so they abut the structure itself. Potted plants can be used to soften walls if necessary.

Zone B (30'-100' from the edge of any qualifying structure)

- Zone B can be planted with a slightly higher density than Zone A. However, care should be taken not to create any horizontal or vertical fuel ladders.
- Screen plantings can be used to hide unsightly views. Hedging can be used provided the species of plant is acceptable and maintenance is performed regularly to minimize any accumulated leaf/twig litter.
- Zone B is the ideal location to introduce larger shade trees, provided they are zone appropriate and the canopies are not continuous.
- Avoid planting woody plant species larger than 2' at maturity directly beneath any tree canopy.

Zone C (100'-200' from the edge of any qualifying structure; may be necessary only if an "extra hazard" has been identified by fuel modification personnel)

- Although Zone C is often not landscaped on many projects, it may still be subject to hazard reduction requirements (brush clearance section 325.2.2 "extra hazard"). Do not denude the property. <http://www.readyforwildfire.org/>
- If Zone C is to be landscaped, avoid creating a landscape that is as dense and hazardous as the unmaintained vegetation.
- A good rule of thumb is to follow the same guidelines as Zones A and B with a slight increase in density.

Adjacent to Access Roads

- Maintain apparatus access roads with a 20' wide path that remains clear to the sky.
- Along roadsides, removal of cured annual grasses and weeds is required to be performed annually. Only well maintained and irrigated plants are allowed provided they do not hinder fire apparatus access.

Basic Fire Behavior – Fuel Ladders

Before selecting and locating plants on a Fuel Modification plan a basic understanding of wildland fire behavior is the key factor in properly arranging plants. Eliminating and avoiding the creation of fuel ladders should be the main focus. Understanding that anything planted in the landscape can become receptive fuel for wildfire and the way in which it is arranged and maintained will greatly influence the intensity of the fire. The following diagrams will aide in arranging appropriate plant compositions.

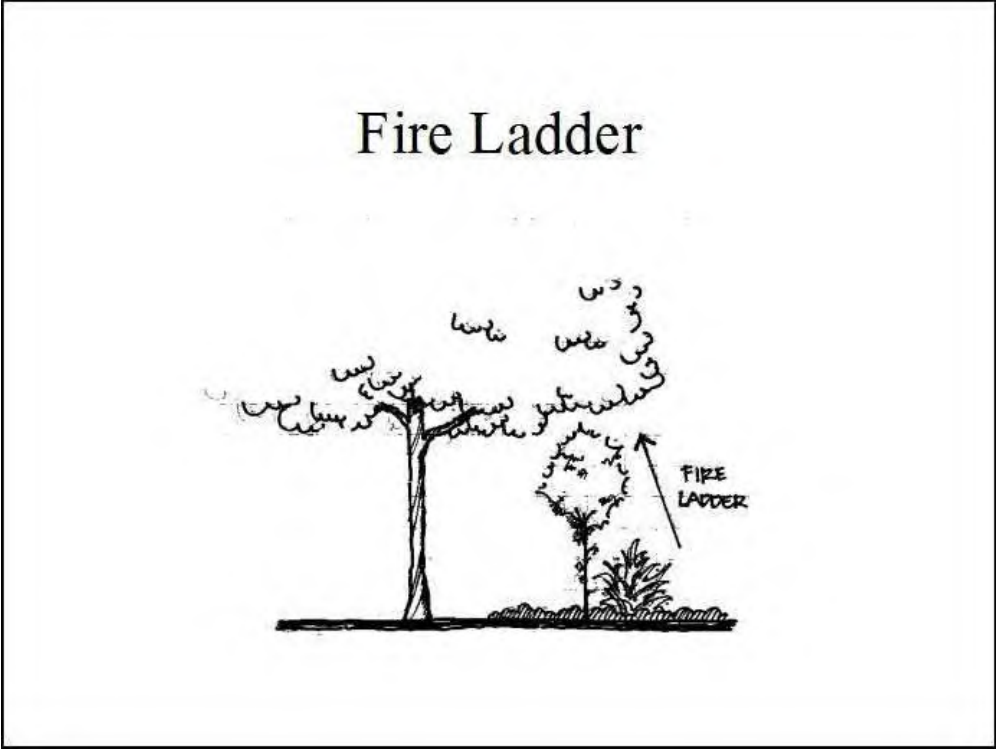


Figure 1: Fire Ladders or Fuel Ladders should be eliminated. The diagram above illustrates what not to do.



Figure 2: The concept of fuel ladders is crucial to planning a Fire-Wise landscape. No matter which plants are chosen, providing sufficient and defined separation between ground covers, shrubs and trees is the most crucial consideration in the design/plant-selection process. Do not use large shrubs or plants under tree canopies that may grow to a height greater than 2 feet at maturity. Pruning is not a long-term alternative to height appropriate plant selection.

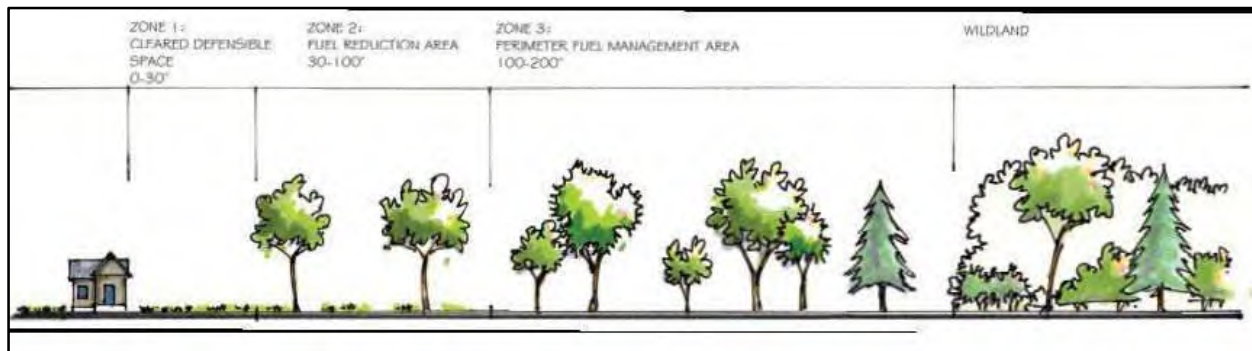


Figure 3: Note the progressive increase in density and arrangement moving away from the structure.

Plant Placement Do's

- Do use “mass plantings” of herbaceous/succulents as ground covers even if they are not traditionally used as such. If properly selected, mass plantings can eliminate fuel ladders.
- Do plant using spacing resulting in complete coverage at maturity, rather than hastening coverage with increased density (the only exception is manufactured slopes where quicker coverage is necessary in which case species selection is critical).
- Do consider using patio trees/un-sheared shrubs with an open habit as an informal screen in Zone A (Example: Toyon).
- Do consider vines as an alternative to hedges on walls or fences 10' from structures and unattached to structures.
- Do select varieties of plants that are slower growing and reach manageable sizes at maturity.
- Do use plants appropriately scaled to the size of the property and structure. E.g. a single story house does not need to be shaded by a 100' tall Sweetgum.

Plant Placement Don'ts

- Don't plant hedges directly against structures; this includes espaliers of large shrubs. Hedges taller than 6' and within 10' of the structure are not allowed.
- Don't plant large shrubs and trees in large masses in Zones A or B.
- Do not plant double hedge-rows.
- Don't plant at densities that result in an “instant landscape.”
- Don't plant large plant species which would require pruning to reduce overall size.
- Don't plant vines on structures. Vines become receptive fuel beds for embers (fire brands).

- Don't assume any plant is "fire proof." All plants will burn and assuming a plant is ignition resistant can be very misleading.
- Don't use large woody species in mass plantings.

Acceptable Plant Selections for Fuel Modification

The plant list provided in the following pages is intended to be a **representative sample** of which types of plants are appropriate for each zone considering their size, moisture content, leaf litter production and chemical composition. This list is not a comprehensive list of plants available commercially. Designers may choose plants that are not on this list if the plants physical characteristics are zone appropriate. Selecting regionally appropriate plants, native species and the consideration of climate and microclimate adaptability is the responsibility of the designer.

Important note: This list is **not** a "pre-approved" list. Any plant listed as appropriate within the designated zone at a designated distance from a structure must still follow restrictions based on the density and arrangement principles stated **above**. Planting densities may be requested to be reduced and plant selections may be asked to be removed when placed inappropriately.

Sample Fuel Modification Plant List			
Botanical Name	Common Name	Zone	Minimum distance from structure
Ground Cover			
Acacia redolens 'Desert Carpet'/'Low Boy'	Desert Carpet Acacia	B	30
Achillea tomentosa	Woolly Yarrow	A	
Ajuga reptans	Carpet Bugle	A	
Arctostaphylos (Prostrate Varieties)	Manzanita	B	
Artemisia californica (Cultivars)	Sagebrush - Prostrate Forms	B	30
Artemisia 'Powis Castle'	NCN	B	
Baccharis pilularis 'Pigeon Point'/'Twin Peaks'	Prostrate Coyote Brush	B	
Campanula poscharkyana	Serbian Bellflower	A	
Ceanothus gloriosus	Point Reyes Ceanothus	B	
Cerastium tomentosum	Snow-In-Summer	A	
Chamaemelum nobile	Chamomile	A	
Cistus salviifolius 'Prostratus'	Sageleaf Rockrose	B	
Coprosma kirkii	Mirror Plant	B	
Coreopsis auriculata 'Nana'	Tickseed	A	
Cotoneaster (Prostrate Varieties)	Cotoneaster	B	

<i>Dalea greggii</i>	Trailing Indigo Bush	B	
<i>Delosperma alba</i>	White Training Ice Plant	A	
<i>Dichondra micrantha</i>	Dichondra	A	
<i>Drosanthemum floribundum</i>	Rosea Ice Plant	A	
<i>Duchesnea indica</i>	Indian Mock Strawberry	A	
<i>Dymondia margaretae</i>	NCN	A	
<i>Erigeron glaucus</i>	Seaside Daisy	A	
<i>E. karvinskianus</i>	Santa Barbara Daisy	B	
<i>Euonymus fortunei</i> 'Colorata'	Purple-Leaf Winter Creeper	B	
<i>Festuca cinerea</i> (ovina'Glauca')	Blue Fescue	A	
<i>F. rubra</i>	Red Fescue	A	
<i>Fragaria chiloensis</i>	Wild Strawberry	A	
Gazania Hybrids	Trailing Gazania	A	
<i>Geranium incanum/sanguineum</i>	Cranesbill	A	
<i>Glechoma hederacea</i>	Ground Ivy	A	
<i>Helianthemum nummularium</i>	Sunrose	A	
<i>Herniaria glabra</i>	Green Carpet	A	
<i>Heuchera</i> species and Cultivars	Coral Bells	A	
<i>Hypericum calycinum/coris</i>	Aaron's Beard	B	
<i>Iberis sempervirens</i>	Evergreen Candytuft	A	
<i>Iva hayesiana</i>	Poverty Weed	B	30
<i>Juniperus</i> (Prostrate species/cultivars)		B	
<i>Laurentia fluviatilis</i>	Blue Star Creeper	A	
<i>Lysimachia nummularia</i>	Moneywort	A	
<i>Liriope spicata</i>	Creeping Lily Turf	A	
<i>Liriope muscari</i>	Lily Turf	A	
<i>Mahonia repens</i>	Creeping Mahonia	B	
<i>Myoporum</i> 'Pacificum' & 'Putah Creek'	Pacific Myoporum	B	
<i>M. parvifolium</i>	NCN	A	
<i>Oenothera berlandieri</i>	Mexican Evening Primrose	B	
<i>O. stubbei</i>	Baja Evening Primrose	A	
<i>Ophiopogon japonicus</i>	Mondo Grass	A	
<i>Pachysandra terminalis</i>	Japanese Spurge	A	
<i>Pelargonium peltatum/tomentosum</i>	Ivy Geranium	A	
<i>Persicaria capitata</i>	Pink Clover	A	
<i>Phlox subulata</i>	Moss Pink	A	10
<i>Phyla nodiflora</i> (<i>Lippia repens</i>)	Lippia	A	
<i>Potentilla tabernaemontanii</i>	Spring Cinquefoil	A	
<i>Ribes viburnifolium</i>	Catalina Perfume	B	
<i>Rosmarinus officinalis</i> (Prostrate Varieties)	Prostrate Rosemary	B	30
<i>Scaevola</i> 'Mauve Clusters'	NCN	A	
<i>Salvia sonomensis</i>	Creeping Sage	B	

Sedum species	Stonecrops	A	
Senecio mandraliscae/serpens	Kleinia/Blue Chalksticks	A	
Soleirolia soleirolii	Baby's Tears	A	
Teucrium cossonii majoricum	Germander	A	
T. X lucidrys 'Prostratum'	Prostrate Germander	A	
Thymus species	Mother of Thyme	A	
Trachelospermum jasminoides	Star Jasmine	A	
Trifolium fragiferum	White Clover	A	
Verbena species (Prostrate Varieties)	Garden Verbena	A	
Vinca minor	Dwarf Periwinkle	A	
Viola odorata	Sweet Violet	A	
Wedelia trilobata	Yellow Dot	B	
Zoysia tenuifolia	Korean Grass	A	
Miscellaneous Perennials, Grasses, Ferns etc.			
Acorous gramineous and Cultivars	Sweet Flag	A	
Agapanthus africanus	Lily of the Nile	A	
Alstroemeria cooperi	Peruvian Lily	A	
Armeria species	Thrifts	A	
Bouetella gracillis	Blue Gramma	A	10
Bergenia cordifolia	Heart Leaf Bergenia	A	
Cycas species	Cycads	A	
Cyrtomium falcatum	Holly Fern	A	
Davalia tricomanooides	Rabbits Foot Fern	A	
Epilobium canum	California Fuchsia	B	
Helictotrichon sempervirens	Blue Oat Grass	A	15
Hemerocallis hybrids	Daylily	A	
Iris douglassiana	Coastal Iris	A	
Iris germanica	Bearded Iris	A	
Kalanchoe species	Kalanchoe	A	
Leymus condensatus 'Canyon Prince'	Canyon Prince Wild Rye	A	20
Lobelia laxiflora		A	15
Pelargonium species	Geranium	A	
Penstemon species	Beard Tongue	A	
Plumeria	Plumeria	A	
Phlebodium aureum	Rabbits Foot Fern	A	
Tulbaghia violacea	Society Garlic	A	
Zephyranthes candida	Zephyr Lily	A	
Shrubs			

<i>Abelia grandiflora</i> (Prostrata)	Glossy Abelia	A	10
<i>Abutilon hybridum</i>	Flowering Maple	A	10
<i>Acanthus mollis</i>	Bear's Breech	A	
<i>Agave</i> species	Agave	A	
<i>Aloe</i> species	Aloe	A	
<i>Alyogyne huegelii</i>	Blue Hibiscus	A	10
<i>Arbutus unedo</i> (Dwarf Cultivars)	Dwarf Strawberry Tree	A	10
<i>Arctostaphylos</i> species	Manzanita	B	
<i>Aucuba japonica</i>	Japanese Aucuba	A	
<i>Baccharis</i> species	Various	B	
<i>Berberis thunbergii</i>	Japanese Barberry	B	
<i>B. thunbergii</i> ' prostrate cultivars'		A	10
<i>Bougainvillea</i> sp.	Bougainvillea	B	
<i>Buddleja davidii</i>	Butterfly Bush	B	
<i>Buxus microphylla japonica</i>	Japanese Boxwood	A	10
<i>Caesalpinia</i> (Shrub Forms)	Bird of Paradise Bush	A	10
<i>Camellia</i> species	Camellia	A	10
<i>Calliandra californica/erriophylla</i>	Baja Fairy Duster	B	
<i>Callistemon citrinus</i>	Lemon Bottlebrush	B	
<i>C. viminalis</i> "Little John"	NCN	A	10
<i>Calycanthus occidentalis</i>	Western Spice Bush	B	
<i>Carissa macrocarpa</i> and Cultivars	Natal Plum	A	10
<i>Carpenteria californica</i>	Bush Anemone	A	10
<i>Cassia artemisioides</i>	Feathery Cassia	A	30
<i>Ceanothus</i> species	Wild Lilac	B	30
<i>Cercocarpus betuloides</i>	Mountain Mahogany	B	30
<i>Choisya ternata</i>	Mexican orange	B	
<i>Cistus</i> species	Rockrose	B	
<i>Comarostaphylis diversifolia</i>	Summer Holly	B	
<i>Convolvulus cneorum</i>	Bush Morning Glory	B	
<i>Coprosma pumila/repens</i>	Mirror Plant	B	
<i>Cotoneaster</i> species & cultivars	Cotoneaster	B	
<i>Crassula</i> species	NCN	A	
<i>Cuphea hyssopifolia</i>	False Heather	A	10
<i>Cycas revoluta</i>	Sago Palm	A	
<i>Dasyllirion quadrangulatum/wheeleri</i>	Mexican Grass Tree	A	10
<i>Dendromecon harfordii</i>	Island Bush Poppy	B	
<i>Dietes bicolor/irioides</i>	Fortnight Lily	A	
<i>Dodonaea viscosa</i> (Purpurea)	Hopseed Bush	B	
<i>Elaeagnus pungens</i> & cultivars	Silverberry	B	

Encelia californica	Coast Sunflower	B	
E. farinosa	Brittle Bush	B	
Erigonum giganteum	St. Catherine's Lace	B	
Escallonia species	Escallonia	A	10
Euonymus japonica & cultivars	Evergreen Euonymus	A	10
Euphorbia species		A	
Euryops pectinatus	NCN	A	
Fatsia japonica	Japanese Aralia	A	
Fouquieria splendens	Ocotillo	A	
Fremontodendron species & cultivars	Flannel Bush	B	
Gardenia jasminoides	Gardenia	A	
Garrya elliptica	Coast Silktassel	B	
Grevillea species & cultivars	Grevillea	B	
Grewia occidentalis	Lavender Starflower	B	
Hakea suaveolens	Sweet Hakea	B	
Hebe species & cultivars	Hebe	A	10
Hesperaloe parviflora	Red Yucca	A	
Hibiscus rosa - sinensis	Chinese Hibiscus	A	10
Ilex species	Holly	B	
Juniperus species	Juniper	B	
Justicia brandegeana	Shrimp Plant	A	10
J. californica	Chuparosa	B	
Keckiella cordifolia	Heart-Leaved Penstemon	B	
Kniphofia uvaria	Red-Hot Poker	A	
Lantana Camara & hybrids	Lantana	A	10
Larrea tridentata	Creosote Bush	B	
Lavandula species	Lavender	A	10
Lavatera assurgentiflora/maritima	California Tree Mallow	B	
Leonotis leonrus	Lion's Tail	B	
Leptospermum scoparium & varieties	New Zealand Tea Tree	B	
Leucophyllum species		B	
Ligustrum japonicum	Wax-leaf Privet	A	10
Lupinus species	Lupine	B	
Mahonia aquifolium ('Compacta')	Oregon Grape	A	10
M. fremontii	Desert Mahonia	B	
M. 'Golden Abundance'	NCN	B	
M. lomariifolia	Venetian Blind Mahonia	A	
Malosma - See Rhus			
Malva species	Mallow	A	10
Melaleuca nesophila	Pink Melaleuca	A	10
Mimulus species (Diplacus)	Monkey Flower	A	10

<i>Myrica californica</i>	Pacific Wax Myrtle	B	
<i>Myrsine africana</i>	African Boxwood	A	10
<i>Myrtus communis</i> 'Compacta'	Dwarf Myrtle	A	10
<i>Nandina domestica</i> (including dwarf varieties)	Heavenly Bamboo	A	
<i>Nerium oleander</i>	Oleander	B	
N.o. 'Petite Salmon'	NCN	A	10
<i>Opuntia</i> species	Prickly Pear, Cholla etc.	A	
<i>Phlomis fruticosa</i>	Jerusalem Sage	A	
<i>Phoenix roebelenii</i>	Pygmy Date Palm	B	50
<i>Phormium tenax</i> and Cultivars	New Zealand Flax	A	
<i>Photinia fraseri</i>	Photinia	B	
<i>Pittosporum tobira</i> ('Variegata')	Tobira	B	
P.t.'Wheeler's Dwarf'	Dwarf Pittosporum	A	
<i>Punica granatum</i> 'Nana'	Dwarf Pomegranate	A	10
<i>Prunus ilicifolia</i>	Hollyleaf Cherry	B	
<i>Pyracantha</i> species	Firethorn	B	
<i>Rhamnus californica/crocea</i>	Coffeeberry	B	
<i>Rhaphiolepis indica</i> and Cultivars	India Hawthorn	A	10
<i>Rhus integrifolia/laurina</i>	Lemonade Berry	B	40
R. ovata	Sugar Bush	B	30
<i>Ribes</i> species	Currant/Gooseberry	A	10
<i>Romneya coulteri</i>	Matilija Poppy	B	
<i>Rosa</i> species (except <i>R. californica</i>)	Rose	A	
<i>Rosmarinus officinalis</i> & cultivars	Rosemary	B	
<i>Salvia</i> species - native varieties	Sage	B	
S. greggii/leucantha	Autumn Sage	A	10
<i>Santolina chamaecyparissus/rosmarinifolius</i>	Lavender Cotton	A	10
<i>Simmondsia chinensis</i>	Jojoba	B	
<i>Strelitzia nicolai/regina</i>	Bird of Paradise	A	
<i>Tagetes lemmonii</i>	Copper Canyon Daisy	B	
<i>Tibouchina urvilleana</i>	Princess Flower	A	10
<i>Trichostema lanatum</i>	Woolly Blue Curls	B	
<i>Viburnum</i> species	Viburnum	A	10
<i>Westringia fruticosa</i>	Coast Rosemary	A	10
<i>Xylosma congestum</i>	Shiny Xylosma	B	
X.c. 'Compacta'	Compact Xylosma	A	10
<i>Yucca</i> species	Yucca	B	
Trees			
<i>Acacia farnesiana</i>	Sweet Acacia	A	15

<i>A. greggii</i>	Catclaw Acacia	B	
<i>A. salicina</i>	Willow Acacia	A	15
<i>A. smallii</i>	NCN	A	15
<i>A. stenophylla</i>	Shoestring Acacia	A	15
<i>Acer negundo</i>	Box Elder	B	
<i>A. palmatum</i>	Japanese Maple	A	
<i>A. saccharinum</i>	Silver Maple	B	40
<i>Aesculus californica</i>	California Buckeye	B	
<i>Agonis flexuosa</i>	Peppermint Tree	B	
<i>Albizia julibrissin</i>	Silk Tree	B	
<i>Alnus rhombifolia</i>	Alder	B	
<i>Arbutus unedo</i> ('Marina')	Strawberry Tree	A	15
<i>Archontophoenix cunninghamiana</i>	King Palm	30	
<i>Bauhinia variegata</i>	Purple Orchid Tree	B	
<i>Betula pendula</i>	European White Birch	A	15
<i>Brachychiton acerifolius/populneus</i>	Flame Tree/Bottle Tree	B	
<i>Callistemon citrinus</i>	Lemon Bottlebrush	B	
<i>C. viminalis</i>	Weeping Bottlebrush	A	15
<i>Calocedrus decurrens</i>	Incense Cedar	B	
<i>Calodendrum capense</i>	Cape Chestnut	B	
<i>Cedrus deodara</i>	Deodar Cedar	B	40
<i>Ceratonia siliqua</i>	Carob	B	30
<i>Cercidium floridum/microphyllum</i>	Blue Palo Verde	A	
<i>Cercis occidentalis/canadensis</i>	Western Redbud	A	10
<i>Chilopsis linearis</i>	Desert Willow	A	15
<i>Chionanthus retusus</i>	Chinese Fringe Tree	A	10
<i>Chitalpa X tashkentensis</i>	Chitalpa	A	10
<i>Chorisia speciosa</i>	Floss Silk Tree	B	
<i>Cinnamomum camphora</i>	Camphor Tree	B	30
<i>Citrus species</i>	Citrus	A	10
<i>Cocculus laurifolius</i>	Laurel Leaf Snail Seed	B	
<i>Cordyline australis</i>	Giant Dracaena	A	
<i>Cyathea cooperi</i>	Australian Tree Fern	A	
<i>Dicksonia antarctica</i>	Tazmanian Tree Fern	A	
<i>Dracaena draco</i>	Dragon Tree	A	
<i>Eriobotrya deflexa/japonica</i>	Bronze Loquat/Loquat	A	10
<i>Erythrina species</i>	Coral Tree	B	
<i>Feijoa sellowiana</i>	Pineapple Guava	A	10
<i>Ficus species</i>	Fig	B	50
<i>Fraxinus species</i>	Ash	B	30
<i>Geijera parviflora</i>	Australian Willow	A	15

<i>Ginkgo biloba</i>	Maidenhair Tree	A	15
<i>Gleditsia triacanthos</i>	Honey Locust	A	15
<i>Grevillea robusta</i>	Silk Oak	B	
<i>Heteromeles arbutifolia</i>	Toyon	A	15
<i>Hymenosporum flavum</i>	Sweetshade Tree	A	15
<i>Jacaranda mimosifolia</i>	Jacaranda	B	
<i>Juglans californica</i>	Black Walnut	B	
<i>Koelreuteria bipinnata/paniculata</i>	Chinese Flame Tree	B	
<i>Lagerstroemia indica</i>	Crape Myrtle	A	10
<i>Laurus nobilis</i>	Sweet Bay	B	
<i>Leptospermum laevigatum</i>	Australian Tea Tree	A	15
<i>Liquidambar formosana</i>	Chinese Sweet Gum	A	15
<i>L. styraciflua</i>	American Sweet Gum	B	
<i>Liriodendron tulipifera</i>	Tulip Tree	B	
<i>Lithocarpus densiflorus</i>	Tanbark Oak	B	
<i>Lophostemon confertus (Tristania)</i>	Brisbane Box	A	15
<i>Lyonothamnus floribundus</i>	Catalina Ironwood	A	15
<i>Magnolia grandiflora</i>	Southern Magnolia	B	
<i>M. X soulangeana</i>	Saucer Magnolia	A	10
<i>Maytenus boaria</i>	Mayten Tree	A	10
<i>Melaleuca quinquenervia</i>	Cajeput Tree	A	15
<i>Metasequoia glypstroboides</i>	Dawn Redwood	A	15
<i>Metrosideros excelsus</i>	New Zealand Christmas Tree	A	10
<i>Morus alba</i>	White Mulberry	B	
<i>Olea europea</i>	Olive - Fruitless only	A	15
<i>Parkinsonia aculeata</i>	Jerusalem Thorn	A	10
<i>Pinus species</i>	Pine	B	75
<i>Pistacia chinensis</i>	Chinese Pistache	B	
<i>Pittosporum phillyraeoides</i>	Willow Pittosporum	A	10
<i>P. rhombifolium</i>	Queensland Pittosporum	B	
<i>Platanus racemosa</i>	California Sycamore	B	
<i>Podocarpus gracilior/macrophyllus</i>	Fern Pine/Yew Pine	B	
<i>Populus fremontii</i>	Fremont Cottonwood	B	50
<i>Prosopis chilensis</i>	Chilean Mesquite	B	
<i>P. glandulosa</i>	Honey Mesquite	A	15
<i>Prunus cerasifera 'Atropurpurea'</i>	Purple-leaf Plum	A	10
<i>Punica granatum</i>	Pomegranate	B	
<i>Pyrus calleryana/kawakamii</i>	Ornamental Pear	A	15
<i>Quercus species</i>	Oak	B	30
<i>Rhus lancea</i>	African Sumac	B	
<i>Robinia ambigua</i>	Locust	B	

<i>Sapium sebiferum</i>	Chinese Tallow Tree	B	
<i>Schefflera actinophylla</i>	Queensland Umbrella Tree	A	
<i>Sophora japonica</i>	Japanese Pagoda Tree	B	
<i>Stenocarpus sinuatus</i>	Firewheel Tree	A	10
<i>Tabebuia species</i>	Trumpet Tree	A	15
<i>Tipuana tipu</i>	Tipu Tree	B	
<i>Tupidanthus calyptratus</i>	Tupidanthus	A	
<i>Umbellularia californica</i>	California Bay	B	
<i>Zelkova serrata</i>	Sawleaf Zelkova	B	

Appendix D

LACoFD Fuel Modification Zones Undesirable Plant List

APPENDIX E
 FUEL MODIFICATION ZONE UNDESIRABLE PLANTS LIST

Botanical Name	Common Name	Comment*
<i>Adenostoma fasciculatum</i>	Chamise	F
<i>Adenostoma sparsifolium</i>	Red Shank	F
<i>Artemesia californica</i>	California Sagebrush	F
<i>Carpobrotus edulis</i>	Hottentot-fig	F, I
<i>Cortaderia spp.</i>	Pampas Grass	F, I
<i>Cupressus spp.</i>	Cypress	F
<i>Eriogonum fasciculatum</i>	Common Buckwheat	F
<i>Eucalyptus spp.</i>	Eucalyptus	F
<i>Jasminum humile</i>	Italian Jasmine	F
<i>Plumbago auriculata</i>	Cape Plumbago	F
<i>Tecoma capensis</i>	Cape Honeysuckle	F

*F = flammable, I = Invasive

Notes:

1. Certain plants are considered to be undesirable in the landscape due to characteristics that make them highly flammable. These characteristics can be either physical or chemical. Physical properties would include large amounts of dead material retained within the plant, rough or peeling bark, and the production of copious amounts of litter. Chemical properties include the presence of volatile substances such as oils, resins, wax, and pitch. Plants with these characteristics should not be planted close to structures in fire hazard areas. These species are typically referred to as “Target Species” since their complete or partial removal from the landscape is a critical part of hazard reduction. Therefore, any plant listed in the above table is not allowed as part of an acceptable Fuel Modification Plan.
2. Plants on this list that are considered invasive are a partial list of commonly found plants. There are many other plants considered invasive that should not be planted in a fuel modification zone and they can be found on The California Invasive Plant Council’s Website www.cal-ipc.org/ip/inventory/index.php. Other plants not considered invasive at this time may be determined to be invasive after further study.
3. For the purpose of using this list as a guide in selecting plant material, it is stipulated that all plant material will burn under various conditions.
4. The absence of a particular plant, shrub, groundcover, or tree, from this list does not necessarily mean it is fire resistive.
5. All vegetation used in Fuel Modification Zones and elsewhere within the Chadwick Ranch Estates Project site shall be subject to approval of the L.A. County Fire Department’s Fuel Modification Unit or Fire Code official.

Appendix E

Grijalva Technical Memo

Technical Memorandum

From: Ruben Grijalva, former State Fire Marshal and Director of CalFIRE

RE: Review of the Fire Protection Plan and Community Wildfire Evacuation Plan for the proposed Entrada South and Valencia Commerce Center Modified Project

Date: February 2025

As a former State Fire Marshal and Director of the California Department of Forestry and Fire Protection (CalFIRE), I have reviewed the Fire Protection Plan and Community Wildfire Evacuation Plan for the proposed Entrada South and Valencia Commerce Center Modified Project. The Modified Project incorporates minor changes and refinements to the development of the Entrada and VCC Planning Areas, as compared to what was evaluated in a prior Environmental Impact Report (EIR) (SCH No. 2000011025; June 2017). The Modified Project is located within State Responsibility Areas designated as Very High Fire Hazard Severity Zone (VHFHSZ) by the CalFIRE.

The prior EIR analyzed wildfire impacts and determined the project would have a less than significant impact on adopted emergency response plans or emergency evacuation plans based on the location of fire stations, a system of improved roads, and fire flows for the project. The prior EIR also determined that, with regulatory compliance and incorporation of mitigation measures, the project would not result in significant impacts related to wildfire or evacuation.

The Modified Project site has long been designated by the Los Angeles County General Plan (through the Santa Clarita Valley Area Plan) and Zoning Ordinance for residential and commercial development consistent with the proposed land uses for the Modified Project. The Area Plan established a comprehensive, regional circulation system that accounted for evacuation and emergency access factors. The Modified Project is largely surrounded by existing development, roads, and infrastructure. The Entrada planning area is bounded by I-5 to the east, Magic Mountain to the north, the Mission Village development (fully graded and under development) to the west, and the existing Westridge community to the south. The Valencia planning area is bounded by I-5 to the east, existing business park development to the north, SR-126 to the south, and the Chiquita Canyon and other developments to the west.

Based on my experience, properly designed master-planned communities built to modern standards present significant opportunities to deliver critical, resilient, and fire-safe housing to Californians.¹ This experience is substantiated by a detailed case study by Patrick Baylis & Judson Boomhower circulated by the National Bureau of Economic Research (NBER) analyzing the benefits of modern building code standards to reduce wildfire risk (“Boomhower and Baylis Case Study” included in Exhibit A).

The Boomhower and Baylis Case Study analyzed the effects of California’s wildfire building code standards particularly focusing on the benefits of code-induced mitigation for neighboring properties. The study analyzed the reduction in risk to homes built after the 2008 adoption of the California Building Code standards in Chapter 7A, finding that code compliance significantly

¹ See list on pages 2-3 below for examples of fire safety measures typically included in properly designed master planned communities; see also Moritz, M. & Bustic, V., “Building to Coexist with Fire; Community Risk Reduction Measures for New Development in California,” (2020) available at <https://escholarship.org/uc/item/6n12m6pn>.

enhanced the resilience of structures against wildfires, not only for the buildings directly adhering to these standards but also for adjacent properties. These findings are particularly relevant for new master-planned communities where homes are built to modern standards, offering a substantial opportunity to deliver fire-resistant housing compared to pre-Chapter 7A homes.

The research found that a home constructed in 2008 or later (under California's modern wildfire building codes) is significantly less likely to be destroyed in a wildfire than a home built in 1990.² Importantly, the study also reveals that code-compliance provides spillover benefits to neighboring properties. Specifically, the presence of a code-compliant home within 10 meters can reduce the likelihood of destruction for a neighboring home. Notably, these benefits increase when a home has multiple code-compliant neighbors nearby, such as would be case for the Modified Project as a modern, master-planned community.

These findings underscore the critical role that new development, built to modern building standards can play in enhancing community resilience to wildfires. Wildfire building codes not only enhance the resilience of the individual homes built under these standards but also provide significant protective benefits to neighboring properties by reducing the likelihood of fire spread. This evidence supports the development of master-planned communities, such as the Modified Project, that adhere to these standards and apply fire-resistant features at the community scale.

Similarly, an analysis of the State Fire Marshal's statistics³ demonstrates that California Building Code standards adopted in Chapter 7A effectively reduce fire risks to homes built in the wildland urban interface (WUI). Newer homes that are built as part of a properly planned and mitigated master-planned communities, have performed significantly better than older homes during recent California wildfires.⁴ Based on an extensive analysis of State Fire Marshal data regarding recent impacts from California's mega-fires, the data shows that over 98.5% of structural damage or loss occurred with homes built before modern Chapter 7A standards, and even of those new homes that were damaged, most involved isolated new construction surrounded by existing, high-risk homes.⁵ The data also suggests that no properly designed and located master-planned community in California, built after the adoption of California Building Code Chapter 7A, has suffered extensive structural losses from recent wildfires.⁶ Accordingly, much of the risk of destruction or damage from wildfires stems from existing home stock built before modern Chapter 7A standards and in high-risk areas.

In contrast, new, properly designed master-planned communities are typically planned, approved, and implemented with numerous fire-safety features and measures, such as:

- Fire-hardened homes built to the latest Chapter 7A standards;
- Community-wide fuel breaks, fire-resistant landscaping, and green belting;

² See Exhibit A, at p. 3. California began strengthening its state and local building codes following the 1991 Oakland Tunnel Fire, and further strengthened the California Building Code in 2008 with the adoption of Chapter 7A standards.

³ See attached Exhibit C (State Fire Marshal Housing Data Analysis).

⁴ See Exhibit C; Exhibit D (L.A. Times Article); see also Knapp, E.E., Valachovic, Y.S., Quarles, S.L. *et al.*, "Housing arrangement and vegetation factors associated with single-family home survival in the 2018 Camp Fire, California," *Fire Ecol* 17, 25 (2021). <https://doi.org/10.1186/s42408-021-00117-0> [analysis of single-family home survival during the 2018 Camp Fire indicated that homes constructed before 1997 had a significantly lower survival rate compared to those built in 1997 and later]; Institute for Business and Home Safety (IBHS), "Mega Fires: The Case for Mitigation," (Jul. 2008) pp. 14-15, 19, available at: <https://ibhs.org/wildfire/post-wildfire-investigations/>.

⁵ Exhibit C.

⁶ See e.g. attached Exhibit B (Master-Planned Community Case Studies).

- Long-term funding, maintenance and enforcement through an HOA;
- Appropriate and reliable fire access and evacuation routes;
- Adequate water supplies (studied pursuant to SB 610);
- Residential fire sprinklers;
- Undergrounded project utilities;
- Community design and siting to minimize fire risks (e.g., slope setbacks); and
- New fire stations and fire equipment.

The fire-resistance benefits of a properly designed master-planned community were highlighted by a Los Angeles Times article, which describes how the Orchard Hills master-planned community in Irvine withstood a direct impact from the Silverado Fire without any loss of structures or material damage.⁷ In October 2020, the Silverado Fire erupted during a Santa Ana wind event, with winds reaching speeds of up to 80 mph. The article describes how the fire advanced to the perimeter of Irvine’s Orchard Hills neighborhood, but did not destroy a single home or result in any significant damage to the community. The article describes how the community was planned with wildfire in mind – detailing the various measures that contributed to the community’s success, including the implementation of fuel modification zones, the use of fire-resistant building materials, stringent HOA guidelines, and ample emergency ingress and egress, among other features.

Based on my review of the Modified Project’s Fire Protection Plan and Community Wildfire Evacuation Plan, the Modified Project includes numerous protective measures and locational attributes that will make it highly resistant to wildfires, protecting both onsite residents and offsite existing communities. The Modified Project includes all the general safety measures described above for master-planned communities, while also providing specific additional enhancements, such as a master homeowners association, funded in perpetuity, that provide for maintenance of fuel modifications over time and educational services to residents about wildfire preparation and evacuation plans.

Further, the Los Angeles County Fire Department (County Fire) requires stringent standards for construction, operations, and evacuation, which the Modified Project must satisfy. CalFIRE has delegated initial responsibility of State Responsibility Areas to County Fire, meaning CalFIRE has entrusted County Fire as the first line of defense against wildfires impacting the Modified Project site. By complying with and going beyond County Fire’s requirements, the Modified Project represents a state-of-the-art master-planned community that will be highly resistant to wildfires compared to older homes built before Chapter 7A standards.

In the Santa Clarita Valley Area Plan, the County accounted for evacuation and emergency access factors when designing the growth patterns and circulation system for the area surrounding the Modified Project. The Modified Project will be constructed in accordance with the Area Plan policies and circulation system. In contrast with many older neighborhoods, the Modified Project will feature code-compliant, wider roadways and multiple points of ingress/egress, which will allow for quicker emergency access and evacuation. In this way, the Modified Project stands in contrast to

⁷ See attached Exhibit D (L.A. Times article).

development that has limited access and does not align with regional circulation plans. The Modified Project is largely surrounded by newer, existing development and infrastructure that is also built to recent standards and is consistent with the Area Plan.

The measures and strategies identified in the Fire Protection Plan and Community Wildfire Evacuation Plan are consistent with providing a fire-safe, master-planned community, based on my experience as the State Fire Marshal and CalFIRE Director. In the midst of a deepening housing crisis, there is a critical need to provide fire-resistant housing, particularly given the unprecedented wildfires we have witnessed in recent years and the growing threat of climate change. The Modified Project presents an opportunity for resilient and fire-resistant housing compared to older homes built before Chapter 7A standards.

Exhibit A

Baylis, P. & Boomhower J. “Mandated vs. Voluntary Adaptation to Natural Disasters: The Case of U.S. Wildfires,” National Bureau of Economic Research, No. 29621, (Dec. 2021)

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MANDATED VS. VOLUNTARY ADAPTATION TO NATURAL DISASTERS:
THE CASE OF U.S. WILDFIRES

Patrick W. Baylis
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Working Paper 29621
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Mandated vs. Voluntary Adaptation to Natural Disasters: The Case of U.S. Wildfires
Patrick W. Baylis and Judson Boomhower
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ABSTRACT

Despite escalating disaster losses and predicted increases in weather-related catastrophes, takeup of protective technologies and behaviors appears limited by myopia, externalities, and other factors. One response to such frictions is to mandate adaptive investment. We measure the effect of California's wildfire building codes on own- and neighboring structure survival using administrative damage and assessment data for most US homes experiencing wildfires since 2000. Differences across jurisdictions and vintages reveal remarkable resilience effects of building codes initially prompted by the deadly 1991 Oakland Firestorm. Codes also benefit neighbors. We use the results to estimate net social benefits of wildfire building standards.

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Worldwide natural disaster losses averaged \$218 billion per year during 2016–2020, a 60% increase in real terms over the preceding 30 years.¹ This trend is predicted to accelerate under future climate change. Efficient investment in adaptation is essential in the face of these escalating risks. Yet takeup of protective technologies and behaviors appears to be hindered by a constellation of market frictions. Homeowners misperceive disaster risks and thus the value of protective investments (Hallstrom and Smith 2005; Donovan, Champ, and Butry 2007; Gallagher 2014; McCoy and Walsh 2018; Bakkensen and Barrage, Forthcoming). Monitoring costs and other insurance market imperfections mean that mitigation behaviors may not be accurately reflected in property insurance prices (Kunreuther and Michel-Kerjan 2011; California Department of Insurance 2018; Wagner, Forthcoming). Public disaster spending programs may reduce private incentives for property protection (Kousky, Luttmer, and Zeckhauser 2006; Deryugina 2017; Baylis and Boomhower 2019). And in some settings, spatial externalities across neighboring properties lead to diverging private and social benefits of mitigation (Shafran 2008; Costello, Qu  rou, and Tomini 2017).

One widely-adopted approach to these market failures is to provide information and subsidies to increase voluntary takeup.² A more controversial but increasingly common alternative is to *mandate* investments in resilience.³ Mandatory standards ensure wider adoption. However, if the regulator misjudges the effectiveness of the required actions, the level of the hazard, or individual risk

1. Loss data are from Munich RE and are in 2020 dollars.

2. Examples in the U.S. include the Ready campaign and Ready.gov website; the Community Rating System under the National Flood Insurance Program; the StormReady, Hurricane Protection Week, and National Tsunami Hazard Mitigation programs; the Firewise USA program; and the Community Wildfire Protection Plan program.

3. Florida has construction standards for hurricane winds, and codes also exist in various regions for winter storms and non-weather disasters such as earthquakes and tsunamis (Federal Emergency Management Agency 2020). In flood-prone areas, U.S. federal rules require homes to be elevated and some localities have imposed even stricter requirements. California, Utah, Nevada, and Pennsylvania have statewide wildfire building standards while in other states, notably Colorado, wildfire codes have been adopted at the local level (Insurance Institute for Business and Home Safety 2019). Australia, New Zealand, France, and Italy also have wildfire building codes (Intini et al. 2020).

preferences, some individuals may be compelled to make costly investments they would have preferred to avoid even if fully informed and fully accountable. Implementing mandatory standards is also more politically challenging.⁴ Despite the important differences between these instruments, there is little empirical evidence about outcomes under a mandated resilience regime compared to a counterfactual of purely voluntary take-up.

In this paper, we consider the case of wildfire building codes in California. California has suffered over \$40 billion dollars in wildfire property damages in the past 5 years. The state also has among the strictest wildfire building codes in the world. We provide the first comprehensive evaluation of the effect of these codes on own-structure survival as well as neighbor spillovers via structure to structure fire spread. We then embed these empirical estimates in an economic model to calculate net social benefits of wildfire building codes as a function of local wildfire hazard and number of close neighbors.

This analysis takes advantage of a new dataset that includes property-level data for almost all U.S. homes exposed to wildfire between 2000 and 2020. We compiled the data by requesting post-incident damage censuses from numerous emergency management agencies and individual county assessors. We merged these lists of damaged homes to assessor data for the universe of (destroyed and surviving) homes inside wildfire burn areas. The data show that even during catastrophic wildfires, more than 50% of exposed homes survive. One of the key advantages of the new data is the ability to observe and learn from these surviving homes. The property-level loss information also distinguishes the wildfire data from floods and other disasters where loss data are typically available at the zip code or Census tract level. In addition to the new loss data, the empirical work also leverages emerging tools in spatial analysis, including high-resolution aerial imagery and precise “rooftop” geocoding of structure locations.

The empirical design leverages rich variation in building code requirements

4. For example, efforts to adopt statewide wildfire building standards in Oregon and Colorado have failed politically (Sommer 2020).

across space and over time. The complex nature of building regulation in California creates a patchwork of wildfire standards across localities. We also observe fires in other states that do not have wildfire building codes. In all of these places, we observe homes built before and after changes in California’s codes. This identifying variation yields credible counterfactual predictions for how homes would have performed in the absence of California’s standards. Our preferred statistical model is a fixed effects regression that compares the likelihood of survival for homes of different vintages on the same residential street during the same wildfire event. These street fixed effects allow us to compare groups of homes that experience essentially identical wildfire exposures.

We find remarkable vintage effects for California homes subject to the state’s wildfire standards. A 2008 or newer home is about 16 percentage points (40%) less likely to be destroyed than a 1990 home experiencing an identical wildfire exposure. There is strong evidence that these effects are due to state and local building code changes - first after the deadly 1991 Oakland Firestorm, and again with the strengthening of wildfire codes in 2008. The observed vintage effects are highly nonlinear, appearing immediately for homes built after building code changes. There are no similar effects in areas of California not subject to these codes or in other states that lack wildfire codes.

We also find that code-induced mitigation benefits neighboring homes, consistent with reduced structure-to-structure spread. These neighbor effects are in keeping with anecdotal reports of home-to-home spread as a factor in urban conflagrations (Cohen 2000; Cohen and Stratton 2008; Cohen 2010).⁵ Our results imply that, all else equal, code-induced mitigation by a neighbor located less than 10 meters away (within the distance fire experts refer to as the home ignition zone) reduces a home’s likelihood of destruction during a wildfire by about 2.5 percentage points (6%). This benefit is even larger when homes have multiple close neighbors.

5. We are also aware of at least one insurance company which will not sell homeowners insurance to homes located next to a home with a wood roof in high-risk areas (Allstate Indemnity Company 2018).

Finally, we embed our estimates of building code benefits in an economic model and calculate the approximate net social benefits of such a policy for a random sample of California homes in wildfire hazard areas. Like other disaster risks, many homeowners are only partially insured (or in the extreme, wholly uninsured) against the full cost of replacing a structure destroyed by wildfire (Klein 2018; California Department of Insurance 2018). This means that the benefits of building codes include not only reductions in expected losses but also additional insurance value due to reduced household exposure to uninsured risk. Our calculations find that wildfire building codes deliver unambiguously positive benefits in the most fire-prone areas of the state, especially where homes are clustered closely together and thus create large risk spillovers. In areas with more moderate wildfire risk, building standards for new homes can also be justified given reasonable assumptions about household risk aversion, future increases in wildfire hazard, and/or co-benefits of building codes (such as reductions in public expenditures on wildland firefighting). On the other hand, the costs of retrofitting existing homes to meet current wildfire building standards are substantial and our analysis suggest full retrofits are only economic in areas with extreme wildfire hazard.

These results are broadly relevant to natural disaster management. In this important setting, a standards-based approach achieved substantially greater compliance with risk mitigation practices. The policy nearly halves loss risk when structures are exposed to the hazard. Moreover, a cost-benefit calculation implies that low takeup in the absence of standards is likely driven by market failures as opposed to a lack of cost-effectiveness. These facts can inform policies to mitigate other risks like floods, hurricanes, tornadoes, and heat waves, where voluntary takeup of adaptation investments also appears to be limited.

This work also has immediate implications for wildfire policy. Our results imply there are gains to be realized from strengthening building codes in other states and countries to match California's. This evidence is relevant to current

proposals in Oregon, Washington, and other states.⁶ Meanwhile, California is moving to expand the geographic coverage of designated wildfire hazard zones and reduce the ability of local jurisdictions to opt out of recommended standards.⁷ Separately, new California legislation from 2020 provides financial incentives for retrofits of existing homes in wildfire-prone areas.⁸ The law specifically calls for support of “cost effective” retrofits, a concept for which the evidence in this study is essential. Additionally, policymakers are confronting pressing issues of insurance rate reform in response to mounting wildfire losses. One key debate is the degree to which individual investments improve structure survival and should thus be rewarded through regulated insurance discounts (California Department of Insurance 2018). This paper’s evidence on the effectiveness of such investments during real wildfires bears directly on this question.

Our work builds on previous studies of natural hazard mitigation. For wildfires, a number of engineering and forestry studies describe the effects of construction materials and vegetation management on structure resilience (Gibbons et al. 2012; Syphard et al. 2012; Syphard, Brennan, and Keeley 2014; Alexandre et al. 2016; Syphard, Brennan, and Keeley 2017; Kramer et al. 2018; Syphard and Keeley 2019). Our paper focuses on the effects of a mandatory mitigation policy, while these previous studies measure technology effectiveness (i.e., survival of homes whose owners did vs. did not choose to take mitigation measures). Two studies on the related topic of hurricanes do consider building codes, with conflicting results. Dehring and Halek (2013) is a small case study of several hundred homes during Hurricane Charley in 2004. Simmons, Czajkowski, and Done (2018) study aggregate zip-code level data on annual insurance claims by homes built in different decades to infer benefits of hurricane building codes in Florida. In contrast, our study uses highly

6. See, e.g., Profita, Cassandra. “The Labor Day Fires Burned Towns and Homes. Oregon Has a Plan to Avoid a Repeat.” Oregon Public Broadcasting, September 7, 2021.

7. S.B. 63, 2021–2022, California. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB63.

8. A.B. 38, 2019–2020, California. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200AB38.

granular property- and event-level loss data for a large sample of wildfires covering several states. Across a range of natural hazards, a parallel engineering literature attempts to calculate the value of building codes through modeling and simulation (e.g. Federal Emergency Management Agency 2020). Finally, our work is methodologically related to a separate literature in economics on building codes and household energy consumption (Jacobsen and Kotchen 2013; Levinson 2016).

This study makes five contributions. First, we provide the first comprehensive evaluation of the effects of wildfire building codes on structure survival. Beyond the wildfire context, this result improves our understanding of disaster resilience under standards-based vs. voluntary policies. Second, we provide the first empirical estimates of the spillover benefits of wildfire mitigation investments to neighboring properties. Third, we compile a comprehensive dataset of structure-level outcomes in wildfires across several states that, to our knowledge, is the most complete accounting in existence. This new dataset will enable future work on the economics of catastrophic wildfire risk. Fourth, we approach the topic in a causal framework with an explicit empirical design, where previous work is primarily descriptive or relies on regression adjustment. Finally, we embed the empirical estimates in an economic model to calculate net social benefits that account for local hazard, neighbor externalities, and household risk aversion.

The rest of the paper proceeds as follows. Section 1 discusses structure survival in wildfires and California’s history of building code updates. Section 2 describes the data and spatial analysis. Section 3 outlines the empirical strategy, and Section 4 presents the results. Section 5 develops the model of net social benefits and Section 6 concludes.

1 Wildfire Building Codes in California and Other States

“Unlike a flash flood or an avalanche, in which a mass engulfs objects in its path, fire spreads because the requirements for com-

bustion are satisfied at locations along the path... A wildland fire cannot spread to homes unless the homes and their adjacent surroundings meet those combustion requirements.” Jack D. Cohen, Journal of Forestry, 2000.

Established forestry and engineering evidence supports the importance of the so-called home ignition zone in determining structure resilience to wildfires. The home ignition zone includes the design of the home itself as well as an imagined area extending 30 meters away from the structure. Fire scientists emphasize the elimination of flammable materials inside this zone (e.g., Cohen 2000, 2010; Calkin et al. 2014). This guidance applies to both vegetation around the home (“defensible space”) and the construction of the home itself, especially the roof.

Among U.S. states, California has gone the furthest in mandating takeup of wildfire resilience investments by property owners. However, the application of these codes varies throughout the state. In areas where CAL FIRE provides firefighting services (State Responsibility Area or SRA), the state directly determines building standards. Within incorporated cities and other areas with their own fire departments (Local Responsibility Area or LRA), local governments have historically had greater control over code requirements.

The development of the modern standards began with the Oakland Hills Firestorm of 1991, which killed 25 people and caused \$1.5 billion in property damage. The tragedy led to a series of legislative actions during the mid-1990s that required more fire-resistant roofing and maintenance of vegetation immediately adjacent to the home. The first of these was the so-called Bates Bill of 1992 (Assembly Bill 337). Among other changes, the Bates Bill encouraged stronger building standards in LRA areas by requiring CAL FIRE to produce maps of recommended Very High Fire Hazard Severity Zones (VHFHSZ). In LRA areas, local governments could then choose whether or not to adopt these recommended hazard maps (and thus the accompanying building standards). This designation process unfolded over several years, with hundreds of local governments adopting or rejecting CAL FIRE’s proposed VHFHSZ maps at

different times. According to Troy 2007, 151 of 208 local governments (73%) either adopted the VHFHSZ regulations or claimed to have promulgated equally strong existing rules.⁹

On the heels of the Bates Bill, Assembly Bill 3819 of 1994 increased requirements for ignition-resistant roofs. These requirements applied in all SRA areas and in the subset of LRA areas where local governments had adopted recommended VHFHSZs. Roofing materials are rated Class A, B, C, or unrated.¹⁰ Starting in 1995, the law required Class B roofs on newly-constructed or re-roofed homes in regulated areas. In 1997, the requirement increased to Class A roofs in high-hazard areas (a substantial improvement in fire resistance). Finally, Assembly Bill 423 in 1999 simplified enforcement of the new roofing codes by outlawing the use of unrated roofing materials throughout the state.

The collective effect of these mid-1990s building code reforms was to substantially increase the fire resistance of roofs on newly-constructed homes in regulated areas after about 1997. The roofing requirements also applied to existing homes, but only at the time of roof replacement. Any homeowner in a regulated area who replaced more than 50% of the roof surface in a single year was in principle obligated to comply. The defensible space provisions also applied to existing and new homes. However, in practice, the primary point of enforcement for these codes was at the time of new construction; enforcement effort for existing homes was limited (see e.g., Maclay 1997).

California strengthened its wildfire codes again in 2008 with the so-called Chapter 7A standards of the California Building Code. These requirements apply to all homes built in 2008 or later in SRA areas and in LRA areas where proposed VHFHSZ designations have been accepted. The codes apply to many dimensions of new homes. Roofs must be rated class A or B, eaves

9. For a detailed qualitative study of the determinants of local VHFHSZ adoption decisions, see Miller, Field, and Mach (2020).

10. These ratings are earned through laboratory testing; for example, the Class A test involves placing a 12-inch by 12-inch burning brand on the roof material under high wind conditions. The material must not ignite for 90 minutes.

and exterior siding must be fire resistant, vents must be covered by a fine wire mesh to resist ember intrusion, windows and doors must resist fire for at least 20 minutes, and decks and other building appendages must be built of non-combustible materials. Chapter 7A also includes additional requirements for defensible space.

The damage data collected for this study also include wildfires in Arizona, Colorado, Oregon, and Washington. None of these had statewide wildfire building standards at the time of the included fires (Insurance Institute for Business and Home Safety 2019). Some local governments – particularly in Colorado – have adopted local standards that include a diverse mix of rules about roofs, other construction materials, and/or defensible space. Our empirical analysis excludes a small number of fires in the comparison states that overlap areas known to have local wildfire building standards.¹¹

While the non-California homes in this study are not subject to mandatory standards, they are targeted by a range of information and incentive programs that seek to increase voluntary home hardening. Programs active in these states include FireWise USA (National Fire Protection Association), the Community Wildfire Protection Plan program (United States Forest Service and Department of Interior), the Fire Adapted Communities Coalition (numerous public agencies and NGOs), the Ready, Set, Go! program (International Association of Fire Chiefs), and numerous other initiatives.

2 Data and Spatial Analysis

This section describes the construction of the database of wildfire damages, property tax assessment information, and structure locations.

11. These are the 2012 Waldo Canyon Fire, 2013 Black Forest Fire, and 2018 Mile Marker 117 Fire in El Paso County, Colorado (Quarles et al. 2013) and the 2012 High Park Fire and 2020 Cameron Peak Fire in Larimer County, Colorado (Larimer County 2020).

2.1 Homes and Damage Data

Damage Inspection Data

We sought to assemble as comprehensive a database as possible of administrative records for homes destroyed or damaged by wildfire in the United States. For recent wildfires in California, this information is managed by CAL FIRE. For earlier California fires and for fires in other states, we contacted individual county assessors (who track these damages in order to update property tax assessments) and other agencies to request historical records of structure damages. To our knowledge, the resulting database is the most complete accounting that exists of U.S. homes lost to wildfire.

California 2013–2020: In California, the CAL FIRE Damage Inspection (DINS) database is a census of destroyed and damaged homes following significant wildfire incidents during 2013–2020. The data include street address and assessor parcel number (APN); limited structure characteristics; and for some fires, an additional sample of undamaged homes. The damage variable has four levels: destroyed ($> 50\%$ damage), major (26–50%), minor (10–25%), and affected (1%–9%). Of these, “destroyed” is the most commonly reported damage category and the only category that appears consistently across all fires. The lack of partially-destroyed structures is consistent with case study observations in Cohen (2000) and subsequent research. We thus follow the literature and focus on “destroyed” as our primary outcome.

California 2003–2013: Data for pre-2013 wildfires in California come from two sources. For the 2003 and 2007 San Diego fire storms, we received damage assessment data from San Diego County. For other counties, CAL FIRE staff provided us with a large collection of unformatted historical damage assessment reports that we compiled and standardized to be usable for research.

Other States: Using ICS-209 incident reports, we identified the 15 counties in states other than California with the greatest number of structures lost to wildfire since 2010. We then contacted county assessors in each of these

counties to request damage data. We have successfully received structure-level damage data from 11 of these 15 counties.

Appendix Table 6 includes the full list of wildfires in the dataset.

Property Tax Assessment Data

We merge the damage records to comprehensive assessment data for all U.S. homes from the Zillow ZTRAX database. The ZTRAX data include information on year built, effective year built (in the case of remodels), building square footage, and other property characteristics. The merge from damage data to ZTRAX uses assessor parcel numbers, and we validate the accuracy of this merge by comparing street addresses across the two datasets. We restrict the data to include only single family homes, which account for most properties inside the wildfire perimeters in our sample. For each incident, we merge the damage data to the most recent historical assessment data from the pre-fire period. In other words, we merge to the population of single family homes that existed immediately prior to the start of the fire. Appendix Table 6 shows the number of single family homes inside of each wildfire perimeter and the share destroyed.

2.2 Spatial Analysis and Dataset Construction

Identifying Structure Rooftop Locations

This study uses the physical locations of the homes in the data in two ways. First, homes must be spatially assigned to building code jurisdictions and to wildfire burned areas. Second, the measurement of spillovers across properties requires precise distances between neighboring structures. The street address-based geocoding methods typically used in academic research are not sufficiently detailed for this second purpose, which requires accurate structure locations at a meter scale. We solved this challenge by combining several spatial datasets to identify precise rooftop locations. First, we limit the population of ZTRAX homes to all homes in zip codes where at least one home was destroyed. We then merge these ZTRAX records to parcel boundary maps

from county assessors using assessor parcel numbers. This yields a parcel polygon for each home. We then use comprehensive building footprint maps from Microsoft to identify the largest structure overlaying each parcel.¹² We call this location the “footprint location.” Figure 1 shows an example for Redding, California in the area of the 2018 Carr Fire. Gray lines are parcel boundaries from the Shasta County Assessor. Blue polygons are building footprints. The purple and yellow markers show the assigned rooftop locations for each structure. Yellow markers show homes that are reported as destroyed in the damage data.

This rooftop geocoding method generates highly accurate locations, but it is dependent on the availability of high-quality parcel boundary GIS data. In areas where such data are not available (representing 13% of homes in the final analysis dataset), we instead geocode home locations using the ESRI StreetMap Premium geocator, a commercially-available address-based product. Our quality checking shows that these locations (henceforth “address-based locations”) are generally reliable to the parcel level but not always to the structure rooftop level. Appendix Section C describes the geocoding in more detail.

Validating Locations and Damage Reports

We quality check the calculated property locations and the damage report data using high-resolution aerial imagery from NearMap. The base image in Figure 1 shows an example. The detailed imagery allows us to manually confirm the accuracy of structure locations, which closely coincide with the blue building footprints in the figure. In addition, the NearMap imagery includes post-fire surveys for many of the incidents in our database. Figure 1 illustrates how destroyed properties are readily visible in these surveys, which allows us to confirm the accuracy and completeness of the damage data. Appendix Table 4 reports accuracy rates in a random sample of homes. For damage reports, 99%

¹² The Microsoft U.S. Building Footprints Database is publicly available at <https://github.com/microsoft/USBuildingFootprints>.

of reported outcomes match the ground truth imagery. For rooftop locations, 98% of the assigned structure locations are on top of the structure rooftop in the ground truth imagery (with 99%+ accuracy in densely developed areas). Locations that rely on street address based geocoding tended to be accurate to the parcel but not always to the actual structure rooftop – about 75% of these assigned locations are on top of the structure rooftop in the ground truth imagery.

Spatial Merge to Wildfire Perimeters and Code Jurisdictions

We restrict the dataset to homes located within final wildfire perimeters (plus a 20-meter buffer). Depending on the state and time period, these digital perimeter maps come from the California Forest and Range Assessment Program (FRAP), the Monitoring Trends in Burn Severity (MTBS) dataset, or the National Interagency Fire Center (NIFC). We merge the homes data to spatial data on fire protection responsibility (SRA vs. LRA) and designated fire hazard (FHSZ) that together determine building codes in a given location in California. We use historical GIS maps provided by CAL FIRE to assign homes to code regimes according to the codes in effect when the home was built.¹³

Calculating Distances Between Neighboring Homes

We construct two measures of distance between homes. The first is the minimum distance between the building footprint polygons associated with the two structures (henceforth the “wall-to-wall” distance). This measure is only available for homes where we assign locations based on building footprints. The second metric uses the distance between assigned point locations, which are available for all homes in the dataset. We call this metric the “centroid to centroid” distance because these points are meant to correspond to the center of the roof. The wall to wall distance is our preferred measure because it more

13. For SRA/LRA boundaries, the historical map data include updates in 1990, 1996, 2003, 2005, and annually from 2010–2020. For FHSZ, the historical map data include updates in 1985, 1998, 2007, and 2008.

accurately captures space between homes and because the footprint-geocoded locations are more accurate than the address-based location points (Appendix Table 4). Our main estimates of neighbor spillovers use the restricted sample of homes for which wall to wall distances are available. For robustness, we also show specifications that use centroid to centroid distances and the full sample of homes.

We identify up to 15 nearest neighbors within one kilometer for each home in the final dataset. Panel (b) of Figure 1 shows two examples. Each image shows wall-to-wall distances (in meters) from the structure marked “0”. Appendix Table 2 summarizes the distribution of number of neighbors at various distances.

Data Summary

The final dataset includes 55,408 single family homes exposed to 112 wildfires in California, Arizona, Colorado, Oregon, and Washington between 2003 and 2020. Thirty-nine percent of these were destroyed. Appendix Figure 1 shows the distribution of year built and fraction destroyed by year built for the full dataset. Appendix Table 6 reports the number of exposed and destroyed homes for each fire.

3 Empirical Strategy

This section describes the empirical design used to measure the effect of wildfire building codes on structure survival. To fix ideas, Figure 2 provides an example of the merged dataset for the 2018 Woolsey Fire in Los Angeles County. The green and purple markers indicate locations of surviving and destroyed single family homes inside the final fire perimeter. The street map data give a sense of development density. The intensity of losses varies significantly within the burned area. Near Malibu, a large share of affected homes were lost. Further north, however, there are several areas where most homes inside the fire perimeter escaped destruction. These differences reflect varying fire

conditions, firefighter response times, landscape vulnerability, structure characteristics, and potentially numerous other factors. This heterogeneity adds noise to empirical analysis of structure survival. It may also introduce bias if year built or other structure traits vary similarly within burned areas. We address these challenges using an empirical design that compares the likelihood of survival for homes of different vintages on the same residential street during the same wildfire. We attribute these vintage effects to building codes by comparing vintage effects across jurisdictions with and without wildfire building codes.

3.1 Treatment Groups

Throughout the rest of the paper, we consider three types of jurisdiction. The first is SRA, where compliance with California building codes was mandatory. The second is LRA areas that were ever recommended by CAL FIRE as VHFHSZ areas (henceforth, “LRA-VHFHSZ”). To be clear, this group includes all proposed VHFHSZ regardless of whether local governments accepted the designation. There is no centralized database that records local VHFHSZ adoption decisions, but Troy (2007) reports high rates of adoption.¹⁴ The final treatment group is areas without wildfire building codes (henceforth, “no-codes”). This includes LRA areas in California that were never recommended for consideration as VHFHSZ, as well as fires in areas of Arizona, Colorado, Oregon, and Washington without any state or local wildfire building codes. Appendix Table 1 reports the number of homes in each treatment group.

14. In addition, historical news accounts show that cities that rejected the official VHFHSZ designation often still adopted the underlying code requirements in the recommended areas. This seems to have been an attempt to achieve the state-recommended resilience requirements while avoiding the VHFHSZ label due to fears about property values (Sullivan 1995; Snyder 1995; Stewart 1995; Yost 1996; Grad 1996). One state fire official’s response: “We didn’t care if they called it a nuclear-free zone, as long as they adopted the regulations” (Maclay 1997).

3.2 Own-structure survival

Event study figures

We begin the regression analysis with the following event study-style model for home i on street s exposed to wildfire incident f . We estimate this model separately for the SRA, LRA-VHFHSZ, and no-codes groups.

$$1[Destroyed]_{isf} = \sum_{v=v_0}^{v=V} \beta_v D_i^v + \gamma_{sf} + X_i \alpha + \epsilon_{isf} \quad (1)$$

The outcome variable is equal to one for destroyed homes and zero otherwise. The V variables $D_i^{v_0}, \dots, D_i^V$ are indicator variables equal to one if house i 's year built falls into bin v . The main parameters of interest are the coefficients β that correspond to these vintage bins. These give the effect of each vintage on probability of survival when exposed to wildfire. The street fixed effects γ_{sf} include separate indicator variables for each street name-zip code combination within fire perimeter f . These fixed effects sweep away arbitrary patterns of damage across streets within the fire perimeter, so that the model is identified by average differences in survival between homes of different vintages on the same street. We also estimate models with finer and coarser fixed effects, including models with incident instead of street fixed effects.

The additional control variables X_i include controls for wildfire vulnerability at the home site. These include ground slope, aspect, and vegetation type from LANDFIRE (Rollins 2009). Some specifications also include property characteristics (lot size, building square footage, number of bedrooms).

Difference in differences

We summarize the overall effects of the wildfire building standards using a difference-in-differences (DiD) model that pools jurisdictions and time periods. We divide the sample into 3 time periods: before 1998; 1998–2007; and 2008 onwards. The latter two periods correspond to the end of the mid-1990s roofing

reforms and the introduction of the Chapter 7A requirements.

3.3 Structure to structure spread

To measure the effect of code-driven mitigation on likelihood of structure-to-structure spread, we estimate the effect of building vintage on likelihood of survival for neighboring homes. Our regression models are of the form,

$$1[Destroyed]_{isf} = \sum_{j=1}^J \rho_j NoCode_j + \sum_{j=1}^J \phi_j Code_j + \sum_{v=v_0}^V \beta_v D_i^v + \gamma_{sf} + X_i \alpha + \epsilon_{isf} \quad (2)$$

Like Equation (1), this specification controls for own year of construction and street-by-incident fixed effects. The additional regressors $NoCode_j$ and $Code_j$ are the number of neighbors within various distance bins j that were built before and after wildfire building codes. Homes are considered post-code in 1998 in SRA areas and in the year the area was first recommended as a VHFHSZ in LRA VHFHSZ areas. The coefficients ρ_j and ϕ_j for $j = 1, \dots, J$ give the effect of these neighbors on own-structure survival. Our preferred specification uses 10-meter bins of wall-to-wall distance. For robustness, we also estimate a specification using centroid to centroid distances. With this latter measure, we define the closest bin as 0-30 meters because 30 meters roughly corresponds to 10 meters of wall-to-wall distance.¹⁵ We apply some additional sample exclusions when estimating Equation 2: The sample is restricted to California since we can only reliably calculate footprint locations for California homes. We further drop condominiums and townhomes to focus on detached single family homes.

This regression identifies the causal effect of code-induced mitigation by neighboring homes if the code regime for neighboring homes is uncorrelated with other determinants of structure- and neighborhood-level risk. This assumption is bolstered by the street fixed effects, which focus on highly local variation.

15. The median building footprint area in the sample is 260 m². A hypothetical circular roof would thus have a radius of 9.1 meters and the centroid-to-centroid distance between two such homes would be 18.2 + wall-to-wall distance.

Intuitively, this specification compares homes on the same street during the same wildfire whose nearest neighbors were built in different years. One might still worry, however, that even within these narrow comparisons and even after controlling for own age, the age of a home’s neighbors may still be correlated with other wildfire risk factors. We address this concern by exploring estimates for homes located slightly further away as a placebo check. Properties located 50 to 100 meters away are outside of the 30-meter home ignition zone and so present more limited direct ignition threat, but should otherwise be subject to the same potential omitted variables as directly adjacent homes.

4 Results and Discussion

4.1 Own-structure survival

4.1.1 Graphical Evidence

Figure 3 shows the raw mean of *Destroyed* for State Responsibility Area homes according to year of construction. About 35% of exposed homes built prior to the mid-1990s were destroyed. These destruction probabilities begin to fall for homes built after the mid-1990s, decreasing quickly to about 20%. This sharp improvement in resilience corresponds in time to the post-Oakland Firestorm building reforms.

There is also some evidence in Figure 3 that homes built before about 1980 may be less likely to be destroyed than homes built just prior to the roof requirements. This may reflect the fact these older homes are more likely to have been re-roofed at least once after the mid-1990s and complied with the requirement for ignition-resistant materials at roof replacement. This pattern would imply a replacement cycle of about 30-40 years. Actual data on roof service lifetimes is scarce, but this period is within the range proposed by the National Association of Home Builders and other sources (National Association of Home Builders 2007). To the extent that some pre-building code homes may be re-roofed with code-compliant materials, our estimates of building code effects are conservative.

Appendix Figure 2 shows that homes built before and after the building code changes are otherwise comparable. There are no meaningful changes in site-level predictors of fire risk, like ground slope, or in structure characteristics such as building square footage.

Figure 4 presents the event study estimates from Equation (1). The top panel shows homes in SRA, where WUI building codes are mandatory. The markers show estimates and 95% confidence intervals for two-year vintage bins. The omitted bin is 1987-1988, so that these estimates can be interpreted as percentage-point differences in likelihood of destruction relative to a 1987 home. The vintage effects are flat prior to about 1993, and then begin to decrease clearly during the 1995–1999 period. The point estimates suggest additional reductions in loss probability following the adoption of the Chapter 7A codes in 2008, although the small number of homes in those bins leads to somewhat noisy vintage estimates. The overall difference in loss probability between a 1987 home and a 2008+ home is about 15 percentage points.

The middle panel shows homes in LRA areas that CAL FIRE recommended for Very High Fire Hazard Severity Zone designation. These areas again show flat trends in resilience prior to the 1991 Oakland Firestorm and subsequent Bates Bill. After the Bates Bill takes effect, the figure shows steady improvements that persist for about 12 years. The slope of these improvements appears more gradual than in SRA areas, which would be consistent with varied timing of adoption of the recommended codes across hundreds of individual municipalities. The post-2008 estimates are again noisy but imply further improvements in resilience following adoption of the Chapter 7A building codes.

Finally, the bottom panel of Figure 4 shows vintage effects for homes in areas not subject to California’s codes. This includes fires in areas of Arizona, Colorado, Oregon, and Washington with no state or local wildfire building codes. It also includes LRA areas in California that were never recommended as Very High Fire Hazard Severity Zones. There are relatively few homes in these groups (Appendix Table 1), so we pool them together and use wider ten-year vintage bins to increase precision. Unlike the top two panels, there

is little evidence of improved resilience for homes built since the mid 1990s in areas without wildfire building codes.

4.1.2 Difference-in-Differences Estimates and Robustness Checks

The regression estimates in Table 1 summarize the effects of building code regimes on structure resilience. We show estimates for SRA, LRA-VHFHSZ, and no-codes areas. The various group by time period estimates can be interpreted as percentage point differences in likelihood of destruction relative to the reference category, which is pre-1998 homes in no-code areas. Column (1) shows the results with street by fire fixed effects. The near-zero coefficient on SRA * Before 1998 implies that SRA homes built before the end of the mid-1990s building codes reforms perform similarly to homes of the same vintage in no-code areas. In contrast, SRA homes built during 1998–2007 or 2008–2016 perform 11.2 percentage points and 15.9 percentage points better, respectively. Differencing the pre-post differences across code areas yields a DiD estimate of 13.1 percentage points. The same pattern exists for LRA VHFHSZ areas, with no difference before 1998 and substantial improvements in the post-code periods. The DiD estimate for LRA VHFHSZ areas is 12.2 percentage points. Lastly, these improvements are smaller or absent in the no-codes comparison group, where homes built in the latter two time periods show only minor improvements that are not statistically distinguishable from zero. This is further evidence that the improvements in the code areas are due to building codes as opposed to other time-varying factors. The regression also includes controls for topography and vegetation. As expected, slope steepness at the home site increases vulnerability. A home on a 10 degree slope would be six percentage points less likely to survive than an otherwise-identical home on flat ground. This specification also includes fixed effects for the dominant vegetation type in the area of the home.¹⁶

The remaining columns of Table 1 explore alternative specifications. Col-

16. We assign vegetation types as the most common fuel model in a 25-meter radius around the home.

umn (2) adds building characteristics from the assessor data. Building square footage, number of bedrooms, and lot size do not appear to have meaningful effects on survival after controlling for year built and street. Home characteristics data are missing for about 20% of homes, which shrinks the sample in this third column. The final three columns show different sets of fixed effects. Column (3) includes separate fixed effects for each group of 100 adjacent homes on each street (ordered by house number). This specification addresses a potential concern that some streets in the sample include many hundreds of homes. The more granular fixed effects do not materially change the estimates. Column (4) groups homes on the same street and side of the street, assuming that house numbers follow the convention of odd and even numbers on opposite sides. This specification also does not change the results. Finally, Column (5) omits the street fixed effects and instead uses incident fixed effects. These incident dummies absorb fire-specific severity and arbitrary time trends in preparedness, but unlike the street fixed effects they do not adjust for differences between exposed homes within the same wildfire incident. The point estimates are slightly larger in SRA areas and slightly smaller in LRA VHFHSZ areas. Notably, the R^2 with incident fixed effects is smaller than with street fixed effects (0.39 vs 0.63). This difference implies that the street fixed effects remove variation in fire severity and other factors within incidents that might otherwise threaten identification. Nevertheless, the estimates are broadly stable across specifications. None of the estimated effects in Columns (2) through (5) are statistically different from those in Column (1).

In principle, the street fixed effects design could underestimate the effect of building codes due to the spillover benefits that we document in the next section. If code-induced investments also benefit nearby pre-code homes, the difference in outcomes between post-code and pre-code homes will understate the true effect of codes on survival.¹⁷ This attenuation could be exacerbated by street fixed effects, which by construction are focused on homes located relatively close to each other. Such reasoning might lead one to prefer incident

17. This is a violation of the Stable Unit Treatment Value Assumption, or SUTVA (Rubin 1980).

fixed effects. In practice, as we show in the next section, spillovers are highly localized and are small compared to the own-resilience effects. In the spirit of exhaustiveness, Appendix Table 3 investigates the quantitative significance of SUTVA concerns by controlling directly for the number of pre- and post-code near neighbors in the street fixed effects regression. Ultimately, the differences in the estimated building code effects across these approaches – street fixed effects, incident fixed effects, and street fixed effects directly controlling for spillovers – are small enough that the various results are not statistically different.

4.2 Spillovers to neighboring properties

This section discusses the spillover benefits of code-induced mitigation to neighboring homes. Figure 5 shows regression results for Equation (2). The top panel shows effects of the presence of pre-code neighbors at various wall-to-wall distances. One or more pre-code neighbors within 0-10 meters increases own-structure loss probability during a wildfire by about 3 percentage points. These effects attenuate with distance, going to zero at 30-40 meters. Notably, this is the distance that wildfire managers consider to be the home ignition zone - the distance within which flammable material presents a risk of structure ignition (Cohen 2000, 2010; Calkin et al. 2014). The near-zero estimates beyond 40 meters bolster the validity of our research design. If our estimates for the nearest neighbors were biased by omitted predictors of resilience that co-vary within neighborhoods, one would expect that bias to also appear in estimates for homes another few dozen meters away (Figure 1b provides a useful illustration of these small distances).

The bottom panel shows the estimates for post-code neighbors. The confidence intervals for these estimates are wider since we observe fewer post-code homes. However, the point estimates suggest that the presence of close neighbors built under WUI building codes does not increase own-structure loss probability. There is also no implied effect of further-away post-code neighbors on own survival, offering additional placebo evidence to support the identifying

assumptions behind this regression.

Table 2 reports regression estimates for near neighbors that allow effects to vary with the number of neighbors. Column (1) considers neighbors at a wall-to-wall distance of less than 10 meters. A single pre-code neighbor increases own-structure loss risk by 2 percentage points. Two or more pre-code near neighbors increases the effect to 3.1 percentage points. This latter category mostly represents the effect of homes with two neighbors, given that very few homes have more than two neighbors within 10 meters (Appendix Table 2). The estimated effects of nearby post-code neighbors are close to zero. Column (2) shows the same regression using a restricted sample of areas where our measured distances between homes are likely to be particularly accurate. This sample includes denser areas (homes with at least 10 neighbors within a 200 meter radius; see Appendix Table 4) and fires since 2013 (for older incidents, it is more likely that parcel boundaries have changed since the fire). The estimated risk posed by pre-code neighbors is slightly larger in this specification, perhaps due to measurement error in wall-to-wall distances in the full sample. The estimates for post-code neighbors are again zero. As another robustness check, Columns (3) and (4) present similar results based on the centroid-to-centroid distance measure. One pre-code neighbor within 30 meters of centroid distance – roughly equivalent to 10 meters of wall distance – increases own loss risk by 2.6 percentage points, and two or more increases risk by 5 percentage points. Again, the point estimates for post-code neighbors are much smaller and close to zero.

5 Net Social Benefits of Building Standards

The empirical results show that compared to reliance on voluntary action alone, California’s wildfire building codes substantially reduced average structure loss risk during a wildfire. They also reduced the risk to a close neighbor’s home. Having documented these large resilience benefits, we now embed the results in a simple economic model in order to benchmark the approximate net social benefits of wildfire building codes. We use our estimates to explore

the minimum annual disaster probability at which universal mitigation investment is welfare-improving, given various values of neighborhood density and household risk aversion. This exercise is intentionally simple and abstracts from many theoretical and practical details that warrant investigation in future work.¹⁸

5.1 An Empirical Model of Hazard Mitigation

N identical individuals own homes in a neighborhood with an annual probability p^F of a disaster. In the event of a disaster, each home i 's baseline probability of destruction is p_0^D . Up-front investment in a binary mitigation measure with cost m by homeowner i reduces own loss risk during a disaster by τ_{ii} and also reduces loss risk by τ_{ji} for a subset of neighbors $j \neq i$ (for example, in our application τ_{ji} is non-zero for neighbors within some distance of home i and zero for the remaining homes). Mitigation benefits are additive so that a home's destruction probability during a disaster is $p_i^D = p_0^D - M_i\tau_{ii} - \sum_{j \neq i} M_j\tau_{ij}$, where $M_i \in \{0, 1\}$ is the homeowner's binary mitigation decision. We capture myopia with perceived disaster probabilities $\hat{p}_i^F \leq p^F$. These perceived probabilities vary across households.

Consistent with stylized facts (e.g., Klein (2018)), disaster losses are partially insured: destruction of the home imposes insured losses L^I for the insurer and uninsured losses L^U for the homeowner. We initially assume frictionless property insurance markets that offer coverage at actuarially fair annual premia $k_i = p^F p_i^D L^I$. The coexistence of uninsured risk exposure and actuarially fair premiums reflects uninsurable losses (for example, mental and emotional distress) and/or household myopia. The exposition in this section uses a static model with no discounting. Our actual calculations assume that households discount future costs and benefits at a 5% annual rate.

We define two potential measures of net benefit, *risk-neutral cost effectiveness* and *expected utility benefit*. Risk-neutral cost effectiveness is simply the

18. A more detailed theoretical treatment of private risk mitigation can be found in Costello, Qu erou, and Tomini (2017).

difference in expected cost with and without mitigation. Expected utility benefit accounts for additional benefits from reduced exposure to uninsured risk. Appendix Section D presents a sketch of the expected utility model. Actually calculating expected utility requires strong assumptions about households' risk aversion, permanent income, ability to smooth across time periods, and other factors. We focus the derivation in this section on risk-neutral cost effectiveness (hereafter, "cost effectiveness"). We note that cost effectiveness is a lower bound on net benefits as long as homeowners are not risk-loving.

Total expected cost across households is,

$$\sum_{i=1}^N [p^F(p_0^D - \sum_{j=1}^N M_j \tau_{ij})(L^I + L^U) + M_i m] \quad (3)$$

The social benefit of mitigation by a homeowner is the sum of private and external benefits (reduced loss probability) minus mitigation costs,

$$p^F(\tau_{ii} + \sum_{j \neq i} \tau_{ji})(L^I + L^U) - m \quad (4)$$

In contrast, a homeowner's perceived change in private expected losses with mitigation is,

$$\hat{p}_i^F \tau_{ii}(L^I + L^U) - m \quad (5)$$

The presence of internalities (\hat{p}_i^F) and externalities (τ_{ji}) means that Expression (5) is weakly less than Expression (4). If households minimize perceived private expected cost, the voluntary takeup rate will be,

$$\mu = \frac{1}{N} \sum_{i=1}^N \mathbb{1}[\hat{p}_i^F \tau_{ii}(L^I + L^U) \geq m] \quad (6)$$

which depends on the distribution of perceived probabilities. Assuming \hat{p}_i^F is independently distributed, total actual expected costs under voluntary takeup are $\sum_{i=1}^N [p^F(p_0^D - \sum_{j=1}^N \mu \tau_{ij})(L^I + L^U) + \mu m]$.

Now consider a policy requiring mitigation by all households. Total expected

cost is given by setting $M_i = 1$ for all households in Expression (3). The difference in expected cost under the mandate vs. the voluntary regime is,

$$(1 - \mu) \left[p^F \left[\sum_{i=1}^N \sum_{j=1}^N \tau_{ij} (L^I + L^U) \right] - Nm \right] \quad (7)$$

The Samuelson (1954)-style expression inside the outer brackets is the sum of private and external mitigation benefits minus total mitigation costs. The factor of $(1 - \mu)$ reflects takeup by a fraction μ of the population without the mandate. A mandate weakly reduces total expected cost if the social value of mitigation (Expression 4) is positive and strictly increases expected cost if the social value of mitigation is negative.

Before proceeding, it is worth noting some restrictions in this model. We assume additive mitigation benefits. There is some support for this in the data - for example, the approximate linearity of risk spillovers for one vs. two near neighbors in Table 2. A more complex model could instead allow the benefits of mitigation to vary with mitigation effort by others, so that mitigation becomes a strategic game between homeowners.¹⁹ We also assume identical homes and homeowners within the neighborhood and independently distributed perceived disaster probabilities. We explore heterogeneity in fire risk and neighborhood density across neighborhoods (zip codes) in the empirical implementation. Expanding the model to allow for greater heterogeneity within neighborhoods would allow a more nuanced exploration of the distribution of net benefits. We see these extensions as useful areas for future work, but prefer this simple and transparent model for the purposes of benchmarking approximate net benefits.

5.2 Implementation

We implement the model for a random sample of 100,000 homes in 424 California zip codes in wildfire hazard areas. Each zip code is modeled as a separate

19. Shafran (2008) develops such a model for vegetation maintenance in wildfire areas.

neighborhood with its own fire probability and number of close neighbors affected by risk spillovers.

Mitigation Benefits

The empirical results in Section 4 allow us to estimate τ_{ii} and τ_{ij} . The reduced form estimates of the effect of building codes on structure survival can be seen as intent-to-treat estimates of the effect of mitigation investment. Given a rate of voluntary takeup for the bundle of mitigation measures in the building code, the standard Wald estimator gives τ_{ii} and τ_{ij} as the ratio of the reduced form estimates and the difference in takeup rates in the codes and no-codes areas.²⁰ In the theoretical model, voluntary takeup μ depends on beliefs about fire risk and might thus be expected to vary between neighborhoods. In practice, survey data on voluntary mitigation is scarce and the available data do not allow us to calculate neighborhood-specific voluntary takeup rates. Our base calculation uses a voluntary takeup rate of one-third. Appendix Section E describes how we calculate this takeup rate based on CAL FIRE inspections of destroyed and surviving homes for a sample of recent California wildfires, including caveats about limitations of the data (which is nevertheless the best existing survey evidence for our purposes).

Our reduced form estimate for own survival benefit for SRA homes implies a value of τ_{ii} of 0.195 ($\frac{.13.1}{1-0.33} = 0.195$). For τ_{ij} , our reduced form estimate of neighbor benefits in Table 2 is 2.3 percentage points for neighbors up to 10 meters away in wall-to-wall distance (and close to zero beyond 10 meters). The effect also appears approximately linear in number of neighbors that mitigate, at least over the limited range of number of neighbors that we can observe in the data. Thus, our estimate of τ_{ij} is 0.034 for each neighbor within 10 meters ($\frac{-0.023}{1-0.33} = -0.034$) and zero for all further-away neighbors.²¹

20. See e.g., Angrist and Pischke (2009) p. 127-133. This calculation assumes perfect compliance by homes subject to codes and a homogeneous effect of mitigation on structure survival.

21. In principle, mitigation at further-away homes also benefits home i through potential “domino effects”: a near neighbor becomes less likely to ignite due to action by that neighbor’s neighbor. Our estimates imply that these effects are small on average (on the order of

Sampling at-risk homes

Unlike the empirical analysis of building code effects, which uses homes located inside historical wildfire perimeters, the net benefits calculation considers a group of homes sampled randomly from *all* California homes in fire hazard areas. To construct this sample, we start from all California homes in designated wildfire severity zones (SRA or LRA) and filter out zip codes containing fewer than 100 homes. We then randomly draw $\min(n, 250)$ homes from each remaining zip code where n is the number of homes in the zip code. This yields a sample of 100,230 homes subject to wildfire building codes in 424 zip codes.

We identify each home’s annual wildfire exposure probability p^F using data from the United States Forest Service (USFS) Wildfire Risk to Communities project. This measure captures the annual probability of moderate to severe wildfire exposure (Scott et al. 2020).²² We also identify each home’s number of neighbors within 30 meters of centroid to centroid distance. This roughly corresponds to the number of neighbors within 10 meters of wall-to-wall distance (see footnote 15) and is less demanding to calculate in this new random sample of homes.

Costs and Losses

Our main estimates of mitigation costs come from Headwaters Economics (2018). That study uses construction estimating tools from R.S. Means to calculate the additional cost to build a home that complies with California’s Chapter 7A wildfire code. Overall, that study reports zero cost difference between code-compliant and standard designs. This counter-intuitive result arises because one aspect of code-compliant construction (exterior siding) is substantially *less* expensive than standard designs. These savings offset increased costs for roofing, landscaping, and other areas. Our main estimate of

0.034²).

22. We use the product of Burn Probability (the total annual wildfire probability) and Flame Length Exceedance Probability 4 (conditional on any fire, the probability that the fire will reach moderate or greater threat status).

code compliance costs ignores savings from code-compliant siding on the theory that owners would make this choice even without standards. This gives a cost estimate of \$15,660. We also report results using alternative cost estimates from the National Association of Home Builders. Their estimated wildfire code compliance costs for newly-built California homes include a low scenario of \$7,868 and a high scenario of \$29,429 (Home Innovation Research Labs 2020).²³ Finally, we show a “retrofit” scenario based on Headwaters Economics’ estimate of \$62,760 to fully replace roofing and exterior walls on an existing home.

Our assumed losses for a home destroyed by wildfire include rebuilding costs, belongings and contents of the home, alternative living costs while the home is rebuilt, and costs for debris removal and hazardous waste cleanup. Rebuilding, contents, and alternative living arrangements costs come from the FEMA Hazus model (Federal Emergency Management Agency 2021). We match as closely as possible the characteristics of the model home used to estimate code compliance costs in Headwaters Economics (2018).²⁴ We regionally adjust these costs to California using geographic adjustment factors from R.S. Means provided in the Hazus model. The resulting cost of reconstruction and contents losses is \$766,725. The Hazus cost for alternative living arrangements and disruption (e.g., moving costs) for 24 months is \$61,696. For debris removal (which is borne by homeowners) and hazardous waste cleanup (borne by governments), we add a total of \$150,000.²⁵

We assume that mitigation investments have a protective lifetime of 40 years.

23. These are costs to meet the International Wildland Urban Interface Code, which is similar to the Chapter 7A code. In the low scenario, we ignore \$3,839 of gross savings from code-compliant siding as we do for Headwaters Economics (2018).

24. The model home in Headwaters Economics (2018) is a 2,500 square-foot single-story home with 2-car garage constructed in Montana for \$140 per square foot. We use Hazus cost estimates for the same size, number of stories, and garage in the “custom” construction class, the closest corresponding cost category.

25. For cleanup and debris removal costs, see Klein (2018); Lewis, Sukey, “Cleaning Up: Inside the Wildfire Debris Removal Job That Cost Taxpayers \$1.3 Billion.” *The California Report*, July 19, 2018; and Bizjak, Tony, “State’s Effort to Clean Up After the Camp Fire is Off to a Rocky Start”, *Sacramento Bee*, January 13, 2019.

In the absence of mitigation investment, the probability of loss when exposed to wildfire for a home with no close neighbors is 44%.²⁶ Households discount future costs and benefits at 5% per year.

5.3 Results of Net Benefit Calculation

Figure 6 illustrates the results of this calculation. The scatter plot shows zip code-level averages of annual wildfire hazard and number of near neighbors. The wildfire hazard reaches strikingly high levels: several zip codes face annual event probabilities above 2% per year, implying a significant wildfire exposure every 50 years on average. The color scale shows the social benefit of mitigation investment in each zip code following Expression (4). The dashed black line shows a threshold for positive net benefits of building standards. Homes to the right of this line have lower expected costs with mitigation investments than without. The threshold bends to the left as the average number of neighbors increases due to the spillover benefits of mitigation across properties. For a home with zero near neighbors, the break-even annual wildfire hazard is about 0.45%. The break-even annual hazard for a home with 1 near neighbor is 0.39% and for a home with 4 near neighbors it is 0.27%.

These cost effectiveness estimates are a lower bound on the net benefits of universal mitigation. One important reason for this is that many homeowners are substantially underinsured for natural disaster losses. Mitigation investments yield additional welfare benefits by reducing exposure to uninsured risk. Even for properties covered by homeowners insurance, Klein (2018) reports that coverage limits for wildfire-destroyed properties are often up to 50% below actual losses. Table 3 reports break-even annual wildfire probabilities for a home with 1.2 near neighbors (the sample mean) based on the expected utility model in Appendix Section D. Although this model requires additional strong assumptions, these back-of-the-envelope numbers depict how risk aversion might affect program benefits. For example, if code compliance costs \$15,660, a homeowner

26. The approximate destruction probability for SRA homes under current codes is $0.4 - .156 = .244$ (Table 1). Combined with the own-structure mitigation effect, this gives the implied loss probability in the absence of mitigation: $.244 + .195 = 0.44$.

with a coefficient of relative risk aversion of 5 and an insurance policy covering two thirds of total losses would be better off investing in mitigation wherever the annual probability of a damaging wildfire exceeds 0.33%.²⁷

Table 3 also reports results using other estimates of mitigation cost. The zero net cost estimate from Headwaters Economics (2018) leads to positive benefits for any level of hazard. The two additional estimates from Home Innovation Research Labs (2020) bracket the main cost estimate. Finally, the estimated retrofit cost of \$62,760 results in much higher break-even hazard levels for existing homes. This kind of full retrofit to existing homes appears to generate positive benefits only for a handful of areas with extreme fire hazard.

Beyond risk aversion, WUI building codes likely have additional benefits that are not included in our calculations. These include reductions in public expenditures on firefighting during large wildfires (Baylis and Boomhower 2019), reduced demand for public assistance among fire victims (Deryugina 2017), avoided emotional and mental distress, and less need for public safety power shutoffs that interrupt electricity service during high fire-risk periods.²⁸ Moreover, if imperfections in property insurance markets cause premiums to systematically exceed expected damages, then mitigation becomes more attractive because it reduces the risk which must be insured in the imperfect insurance market. Scientists also agree that annual wildfire probabilities are increasing throughout North America such that net benefits of WUI building codes will grow in the future. On the other hand, a more detailed analysis would need to consider possible heterogeneity in household net benefits. If some individuals have very high perceived private costs of choosing fire resistant materials and landscaping (perhaps due to strong aesthetic preferences), building standards could be costly for these households.

27. Studies of the property insurance market generally report high implied levels of relative risk aversion. Cohen and Einav (2007) and Sydnor (2010) examine deductible choices in auto and homeowners insurance respectively and find double-digit values for the mean household across a variety of specifications. Evidence from other markets suggests values closer to the low single digits (e.g., Gertner 1993; Chetty 2006).

28. For a systematic review of catastrophic wildfire costs, see Feo et al. (2020).

In summary, our empirical estimates and model calculations suggest that wildfire building codes yield unambiguous benefits in the most fire-prone areas of California, especially when homes are clustered closely together such that there are large risk spillovers. For areas with lower fire risk, the sign of net benefits is more sensitive to modeling choices and the assumed co-benefits of building codes. Further work on the cost-effectiveness of wildfire mitigation measures in low- and moderate-risk areas is an important area for additional research.

6 Conclusion

Efficient investment in adaptation is essential in the face of rapidly accelerating disaster losses. Yet takeup of protective technologies and behaviors is thought to be constrained by misperception of risk, insurance market failures, spatial externalities, and other frictions. The pressing question facing researchers and policymakers is how to best respond to these market barriers. One suite of policies focuses on increasing voluntary takeup through information or subsidies. Another option is to override individual decisions and mandate certain investments in hazard areas. These policies may differ substantially in their effects and their political acceptability.

This study contributes evidence on the effects and net economic benefits of a mandatory adaptation policy. We provide the first comprehensive empirical evaluation of California's strict wildfire building codes. The analysis uses a new dataset of property-level data on U.S. homes destroyed by wildfire that was created for this study. The new data combine nationwide property characteristics information with post-fire damage assessment records collected from numerous local and state agencies. This resource has three important advantages: it collects and harmonizes previously disparate damage data; it contains a complete record of homes that survive as well as homes that are destroyed; and unlike data for floods and other losses, it is reported at the individual property level. Beyond this study, the new data will enable additional important research on disaster losses.

The empirical analysis in this study is bolstered by our ability to observe differences in building code regimes over time, across jurisdictions within California, and between California and other states. The empirical strategy isolates the effect of building code changes using a fixed effects design that compares outcomes for pre- and post-code homes on the same residential street. This approach narrows the comparison to homes experiencing essentially identical wildfire exposures.

The results show that compared to reliance on voluntary action alone, California's wildfire building codes reduced average structure loss risk during a wildfire by 16 percentage points, or about a 40% reduction. They also reduced the risk to a close neighbor's home by about 2 percentage points or 6%. These striking results imply materially different levels of resilience in communities with and without such codes. Moreover, the spatial externalities provide a classic rationale for public policy intervention even if homeowners were fully informed and rational about wildfire risk.

Having documented these large resilience benefits, we then show how the empirical results can be embedded in an economic model that accounts for mitigation costs, spatial spillovers, and risk preferences. We use our results and other values from the literature to provide a back-of-the-envelope approximation of the minimum annual wildfire risk at which universal mitigation generates positive net benefits. In the most fire-prone areas of California, the calculation shows large net benefits of building codes for new homes. Given the high cost of fully retrofitting existing homes to modern standards, full retrofits do not pass a benefit-cost test in most areas. An important task for future research is to identify individual low-cost investments that can cost-effectively improve the resilience of existing homes in high hazard areas.

In summary, the data show that an adaptation mandate substantially improved resilience to wildfires and a cost-benefit approximation suggests that low takeup without standards is more likely driven by market failures than by fully-informed individual decisionmaking. These results are immediately applicable to policy debates in the U.S., Canada, Australia, the European

Union, and other jurisdictions that are seeking to respond to escalating wildfire risk. More broadly, these facts should be of interest to policymakers and researchers confronting other hazards like floods, hurricanes, and heat waves where voluntary take-up of self-protective investments seems to be constrained by similar barriers. As climate change continues to increase disaster losses, this type of research on the role of public policy and market incentives in shaping adaptation is increasingly urgent.

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Figure 1: Building and Validating the Dataset

(a) Roof Locations and Damage Reports

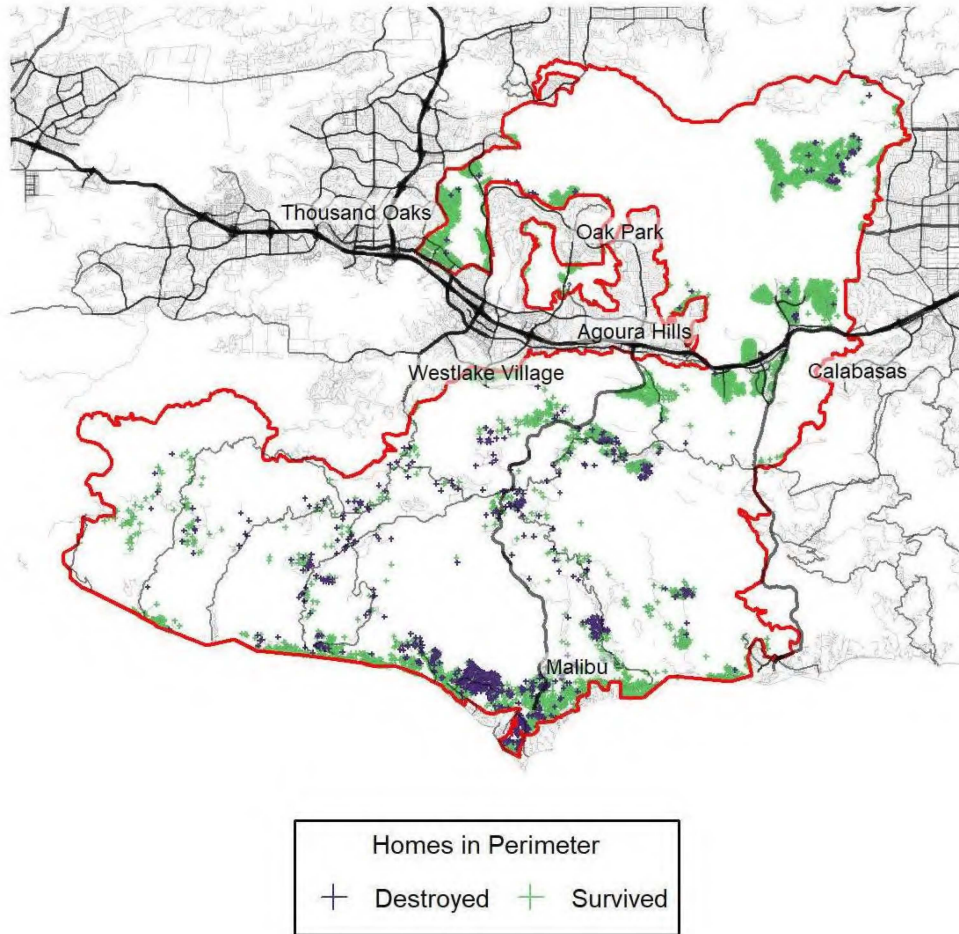


(b) Distance Between Structures



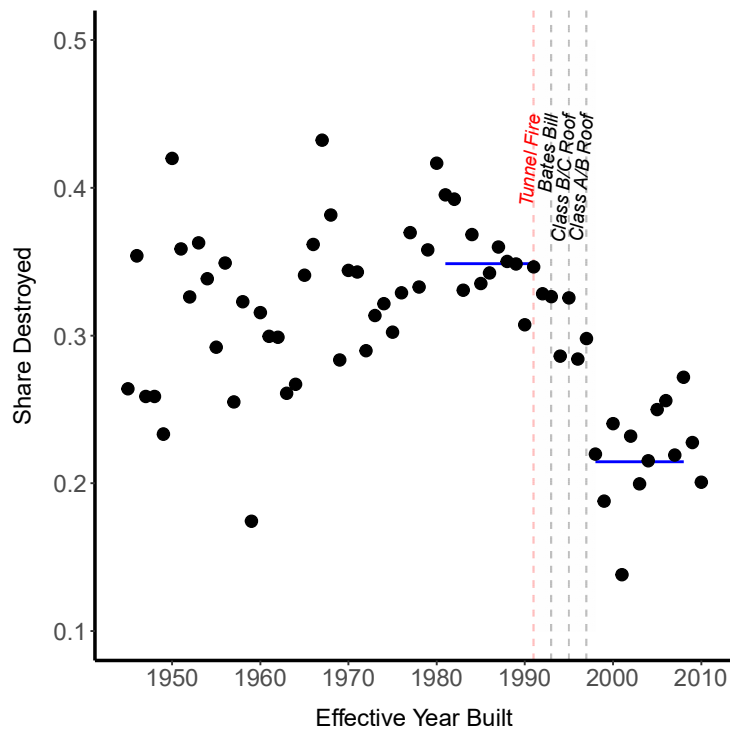
Notes: Best viewed in color. **(Panel a)** Homes affected by the Carr Fire (2018). Markers are geocoded structure locations. Green square markers are structures reported as destroyed in the damage inspection data; yellow circular markers are all other homes in the data. The background image is aerial imagery before and after the Carr Fire from NearMap. Blue building shapes and gray parcel outlines are the building footprint data and assessor parcel boundary data used to identify structure locations (see text for details). **(Panel b)** Examples of calculated distances between structure walls. Images are pre-fire aerial imagery of homes affected by the Thomas Fire (2017) and Tubbs Fire (2017). Figure shows the wall-to-wall distance from the structure marked '0' to the other homes.

Figure 2: Merged data example: Structure-level outcomes in the Woolsey Fire



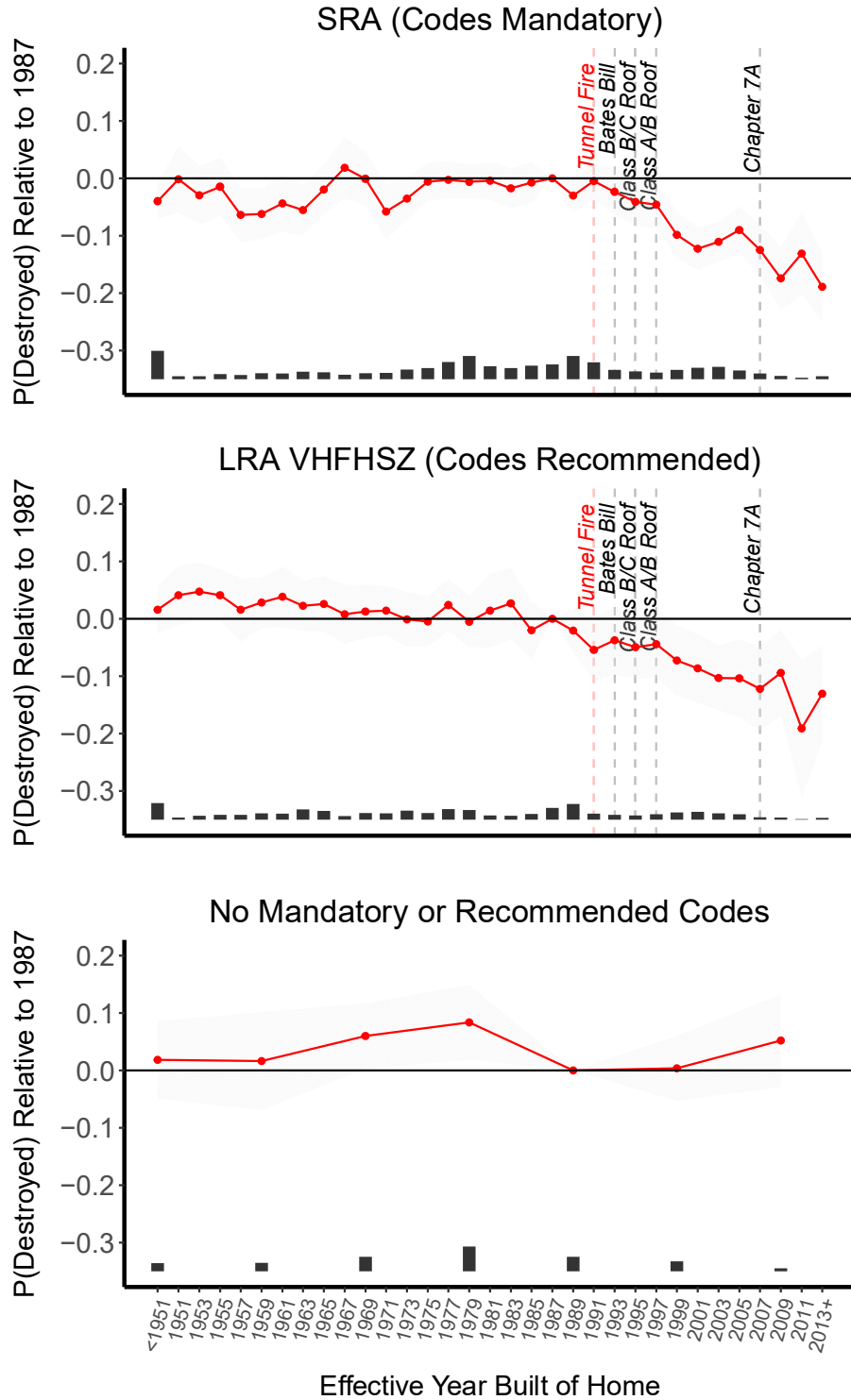
Notes: Best viewed in color. Example of merged inspection, assessor, and fire perimeter data for one fire in our dataset. Markers indicate the locations of single family homes inside the final Woolsey Fire perimeter (shown in red). Purple homes are reported destroyed in damage inspection data; green homes are all remaining homes in the ZTRAX assessment data. Street map data are from Open Street Map.

Figure 3: Share Destroyed by Year Built in Mandatory Code Areas



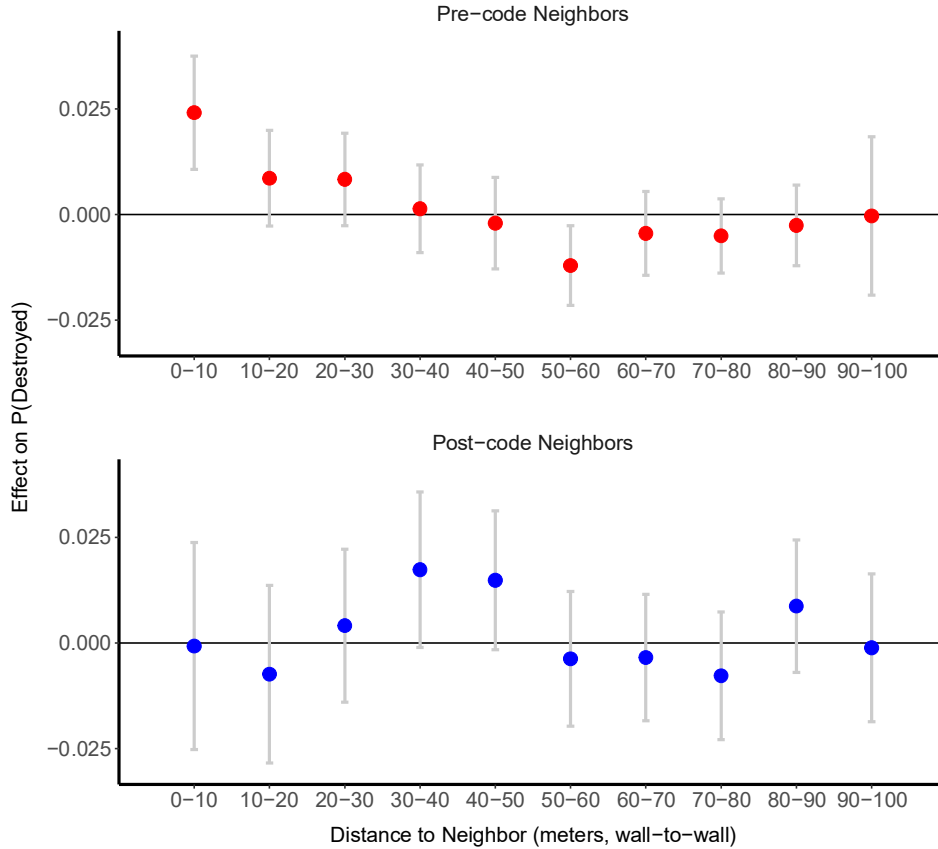
Notes: This figure shows the share of homes inside wildfire perimeters that were destroyed, according to the year that the home was built. The sample is limited to homes in State Responsibility Area. The blue lines show ten-year averages.

Figure 4: Estimated Vintage Effects by Building Code Jurisdiction



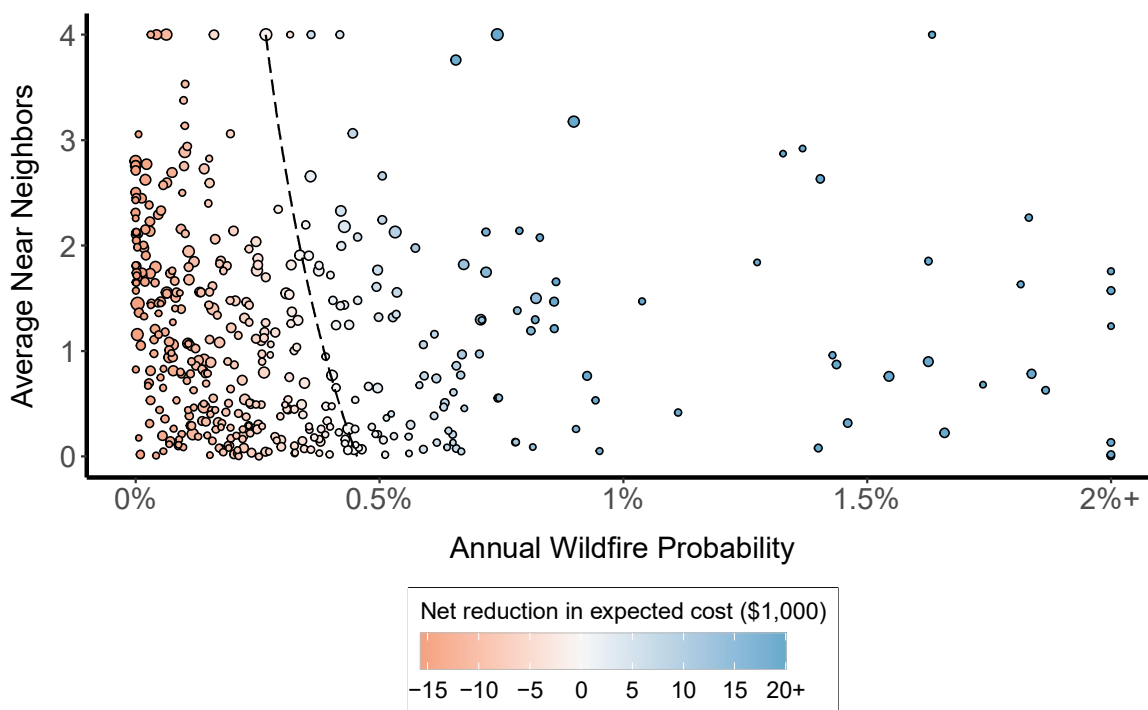
Notes: Figure plots point estimates and 95% confidence intervals from 3 separate OLS regressions of an indicator for Destroyed on bins of effective year built. Each regression includes street by incident fixed effects and other controls described in the text. Panel (a) shows homes in state responsibility area (SRA). Panel (b) shows homes in local responsibility area (LRA) inside state-recommended Very High Fire Hazard Severity Zones (VHFHSZ). Panel (c) shows homes in states without wildfire building codes (AZ, CO, OR, WA) and LRA areas in California outside of state-recommended VHFHSZ. Standard errors are clustered by street. The histogram below each panel shows the relative number of observations in each bin.

Figure 5: The effect of neighboring homes on survival



Notes: Figure shows coefficients and 95% confidence intervals from a single OLS regression of “Destroyed” on the presence of pre- and post-code neighbors at various distances. The top panel shows estimates for indicator variables for the presence of one or more neighbors built without wildfire building codes. The bottom panel shows estimates for indicator variables for the presence of one or more neighbors built after wildfire building codes. The regression also includes own year built (in four year bins), street by incident fixed effects, and topographic controls. Distance to neighboring home is wall-to-wall distance. See text for details.

Figure 6: Lower-bound Net Benefits by Fire Hazard and Number of Neighbors



Notes: This figure plots the annual probability of a damaging wildfire and average number of close neighbors for a random sample of 100,230 California homes in areas subject to the Chapter 7A building codes. Markers represent zip-code averages. Marker color indicates average net benefits in the zip code using the cost-effectiveness measure, which is a conservative lower bound on total net benefits. Annual wildfire hazard is from Scott et al. (2020) and represents a snapshot as of 2014. Number of neighbors is the number of homes within a 30-meter centroid to centroid distance. Marker size is proportional to number of homes in the zip code. The dashed line shows a threshold for zero net reduction in expected cost. See text for discussion and alternative scenarios.

Table 1: Regression estimates of building code effects on own survival

	(1)	(2)	(3)	(4)	(5)
SRA * Before 1998	-0.022 (0.033)	-0.045 (0.041)	-0.027 (0.029)	-0.021 (0.037)	-0.029 (0.020)
SRA * 1998–2007	-0.112*** (0.034)	-0.138*** (0.043)	-0.117*** (0.031)	-0.113*** (0.039)	-0.160*** (0.022)
SRA * 2008–2016	-0.159*** (0.036)	-0.190*** (0.044)	-0.164*** (0.033)	-0.151*** (0.041)	-0.204*** (0.027)
LRA VHFHSZ * Before 1998	-0.031 (0.033)	-0.048 (0.050)	-0.038 (0.030)	-0.028 (0.037)	-0.005 (0.021)
LRA VHFHSZ * 1998–2007	-0.121*** (0.034)	-0.142*** (0.048)	-0.126*** (0.032)	-0.127*** (0.038)	-0.095*** (0.025)
LRA VHFHSZ * 2008–2016	-0.159*** (0.037)	-0.178*** (0.050)	-0.162*** (0.035)	-0.163*** (0.041)	-0.130*** (0.030)
No Codes * 1998–2007	-0.038 (0.025)	-0.029 (0.026)	-0.045* (0.026)	-0.044* (0.024)	-0.035 (0.030)
No Codes * 2008–2016	-0.006 (0.033)	0.035 (0.040)	0.012 (0.041)	-0.010 (0.033)	-0.071 (0.044)
Ground slope (degrees)	0.006*** (0.001)	0.005*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.005*** (0.001)
Lot size (acres)		-0.000 (0.000)			
Building square feet		-0.000 (0.000)			
Bedrooms		0.001 (0.003)			
Street FE	✓	✓			
Fuel model FE	✓	✓	✓	✓	✓
Street X 100 homes FE			✓		
Street X side of street FE				✓	
Incident FE					✓
Observations	48,843	38,991	48,843	48,843	48,843
R ²	0.62	0.63	0.63	0.66	0.39
Dep. Var. Mean	0.41	0.46	0.41	0.41	0.41

Notes: Table shows estimates and standard errors from five separate OLS regressions. The outcome variable is an indicator for Destroyed. Street fixed effects includes separate dummies for each street-by-incident. Incident fixed effects are dummies for each wildfire. Fuel model fixed effects are dummies for Anderson fire behavior fuel models. Standard errors are clustered by street.

Table 2: Neighbor Effects

	Destroyed			
	(1)	(2)	(3)	(4)
1 pre-code nearby homes	0.020*** (0.007)	0.023*** (0.007)	0.026*** (0.007)	0.027*** (0.007)
2+ pre-code nearby homes	0.031*** (0.009)	0.039*** (0.010)	0.050*** (0.009)	0.051*** (0.009)
1 post-code nearby home	0.001 (0.013)	0.002 (0.013)	0.010 (0.012)	0.001 (0.013)
2+ post-code nearby homes	-0.001 (0.016)	0.001 (0.018)	0.003 (0.018)	-0.009 (0.021)
Own Year Built	✓	✓	✓	✓
Topography	✓	✓	✓	✓
Street FE	✓	✓	✓	✓
Observations	38,226	23,564	44,923	26,842
R ²	0.64	0.68	0.63	0.68
Distances	Walls	Walls	Centroids	Centroids
Subsample		✓		✓
Dep. Var. Mean	0.40	0.49	0.40	0.51

Notes: Table shows estimates and standard errors from 4 separate OLS regressions. The outcome variable is an indicator for Destroyed, and each regression also includes dummy variables for own year built (in four year bins) and street-by-incident fixed effects. Columns (1) and (2) use wall-to-wall distances to assign neighbors, while Columns (3) and (4) use the centroid-to-centroid distance measure. Columns (1) and (3) use the full sample of single family homes, while columns (2) and (4) use a subsample in areas where our distance measures are likely to be particularly accurate. See text for details. Standard errors are clustered by street.

Table 3: Break-even Hazard under Risk Aversion and Alternative Costs

		Insured %	100	67		33	
				$\gamma = 2$	$\gamma = 5$	$\gamma = 2$	$\gamma = 5$
Cost Estimate	Source						
New Home							
\$ 0	<i>HE-Low</i>		0	0	0	0	0
\$ 4,029	<i>NAHB-Low</i>		0.10%	0.09%	0.08%	0.08%	0.05%
\$15,660	<i>HE</i>		0.38%	0.36%	0.33%	0.30%	0.20%
\$29,429	<i>NAHB-High</i>		0.71%	0.68%	0.63%	0.58%	0.41%
Retrofit							
\$62,760	<i>HE</i>		1.50%	1.46%	1.40%	1.33%	1.15%

Notes: Table shows estimated minimum annual wildfire probability for which building standards yield positive net benefits under various assumptions about cost, share of losses insured, and risk aversion. Probabilities are reported as percentages (e.g., 0.32% per year). For partial insurance scenarios, γ is the coefficient of relative risk aversion. Calculations assume 1.2 near neighbors. See text for details of these calculations. Source code HE represents Headwaters Economics (2018) and NAHB represents Home Innovation Research Labs (2020).

Exhibit B – Master-Planned Community Case Studies



Defensible space, roads and vegetation-management areas (i.e., thinning zones and irrigated zones) create fire buffers around homes and defensible line for fire fighters.



Fire protection plan took predominate wind directions into account

Wind

Heat damage to orchards not homes

Silverado Fire 2020

No structures lost or damaged

Perimeter roads used in Fuel Modification

Streets provide emergency access and evacuation routes

Non-combustible roofs

- Irrigated Fuel Modification (Zone B)
- Thinning Fuel Modification (Zone C)

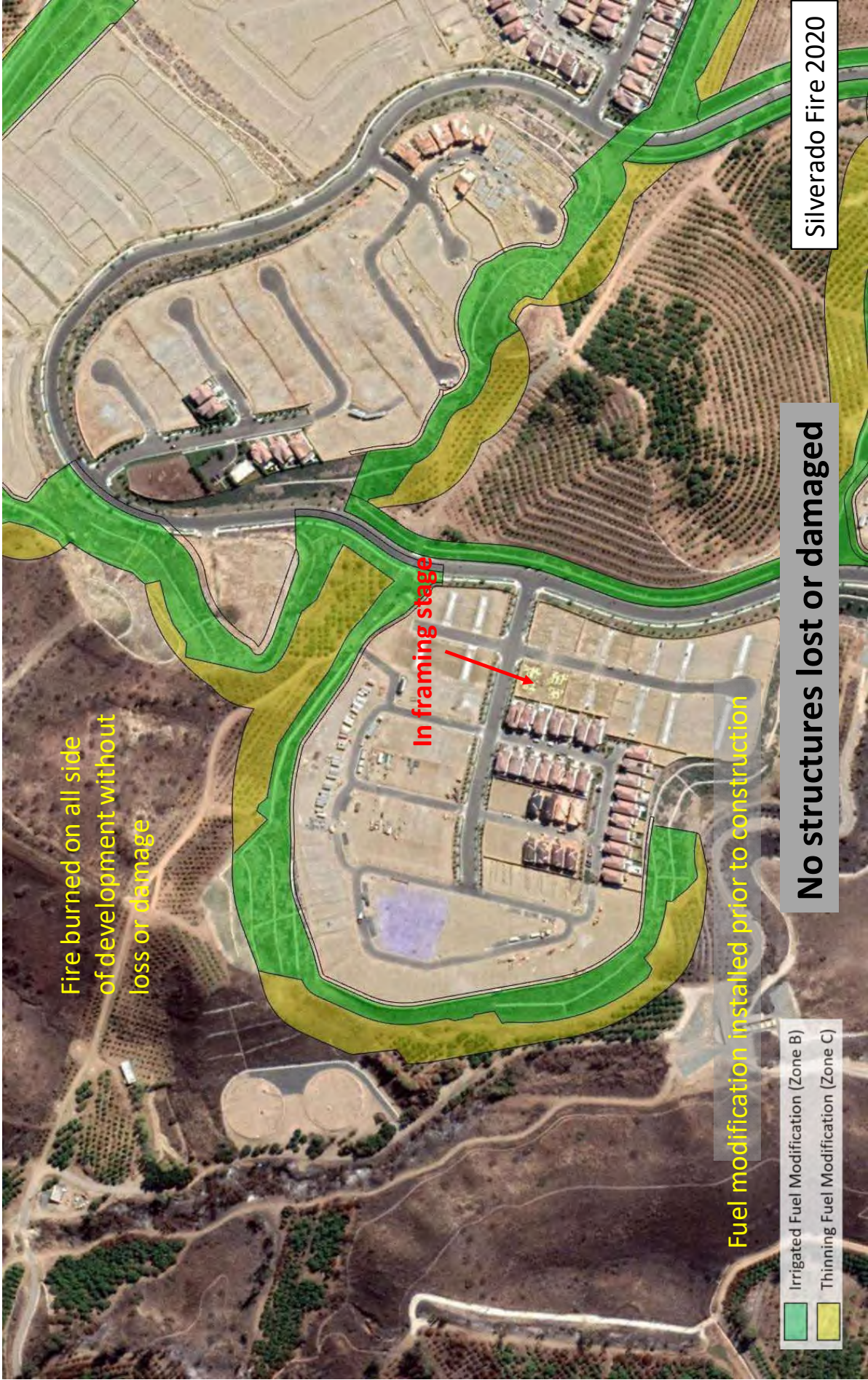




Exhibit C – State Fire Marshall Housing Data Analysis



MEMORANDUM

January 18, 2022

To: Dan Dunmoyer, President and CEO of CBIA
From: Bob Raymer¹
Subject: Analysis of State Fire Marshal Property Loss Data

This memorandum evaluates Office of the State Fire Marshal data to determine how new homes constructed after January 1, 2010 fared in the ten worst property-loss fires dating back to 2017, compared to homes built prior to 2010.

I. METHODS

The State Fire Marshal maintains an extensive data retrieval service of fire incidents across the state, including those related to fires occurring in the Wildland-Urban Interface (WUI).² For the nine worst property-loss fires dating back to 2017, CBIA requested residential data that identified:

- Whether the dwelling was single-family or multifamily;
- damage assessment (destroyed, major damage, affected, no damage);
- valuation of the structure; and
- year the structure was built

The data provided by the State Fire Marshal is attached hereto. Regulatory standards applicable to new construction include:

- The State Fire Marshal's "fire hardening" building standards³

¹ Bob Raymer has degrees in Mechanical Engineering (Bachelor of Science), Engineering Technology/Physics (Bachelor of Science and Environmental Science (Bachelor of Arts). He is a licensed Professional Engineer in the State of California and has been involved in building code development and implementation at the state and national level for 40+ years.

² See California Incident Data and Statistics Program, available at <https://osfm.fire.ca.gov/divisions/community-wildfire-preparedness-and-mitigation/california-incident-data-and-statistics-program/>.

³ Cal. Code. Regs Title 24, Part 2, Chapter 7A

- Defensible space mandates⁴
- Cal Fire’s Fire Safe Development Standards⁵

We selected January 1, 2010 as a conservative date after which these rules were being consistently implemented in new construction in the WUI in California. The results of our analysis are provided below.

II. SUMMARY OF FINDINGS

On average, for the nine worst property-loss fires dating back to 2017, only approximately 1% of the homes and apartments destroyed, damaged, or affected were new dwellings (built after 1/1/10) even though new dwellings make up roughly 7% of the state’s total housing stock.

Between 1/1/10-1/1/2020, roughly 1 million homes and apartments were built out of a total housing stock of 14 million, based on building permit data tracked by the Construction Industry Research Board (CIRB). For all these fires, evidence indicates that substantial, initial residential development took place in the period of 1945-1980, decades before these critical rules were put in place.⁶

New homes fared extremely well compared with older neighborhoods during these major fires. Of the 31,000 data points retrieved from the State Fire Marshal, it was extremely rare to see more than two new homes on the same street destroyed or affected by the fires, while it was commonplace for entire neighborhoods of older dwellings to be destroyed. As opposed to custom home production where a single home is done separate of others, production-style home development is done in phases, usually 8-15 homes at a time. This typical production-style construction creates blocks or areas of fire-resistant homes, which are much more effective at withstanding wildfire intrusion and decreasing home-to-home spread. Notably, we are not aware of any master-planned community in California constructed after January 1, 2010 (i.e., a planned community with all new homes and typically including measures such as fuel breaks) suffering significant structural loss even during extreme fire events.

As illustrated below, we analyzed data from the nine worst property loss fires over the past seven years, and there was no case of more than three “new homes” in the same contiguous area being destroyed. There was only one case where three new homes next to each other were destroyed. These findings are in stark contrast to older homes, where it was commonplace for groups of homes to be destroyed at the same time, even entire neighborhoods. In this way, new

⁴ Pub. Res. Code 4291.

⁵ Cal. Code Regs. Title 14, Division 1.5, Chapter 7 Fire Protection, Subchapter 2, Articles 1-5 (SRA Fire Safe Regulations).

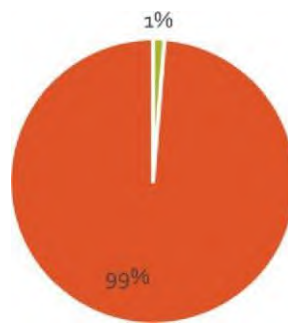
⁶ See age-of-dwelling data provided by the State Fire Marshal as described herein.

homes not only are more fire protective individually as compared to older homes, but new homes (particularly aggregations of new homes) help resist the spread of fire within residential areas by decreasing home-to-home spread and ember intrusion-based spread.

III. FIRE SPECIFIC DATA⁷

A. Camp Fire

1. Total Structures Affected or Destroyed: 10,582



- Homes Built After 2010: 136
- Homes Built Before 2010: 10,446

2. Data

Total Homes Destroyed/Major Damage/Affected: 10,582

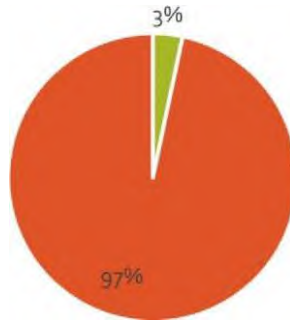
Built after 1/1/10: 112 destroyed = 0.0106 (3 homes on same street)

$$\frac{24 \text{ affected}}{136 \text{ total}} = 0.0022 = \mathbf{0.0129 \text{ or } 1.3\%}$$

B. Carr Fire

1. Total Structures Affected or Destroyed: 1,082

⁷ Information taken from State Fire Marshal data attached hereto.



- Homes Built After 2010: 36
- Homes Built Before 2010: 1,046

2. Data

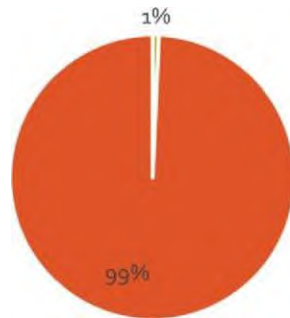
Total Homes Destroyed/Major Damage/Affected: 1,082

Built after 1/1/10: 24 destroyed = 0.0222 (9 homes on same street)

$$\frac{12 \text{ affected}}{36 \text{ total}} = 0.0111 = 0.0333 \text{ or } 3.3\%$$

C. CZU Lightening Fire

1. Total Structures Affected or Destroyed: 998



- Homes Built After 2010: 7
- Homes Built Before 2010: 992

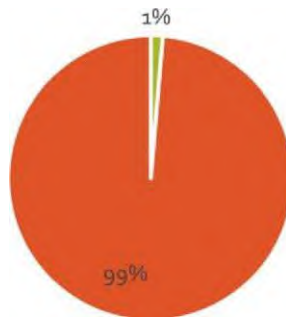
2. Data

Total Homes Destroyed/Major Damage/Affected: 998

Built after 1/1/10: 5 destroyed = **0.0050** (no homes on same street)
1 affected = 0.0010
1 inaccessible = 0.0010
7 total = 0.0070 or 0.7%

D. Glass Fire

1. Total Structures Affected or Destroyed: 737



- Homes Built After 2010: 10
- Homes Built Before 2010: 727

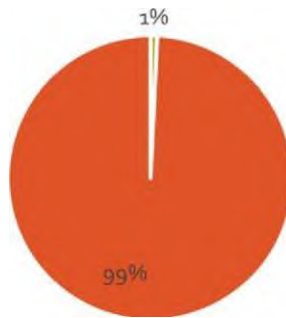
2. Data

Total Homes Destroyed/Major Damage/Affected: 737

Built after 1/1/10: 4 destroyed = 0.0054 (No homes on same street)
6 affected = 0.0081
10 Total = 0.0136 or 1.4%

E. LNU Lightening Fire

1. Total Structures Affected or Destroyed: 1,559



- Homes Built After 2010: 12
- Homes Built Before 2010: 1,547

2. Data

Total Homes Destroyed/Major Damage/Affected: 1,559

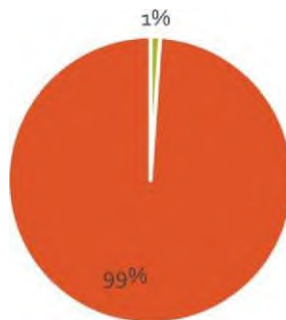
Built after 1/1/10: 5 destroyed = 0.0032 (2 homes on same street)

 7 affected = 0.0045

12 Total = 0.0077 or 0.8%

F. North Complex Fire

1. Total Structures Affected or Destroyed: 732



- Homes Built After 2010: 8
- Homes Built Before 2010: 724

2. Data

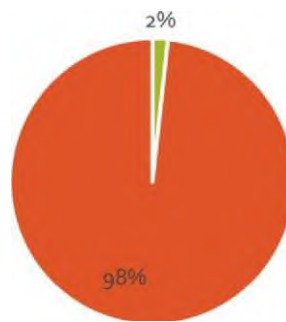
Total Homes Destroyed/Major Damage/Affected: 732

Built after 2010: 7 destroyed = 0.0096 (No homes on same street)

$$\frac{1 \text{ affected}}{8 \text{ Total}} = 0.0014$$
$$= \mathbf{0.0109 \text{ or } 1.1\%}$$

G. Nuns Fire

1. Total Structures Affected or Destroyed: 687



- Homes Built After 2010: 12
- Homes Built Before 2010: 675

2. Data

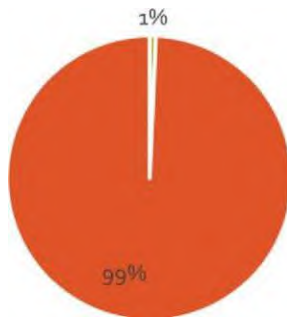
Total Homes Destroyed/Major Damage/Affected: 687

Built after 2010: 10 destroyed = 0.0146 (2 homes on same street)

$$\frac{2 \text{ affected}}{12 \text{ Total}} = 0.0029$$
$$= \mathbf{0.0175 \text{ or } 1.8\%}$$

H. Thomas Fire

1. Total Structures Affected or Destroyed: 855



- Homes Built After 2010: 6
- Homes Built Before 2010: 848

2. Data

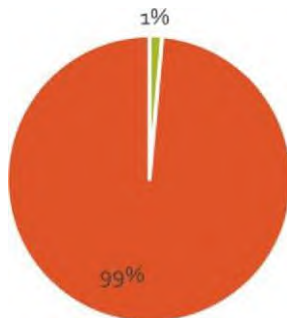
Total Homes Destroyed/Major Damage/Affected: 855

Built after 1/1/10: 5 destroyed = 0.0058 (4 homes on same street)

$$\frac{1 \text{ affected}}{6 \text{ Total}} = 0.0012 = 0.0070 \text{ or } 0.7\%$$

I. Woolsey Fire

1. Total Structures Affected or Destroyed: 1,319



- Homes Built After 2010: 19
- Homes Built Before 2010: 1,300

2. Data

Total Homes Destroyed/Major Damage/Affected: 1,319

Built after 1/1/10: 12 destroyed = 0.0091 (2 homes on same street)

7 affected = 0.0053
19 Total = **0.0144 or 1.4%**

Exhibit D – Flemming, Jack, “Could this Irvine neighborhood be the blueprint for a more fire-resistant L.A.?” Los Angeles Times, (Feb. 2025).



CALIFORNIA

Could this Irvine neighborhood be the blueprint for a more fire-resistant L.A.?



An aerial view of Orchard Hills in Irvine, where homes were planned and built to be fire-resistant. The master-planned community, which straddles the wildland-urban interface, was in the path of the 2020 Silverado fire but escaped damage.

By Jack Flemming

Staff Writer

Photography by Allen J. Schaben

Feb. 19, 2025 3 AM PT

Four years before the Palisades and Eaton [fires ravaged L.A.](#), Irvine braced for a blaze of its own.

A bone-dry summer left the landscape parched and primed to ignite as Santa Ana winds roared through the region at 80 mph. On the morning of Oct. 26, 2020, [the Silverado fire](#) erupted.

Firefighters deployed. The city initiated its emergency plan. Residents of Orchard Hills — a master-planned community straddling the wildland-urban interface and sitting in the path of the quickly growing fire — fled, not knowing whether they'd ever see their homes again.



Orange County Fire Authority firefighters work to protect homes in the Orchard Hills neighborhood of Irvine during the Silverado fire in October 2020.

All of them would. The flames licked at the neighborhood's outskirts, toasting a few leaves at the perimeter, but didn't damage a single residence in the community.

The firefight was [an unequivocal victory](#) — a product of the meticulous planning of the neighborhood, the design of its homes and the painstaking plan set in place by the city.

As L.A. looks to fortify itself against future fires, Orchard Hills could serve as the road map to get there.

Of course, the comparison isn't exact. Irvine is a newer city with modern homes built using lessons learned from dozens of deadly fires over the years. Altadena and Pacific Palisades are communities with tree canopies and century-old houses navigated by narrow, sometimes winding roads chock-full of vegetation.

But as climate change sees Southern California burn time and time again, experts say that success stories should be extracted and mined for all they're worth.

You could argue that Orchard Hills' fire resistance began a century ago, when Irvine Valencia Growers planted an avocado orchard in the hills above the community. The orchard grew into one of the nation's largest avocado producers in the decades since, with roughly [100,000 trees](#) across 800 acres.

It offers the neighborhood a lot more than guacamole.

"The orchards have a built-in irrigation system, so when a fire starts, the landscape is already watered," said Sean Doran, a fire captain with the Orange County Fire Authority.

Doran, who fought the Silverado fire, said his team had a leg up thanks to a decade-long partnership between Orchard Hills and the fire authority stretching back to

when the developer, Irvine Co., broke ground in 2014.

In Irvine, building plans must go through the fire authority as a condition of a developer's conditional use permit.

“It's inherent in the process,” Doran said. “If you're a developer, at some point you're going to be walking through our door.”

The partnership between the developer and the fire authority brings strict rules for what can and can't be built, and many homebuyers are grateful for the regulations.

Ron Nestor, an Orchard Hills resident and senior principal at [William Hezmalhalch Architects](#), noticed a small coil of smoke while walking his dog on the morning of the Silverado fire. An hour later, he evacuated his home.



Ron Nestor and his dog, Enzo, enjoy his backyard in Orchard Hills in Irvine this month.

He was gone for three days. When he returned, there was no damage whatsoever.

“It’s a testament to the way this place was planned,” he said.

When Nestor moved into Orchard Hills five months before, the neighborhood’s fire plan, which Irvine Co. [touts on its website](#), was a factor for moving in. The parameters were created by the developer, the fire authority and a third-party fire behavior analyst who examined wind patterns, topography and fire history.

Orchard Hills is designed with numerous levels of defense for an oncoming fire: in the open land surrounding the neighborhood, in the yards and in the homes themselves.

It starts with the fuel modification zone — open space around the community that can be modified to reduce fire risk by replacing combustible vegetation with fire-resistant shrubs. Orchard Hills’ zone is filled with prickly pear cacti, Japanese honeysuckle and Formosa firethorn.

[Orange County’s fire guidelines](#) call for three different tiers of fuel modification zones, with different construction requirements and shrub removal rates typically extending up to 200 feet outside the perimeter. If a developer wants to tighten that zone down to 100 feet, they have to make up for it in other ways, such as building an exterior wall around the neighborhood, or adding extra fortification on homes at the edge of the neighborhood, so they don’t ignite and bring the fire inward.



Open space around Orchard Hills is filled with prickly pear cacti, Japanese honeysuckle and Formosa firethorn.

“Not everything is concrete, so we can give some leeway in one area and tighten up another,” Doran said. “We’re here to support a fire-hardened community. Whatever makes that happen is a success for both parties.”

In the case of Orchard Hills, the fire authority worked with farmers to tweak the spacing of avocado trees to have fewer trees per acre and cleared the brush and sage in the orchards to limit flammable objects in the 170-foot fuel modification zone.

The next level of defense comes where the open space meets the outer rim of homes.

Irvine Co. erected a 6-foot wall around an enclave on the north part of the neighborhood — where a Santa Ana wind-driven fire would most likely hit first — to protect the most vulnerable properties from radiant heat and keep low-flying embers out of the development.

It beefed up the homes along that rim beyond the fire-hardening standards required in the rest of the neighborhood. These sections call for fire-rated exterior doors and stringent guidelines on outdoor features such as decks and trellises.

The last line of defense comes inside the neighborhood.

You won't find wood-shingled Craftsmans in Orchard Hills. In fact, there's not much exposed wood at all, and if there is, it's treated to be fire-retardant. Masonry walls and vinyl fences separate properties, and the few wooden gates are isolated by metal posts so they can't spread fire to the house, Nestor said.





1. A view of asphalt shingle vents that are placed on roof tiles on homes. 2. Masonry walls and vinyl fences separate properties, and the few wooden gates are isolated by metal posts so they can't spread fire to the house. 3. Ron Nestor's home, which was built to be fire-resistant.

Orchard Hills homes are constructed with two factors in mind: radiant heat and ember intrusion. Radiant heat is the heat projected by fire; if a home's exterior is made of flammable materials, the house can heat up to the point of igniting. So houses are mostly Mediterranean, wrapped with stucco or fiber cement — noncombustible materials — with a few splashes of stone and brick thrown in.

The other factor, ember intrusion, is when embers enter a home through an opening and ignite it from within. Orchard Hills homes are outfitted with tempered glass, which is [stronger than single-pane windows](#) that tend to break in fires. Roof vents have mesh filters that block embers. And roofs are laid with either concrete or clay tile. The concrete tile lies flat, stopping embers from entering. With the barrel clay tiles, the opening on the bottom of each row is plugged with a bird stop, which keeps out birds — and embers.

The HOA guidelines are rigorous and firm, dictating acceptable plant types and where trees are allowed to be planted. Nestor said he appreciates the precautionary measures.

“People are confident that their homes will survive because when the neighborhood was put to the test, it held up,” Nestor said. “Everything went exactly according to plan.”

Doran said the fuel modification zone, combined with the wall, helped stop the Silverado fire in its tracks.

“I watched the fire burn up to the edge of the wall and then die down,” he said.

Fire after fire has shown that one of the most crucial aspects of the emergency are the roads. In the Camp fire in 2018, eight of the 84 people who died were stuck in a

traffic jam when the flames roared over them.

Most of Irvine is navigated by smooth, wide roads, making it much easier for people to evacuate and firetrucks to get to the fire. In Orchard Hills, 7-foot-wide paths run behind the properties, so fire crews and vehicles can better access the back sides of homes.

Bobby Simmons, Irvine's emergency services manager, helps coordinate the city's strategy.

In 2019, in the wake of the [Camp](#) and [Woolsey](#) fires and a year before the Silverado fire, Simmons helped form a 25-person initiative to create an all-inclusive wildfire plan so if one ever broke out in Irvine, every city department would know its role exactly.



Firefighters defend homes in Orchard Hills in 2020. The Silverado fire licked at the Irvine neighborhood's outskirts but didn't damage any houses in the community.

The police department dispatches patrols to specific intersections to aid evacuations. The traffic management center remotely controls signals, avoiding traffic jams by turning all the lights green for street lanes going away from the fire. Simmons said the Office of Emergency Management mobilizes an emergency operations center and activates an emergency landing page on its website leading to a real-time evacuation map — with bandwidth for more than 3 million visitors over three days without crashing.

“We developed the plan, challenged it and tested it so much that when rubber met the road on Oct. 26, we provided a structured process for a chaotic event,” Simmons said. “All things considered, it went smoothly.”

During the Silverado fire, the city evacuated 90,000 people in four hours from northern Irvine communities such as Orchard Hills and Portola Springs.



The Silverado fire turns the sky orange as it burns close to a home in Orchard Hills in 2020.

Ultimately, the Silverado fire still took a toll. Although there was no damage in Orchard Hills, [five structures were destroyed](#) elsewhere, 11 were damaged, and [two firefighters](#) were critically injured. And although traffic quickly flowed out of the neighborhoods, cars were backed up for more than a mile because the lights getting onto the 5 Freeway were controlled by Caltrans, not Irvine, and couldn't be programmed to accept the droves of cars coming from the northeast.

There's always more to learn.

"Now, we identify the lessons we learned to get ready for the next one," Simmons said.

More to Read

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Feb. 13, 2025



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Feb. 4, 2025



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Jan. 30, 2025



Jack Flemming

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Allen J. Schaben

Los Angeles Times staff photographer Allen J. Schaben is an award-winning journalist capturing a wide range of images over the past 34 years. Before joining The Times, he honed his craft at the Detroit Free Press, Dallas Morning News, Wichita Eagle and Connecticut Post. Schaben earned his bachelor's degree in journalism at the University of Nebraska-Lincoln in 1993.