FIRE PROTECTION PLAN
for the
WEST OAKS PROJECT
CITY OF CARLSBAD, CALIFORNIA

Prepared for:

Carlsbad Fire Department
1635 Faraday Avenue
Carlsbad, California 92008

Project Applicant:

The Carlsbad West Oaks Project Owner LLC,
A Delaware Limited Liability Company
2235 Encinitas Boulevard, Suite 216
Encinitas, California 92024
Contact: Greg Waite

Prepared by:

DUDEK
605 Third Street
Encinitas, California 92024
Tel. 619.992.9161

JULY 2019

Printed on 30% post-consumer recycled material.

TABLE OF CONTENTS

Section **Page No.**

TABLE OF CONTENTS (Continued)

Section **Page No.**

APPENDICES

FIGURES

TABLES

EXECUTIVE SUMMARY

The West Oaks Project is a proposed private residential development on a 12.53-acre site within City of Carlsbad (City), California. The project proposes a Vesting Tentative Map and Major Use Permit with the development of approximately 192 dwelling units. The project is further divided into private drive lots, HOA lots, lettered open space lots, and San Diego Gas & Electric (SDG&E) easement lot. The project is located on West Oaks Way in Carlsbad. The Project will be accessed by Palomar Oaks Way off Palomar Airport Road, approximately two miles east of Interstate 5. The proposed development will include:

- Approximately 192-unit multi-family apartments
- Residential streets, driveways, fire hydrants, and associated infrastructure
- Biological open space lot including Carlsbad HMP and riparian habitat and buffers
- Primary ingress/egress off of Palomar Oaks Way with emergency vehicle access in the western portion of development directly onto Palomar Airport Road

The West Oaks Project lies within an area that can be considered a wildland urban interface, but is not statutorily designated a Local or State Responsibility Area (SRA) "Very High Fire Hazard Severity Zone". Fire hazard designations are based on topography, vegetation, and weather, amongst other factors with more hazardous sites including steep terrain, unmaintained fuels/vegetation, and wildland urban interface (WUI) locations. The nearest open space areas that include very high fire hazard severity designation occur south and west of the site and a riparian area to the north of the site.

The site is located at the base of a vegetated slope, which rises up and away from the site's southern boundary. The Encinas Creek runs through the site, occurring on the northerly project boundary. Based upon field investigations, the project site contains Diegan coastal sage scrub, Southern Willow Scrub, Southern Mixed Chaparral, open water, and disturbed habitats. The site is currently disturbed including tilled areas and West Oaks Way paved roadway. Urban development including Palomar Airport, The Crossings Golf Course, commercial, industrial, and residential development occur in all directions from the Project site. The terrain on, and within the vicinity of the project, is characterized by gentle slopes on site and steeper terrain to the south associated with a hillside that slopes up and away from the West Oaks Project. The area, like all of San Diego County, is subject to seasonal weather conditions that can heighten the likelihood of fire ignition and spread, however, considering the site's terrain and vegetation, would be expected to result in primarily a low- to moderate-intensity wildfire.

The project site is within the jurisdiction of the Carlsbad Fire Department (CFD) and the closest fire station is in the City of Carlsbad (City) Station #5, located approximately 2.4 miles from the Project with a less than five minutes travel time to all Project structures. The CFD operates at least two other fire stations that could respond to an incident on the site under seven minutes travel time in compliance with the City's Service Delivery Benchmarks (City 2015). In addition, automatic/mutual aid agreements are in place with neighboring fire agencies to augment response, especially at the fringe area of CFD's jurisdiction.

The project will be constructed to the ignition resistant code requirements of the 2016 California Fire and Building Codes (Chapter 7A) as amended by the City (Title 17.04.014). Construction shall include enhanced ignition resistant features, automatic interior sprinklers, appropriate fire flow and water capacity, roads, and supporting infrastructure, and fuel modification areas, as well as measures above and beyond the requirements where they are expected to compensate for modified fuel management areas. The identified non-conformities related to fuel modification are provided alternative materials and/or methods for consistency with the currently adopted codes/requirements.

1 INTRODUCTION

This Fire Protection Plan (FPP) has been prepared for the proposed West Oaks Project (project) within Carlsbad, San Diego County, California (Figure 1, Vicinity Map). The purpose of the FPP is to assess the potential impacts resulting from wildland fire hazards and identify the measures necessary to adequately mitigate those impacts. As part of the assessment, this plan has considered the fire risk presented by the site including: property location and topography, terrain (slope, elevation, and aspect), combustible vegetation (fuel types), climatic conditions, fire history and the proposed land use and configuration. This FPP addresses water supply, access (including secondary access), structural ignitability and ignition resistive building features, fire protection systems and equipment, impacts to existing emergency services, defensible space, and vegetation management. The plan identifies fuel modification/ management zones and recommends the types and methods of treatment that will protect this project and its essential infrastructure. The FPP recommends measures that property owners will take to reduce the probability of structural ignition throughout the project.

The FPP is consistent with the Carlsbad Fire Department (CFD) Fire Code Ordinance (Title 17 of Municipal Code) and California Code of Regulations Titles 14 and 24 and State Fire and Building Codes (2016). The purpose of this plan is to generate and memorialize the fire safety requirements of the Fire Authority Having Jurisdiction (FAHJ), namely the CFD. Requirements are based on site-specific characteristics and incorporate input from the project landowner, project planners, engineers, and architects.

1.1 Project Summary

1.1.1 Location

The approximately 12.53-acre site (including West Oaks Way) is located within the City of Carlsbad, California, San Diego County, California. The site is located roughly 2.1 miles east of the Pacific Ocean and is within the Coastal Zone Boundary. Specifically, the site is located approximately 0.5-mile east of Aviara Parkway, directly west of Palomar Oaks Way, and immediately south of Palomar Airport Road. The approximate centroid of the project site is at longitude 117.2925° West and latitude 33.1210° North within Section 22, Township 12 South, Range 4 West on the U.S. Geological Survey 7.5-minute Encinitas Quadrangle map (Figure 1, Vicinity Map).

According to the San Diego Basin Plan, the site is located within the Carlsbad Watershed Encinas Hydrologic Area within the Canyon del las Encinas Basin. The project is located on Assessor's Parcel Numbers: 212-110-01 through 212-110-07 and 212-040-26. The property lies within an area that can be considered wildland urban interface, but is not a State or Local Responsibility Area (SRA) Very High Fire Hazard Severity Zone (VHFHSZ).

The project site is within an area of the City that includes industrial, commercial, and residential development. Palomar Airport Road is immediately north of the site, a commercial complex is located approximately 350 feet to the west, a residential housing tract is located approximately 425 feet to the south, and another commercial complex is located approximately 300 feet to the east.

1.1.2 Project Description

The proposed project would develop, approximately, 192-unit multi-family apartments in a 3-story walk-up Type VB construction (Figure 2). The residences will consist of 42 affordable units (built on-site) and 150 market-rate units. The project proposes a roundabout at the main entrance to the development where Palomar Oaks Way intersects with West Oaks Way. The proposed project also considers making West Oaks Way a private driveway, which includes an emergency vehicle, pedestrian and bicycle access bridge at the western end of the project in addition to adding a new internal loop road that provides access back onto Palomar Oaks Way. Additionally, the project is proposing to provide 362 open parking spaces, 192 of which will be covered parking spaces per City requirement. These carports will built of non-combustible materials. Some of the carports may include solar panels, if the proposed buildings don't have enough space on the roofs.

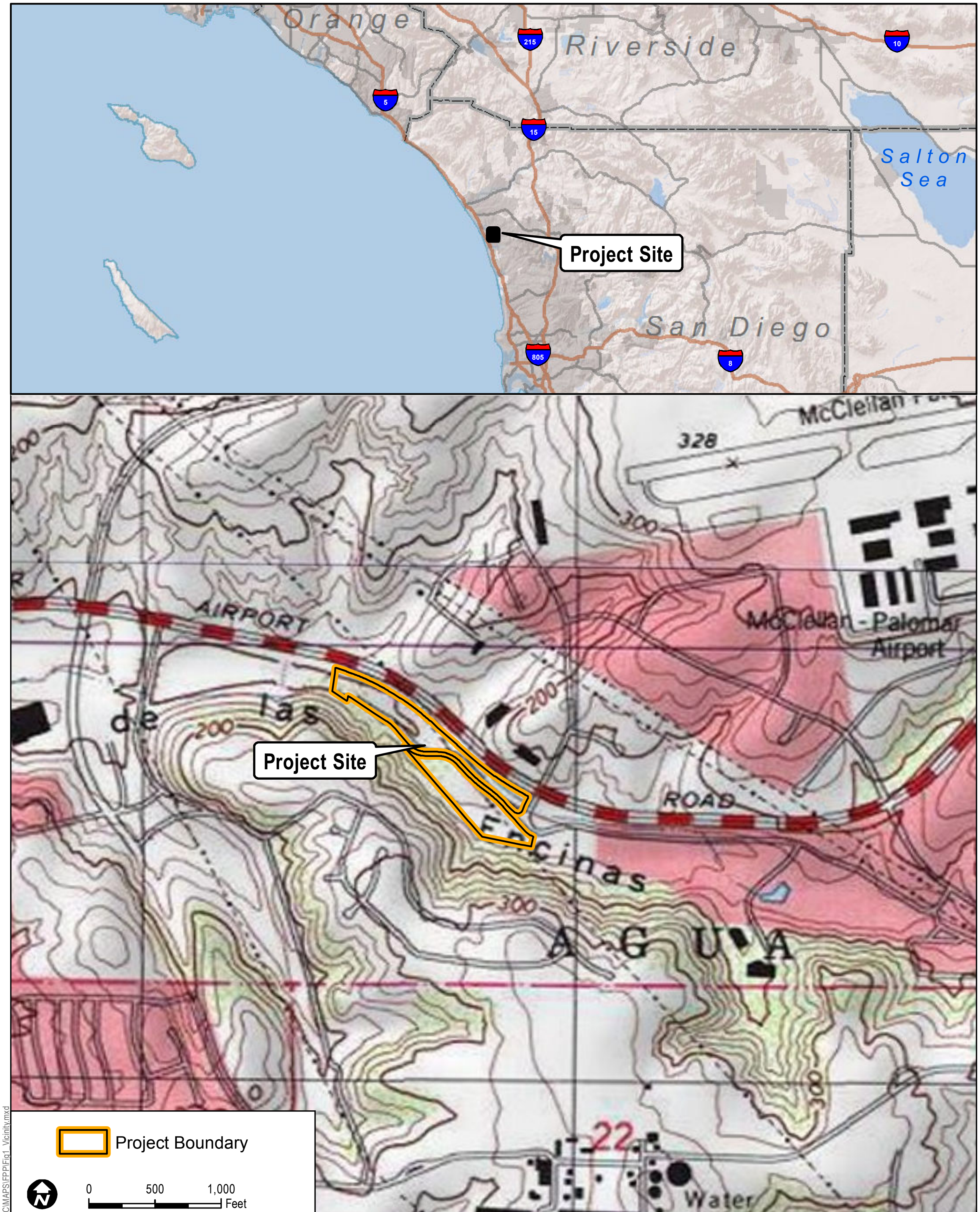
In addition, the development includes bypassing and abandoning the existing gravity fed sewer line in favor of a new gravity sewer line through the property to improve accessibility for maintenance. An existing forced main sewer line is also planned to be relocated with the gravity line. The project will include stormwater facilities on site.

1.1.3 Environmental Setting

Dudek evaluated the site via several approaches (Table 1), including site evaluations on August 26 and September 7, 2016. The site inspection included documentation of the site's topography, on- and off-site vegetation/fuels assessment, existing infrastructure evaluations, documentation of existing conditions, surrounding land use confirmations, and necessary fire behavior modeling data collection.

Table 1
Site Evaluation Dates

Date	Evaluation	Personnel
8/16/16	Aerial Image Evaluation of Project site and Surrounding Area	Michael Huff Mike Scott
8/27/16	Site Reconnaissance Survey	Michael Huff Mike Scott
9/7/2016	On-site fuels, access, topography, fire environment evaluation	Michael Huff
9/8 – 9/15	Aerial image review, site plan analysis, plan check	Mike Scott Michael Huff



DUDEK

9897

SOURCE: USGS 7.5 Minute Series Topographic Maps

FIGURE 1
Vicinity Map

WEST OAKS FIRE PROTECTION PLAN

Path: Z:\Projects\j989701\MAPDOC\MAPS\FPP\Fig1_Vicinity.mxd

INTENTIONALLY LEFT BLANK

DUDEK

9897

SOURCE: AERIAL-SANGIS IMAGERY 2017; DESIGN-FUSCOE ENGINEERING 2019

FIGURE 2
Site Plan

WEST OAKS FIRE PROTECTION PLAN

INTENTIONALLY LEFT BLANK

1.1.3.1 Topography

Encinas Creek runs throughout the project site and is present along the north boundary of the site. Natural rolling hillsides are present immediately south of the site that abut existing residential housing tract properties. The site consists of relatively flat areas (less than 20% slopes) as a result of the grading from a previously approved project on the site that gently slope to the west, with on-site elevations ranging from approximately 114 to 150 feet above mean sea level (AMSL).

1.1.3.2 Vegetation and Land Cover

Based on the project's Biological Technical Report (Dudek 2018a), there are eight vegetation communities/land cover types in the project site boundaries. They include southern willow scrub, open water, Open water within a concrete channel, coastal sage scrub, southern mixed chaparral, disturbed land, developed land, and developed within a concrete channel. The acreage of each of these vegetation communities or land cover types are provided in Table 2 and illustrated in Figure 3.

Table 2
Existing Plant Communities/Land Covers on the West Oaks Project Site

Plant Community/Land Cover	Acreage
Group A	
Southern willow scrub	1.35
Open water	0.16
Open water/concrete-channel	0.03
Group C	
Coastal sage scrub	1.38
Group D	
Southern mixed chaparral	0.08
Group F	
Disturbed land	8.06
Other Lands	
Developed	0.15
Developed/concrete-channel	0.08
Total*	**11.29**

Vegetation communities of concern are those that are more likely to facilitate fire spread into the proposed development. One vegetation community (photographs are in Appendix A) and two off-site communities not listed in the Dudek's Biological Resources Technical Report (2018a) were identified as potentially facilitating fire spread toward the project. They are as follows:

Southern Mixed Chaparral (Off-site)

Southern mixed chaparral is composed of broad-leaved sclerophyllous shrubs that can reach heights of 10 feet. The shrubs are generally deep rooted, with well-developed soil litter layer, and high canopy coverage. Dominant plant species in this vegetation community off- site include chamise (*Adenostoma fasciculatum*), lemonade berry (*Rhus integrifolia*), California sagebrush (*Artemisia californica*), mission manzanita (*Xylococcus bicolor*), and bushrue (*Cneoridium dumosum*). This habitat also occurs off site, south of the project site.

Coastal Sage Scrub

Coastal sage scrub is a native plant community composed of a variety of soft, low, aromatic shrubs, characteristically dominated by drought-deciduous species such as coastal sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), and sages (*Salvia* spp.), with scattered evergreen shrubs, including lemonade berry (*Rhus integrifolia*), laurel sumac (*Malosma laurina*), and toyon (*Heteromeles arbutifolia*). It typically develops on south-facing slopes and other xeric situations.

Coastal sage scrub occurs mainly along the north and east slopes of the site and consists of a mix of typical species including coastal sagebrush, lemonade berry, California buckwheat, and toyon. Coastal sage scrub is recognized as a special-status vegetation community by local, state, and federal resource agencies. It supports a rich diversity of special-status plants and animals and is the focus of the current State of California Natural Community Conservation Program, of which the Multiple Habitat Conservation Program (MHCP) and City of Carlsbad HMP are a part.

Southern Willow Scrub

Southern willow scrub is a dense, broad-leaved, winter-deciduous riparian thicket dominated by several species of willow (*Salix* spp.) that occurs on loose, large-grained alluvium along stream channels. The closed canopy inhibits the development of a diverse understory. It may contain scattered Fremont's cottonwood (*Populus fremontii*) and western sycamore (*Platanus racemosa*) trees emerging above the willow canopy and requires repeated flooding to avoid succession to a community dominated by these trees (Holland 1986).

On site, southern willow scrub occurs in patches dominated by arroyo willow (*Salix lasiolepis*) and red willow (*Salix laevigata*), with an understory of mulefat (*Baccharis salicifolia*).

DUDEK

SOURCE: Fuscoe 2016; SANDAG Imagery 2014

FIGURE 3

Vegetation Map

WEST OAKS FIRE PROTECTION PLAN

INTENTIONALLY LEFT BLANK

1.1.3.3 Fuel Loads

The vegetation described above translates to fuel models used for fire behavior modeling, discussed in Chapter 3 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 (leaf size, branching patterns), and overall fuel loading. Vegetative fuels within the proposed development and within the project grading limits will be converted to roads, ignition-resistant homes, and fire smart landscaping following project completion.

Off-site fuels include native chaparral and coastal sage scrub to the south, southern willow scrub to the north and west and developed landscapes to the east. From a regional landscape perspective, the unmaintained fuel areas/open space are relatively small in size, non-continuous, and are islands of fuel within a larger, developed landscape. Directly beyond these areas, irrigated ornamental vegetation on residential, commercial and industrial properties are prominent features.

Chaparral on the slopes to the south exhibit semi-continuous fuel beds comprised of live and dead woody material. Fuel bed heights for adjacent chaparral are 6 to 12 feet, with a moderate amount of dead branches and foliage. Wildland fire behavior and intensity in this vegetative fuel type will be moderate to high depending on live and dead fuel moisture content and weather conditions. In the northern portion of the project site, Encinas Creek runs east–west and is vegetated with southern willow scrub and includes occasional non-native trees. Understory fuels are present and comprise an estimated 2–3 tons per acre with respect to fuel loading. Fires could spread along the creek bed drainage, like the "wick" on a candle, to homes that abut these vegetative fuel types. Typical fire behavior in riparian fuel types are slow burning, low intensity fires burning in the duff layer or low herbaceous, surface fuels. However, a crown fire can occur as the fuel loading buildups from dead and down trees or dead branches and low hanging foliage left on the standing trees. The riparian vegetation is surrounded by roads on both sides and would be easily accessed during a fire.

Additionally, the majority of the fuel types (both on and off the project site) have not burned in over 100 years, according to the area's available fire history data.

1.1.3.4 Fire History

Fire history is an important component of a Project FPP. Fire history information can provide an understanding of fire frequency, fire type, most vulnerable project areas, and significant ignition sources, amongst others. Fire frequency, behavior, and ignition sources are important for fire response and planning purposes. One important use for this information is as a tool for preplanning. 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. According to available data from CAL FIRE's Fire and Resource Assessment Program (CAL FIRE 2015), seven fires have burned in the vicinity of the project site since the beginning of the historical fire data record (Appendix B, Fire History Map). These fires, occurring in 1935, 1970, 1979, 1982, 1987, 1996, and 2014 burned within 3 miles of the project site. No fires in the recorded history have burned across the project site. The 2014 Poinsettia Fire with a total burned area of over 600 acres was the most recent and largest wildfire near the project site.

Based on an analysis of this fire history data set, specifically the years in which the fires burned, the average interval between wildfires burning within a 3-mile radius of the project site was calculated to be 13 years with intervals ranging between 3 and 35 years. Based on this analysis, the area is expected to be subject to regular, widespread wildfire, but may include smaller fires during typical weather conditions and has the potential for larger wildfires during extreme weather conditions. 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 east, although a fire approaching from the west during more typical on-shore weather patterns is possible.

1.1.3.5 Climate

North San Diego County and the project area are influenced by the Pacific Ocean and are frequently under the influence of 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. The average high temperature for the project area is approximately 75°F, with daily highs in the summer and early fall months (July–October) exceeding 93°F. Precipitation typically occurs between December and April1.

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 west–southwest (sea) and at night, winds are from the northeast (land), averaging two miles per hour (mph). During the summer season, the diurnal winds may average slightly higher (approximately 19 mph) than the winds during the winter season due to greater pressure gradient forces. Surface winds can also be influenced locally by topography and slope variations. The highest wind velocities are associated with downslope, canyon, and Santa Ana winds.

Typically, the highest fire danger is produced by the high-pressure systems that occur in the Great Basin, which result in the Santa Ana winds of Southern California. Sustained wind

[1] http://www.usclimatedata.com/climate/carlsbad/california.

speeds recorded during recent major fires in San Diego County exceeded 30 mph and may exceed 50 mph during extreme conditions. The Santa Ana wind conditions are a reversal of the prevailing southwesterly winds that usually occur on a region-wide basis during late summer and early fall. Santa Ana winds are warm winds that flow from the higher desert elevations in the north through the mountain passes and canyons. As they converge through the canyons, their velocities increase. Consequently, peak velocities are highest at the mouths of canyons and dissipate as they spread across valley floors. Santa Ana winds generally coincide with the regional drought period and the period of highest fire danger. The project site is affected by strong winds, such as Santa Anas.

1.1.3.6 Current Land Use

The project parcels are approximately 12.5 acres and the entire area is fenced. Much of the site is disturbed through regular mowing/disking or previous grading, and much of the vegetation is non-native. Encinas Creek flows through the project site along the northern edge, adjacent to Palomar Airport Road. The perennial creek consists of an unvegetated channel that is surrounded by southern willow scrub, non-native species along its banks.

1.1.3.7 Proposed Land Use

The project, as proposed, will include:

- Approximately 192 residential units;
- Extended defensible space throughout most of the perimeter through incorporation of paved roads and parking lots
- Reduced fuel modification zones (with provided alternative materials and methods) primarily for structures in the west half of the proposed development;
- Streets, fire hydrants, and associated infrastructure;
- Secondary emergency ingress/egress route at the west end of the development which connects to Palomar Airport Road;
- Primary access road onto the property from Palomar Airport Road via Palomar Oaks Way.

The proposed land use improvements described above would be completed according to the City's Fire and Building Codes in effect at the time of building plan submittal and would include ignition-resistive construction, interior sprinklers, required fire flow, and a designated fuel modification area, among other requirements as described further in this FPP.

INTENTIONALLY LEFT BLANK

2 DETERMINATION OF PROJECT EFFECTS

FPPs provide an evaluation of the adverse environmental effects a proposed project may have from wildland fire. The FPP must provide mitigation for identified impacts to ensure that development projects do not unnecessarily expose people or structures to a significant loss, injury or death involving wildland fires. Significance is determined by answering the following questions:

Would the project expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?

The wildland fire risk in the vicinity of the project site has been analyzed and it has been determined that wildfires may occur in wildland areas to the south, west, and north of the project site, but would not be significantly increased in frequency, duration, or size with the construction of the project. The project would include conversion of existing vegetation to maintained urban development with designated landscaping and fuel modification areas.

The types of potential ignition sources that currently exist in the area include vehicle and roadway, electrical transmission line, and machinery associated with various land uses in the vicinity, as well as from off-site residential neighborhoods. The project would introduce potential ignition sources, but would also include conversion of fuels to lower flammability landscape and include better access throughout the site, managed and maintained landscapes, higher site awareness/monitoring, and generally a reduction in the receptiveness of the areas landscape to ignition. Fires from off-site would not have continuous fuels across this site and would therefore be expected to burn around and/or over the site via spotting. Burning vegetation embers may land on project structures, but are not likely to result in ignition based on ember decay rates and the types of non-combustible and ignition resistant materials that will be used on site.

The project would comply with ignition resistant fire and building codes and would include a layered fire protection system designed to current codes and inclusive of site-specific measures that will result in a project that is less susceptible to wildfire than surrounding landscapes and that would facilitate fire fighter and medical aid response.

Would the project result in inadequate emergency access?

Fire apparatus access throughout the development will include roads that meet the fire code requirements for width, grade, clearance, dead-end length and turnarounds. Therefore, the Project's access is considered consistent with City code requirements.

Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance service ratios, response times or other performance objectives for fire protection?

The Project is projected to add an estimated fewer than 40 calls per year to the CFD's existing call load. This estimate is a conservative estimate in that it uses CFD-wide data, which incorporates call volumes from typically higher volume areas than would be expected from this site. The primary response (first-in) would be provided by Station # 4 or #5, both of which can respond to all structures in the Project within five minutes travel. The addition of 40 calls per year (approximately one call per week) to CFD's call volume is considered insignificant and will not require the construction of additional Fire Station facilities based on that increase alone. A portion of the project's parcel tax revenue will be allocated to fire protection, which can be used to maintain current levels of protection without affecting existing citizens.

Would the project have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?

The project will be served by Carlsbad Municipal Water District and sufficient water supplies will be available to serve the project from existing entitlements and resources. The CFD requires new development to meet a 2,500-gpm fire flow for sprinklered residential structures. The pressures in the development will remain above 20 psi when meeting the fire requirements for the CFD.

The measures described in the responses to these significance questions are provided more detail in the following sections.

3 ANTICIPATED FIRE BEHAVIOR

3.1 Fire Behavior Modeling

Following field data collection efforts and available data analysis, fire behavior modeling was conducted to document the type and intensity of fire that would be expected adjacent to the project site given characteristic site features such as topography, vegetation, and weather. The BehavePlus 5.0.5. fire behavior modeling software package, the latest version of the industry standard fire behavior prediction software, was utilized in evaluating anticipated fire behavior adjacent to proposed development and landscaping for the entire project site. Results are provided below and a more detailed presentation of the modeling inputs and results is provided in Appendix C.

3.1.1 Fuel Models

Fuel Models are simply tools to help fire experts realistically estimate fire behavior for a vegetation type. Fuel models are selected by their vegetation type; fuel stratum most likely to carry the fire; and depth and compactness of the fuels. Fire behavior modeling was conducted for vegetative types that surround the proposed development. The vegetation types are represented primarily by three fuel models as shown in Table 3. Other fuel models may exist, but not at quantities that significantly influence fire behavior in and around the proposed development. Fuel models were selected from *Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model* (Scott and Burgan 2005).

Table 3
West Oak Project Fire Behavior Model Variables

Scenario	Weather	Fuel Model(s)	Slope	Aspect
1	Summer (Onshore)	Chaparral (FM4), Grasslands (GR4), and Southern willow scrub (Sh2)	2% to 35%	Flat to North
2	Peak (Santa Ana)	Chaparral (FM4)	39%	North

3.1.2 Fuel Model Output Results

Fire Behavior results derived from the BehavePlus modeling efforts are presented in Table 4 and in Figure 4, West Oaks Project BehavePlus Analysis Map. Two focused analyses (fire scenarios) were completed, each assuming worst-case fire weather conditions for a fire approaching the project site from the west or east. The site and adjacent areas were modeled as a Fuel Model FM 4 (Chaparral fuelbed), Fuel Model Gr4 (short grass fuelbed), and Fuel Model Sh2 (southern willow scrub fuelbed). This detailed analysis compared fire behavior outside the proposed development with outputs including flame length (feet), rate of spread (mph), and fireline intensity (BTU/ft/s).

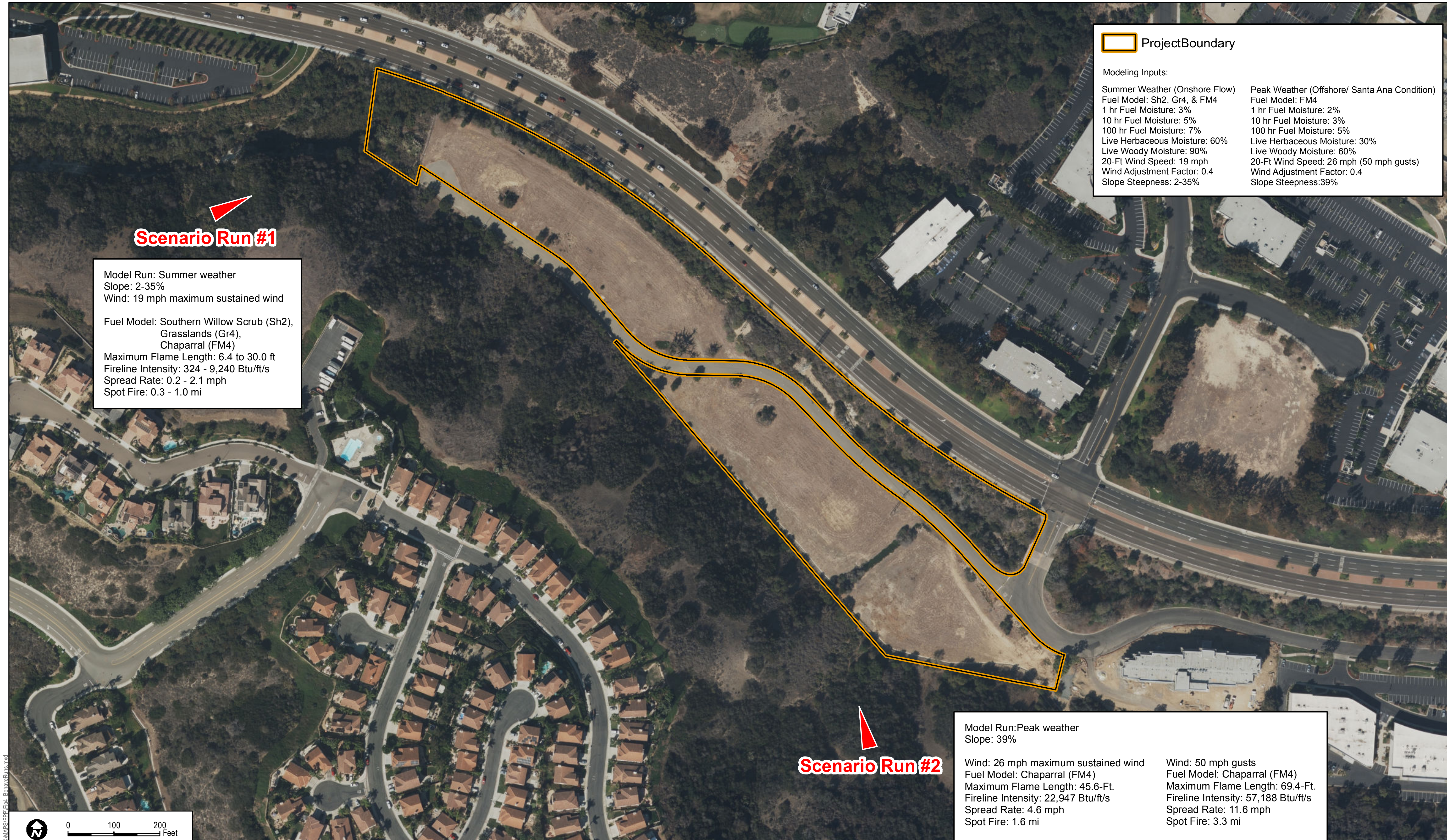
Table 4
BehavePlus Fire Behavior Model Results for the West Oak Project

Fire Scenario	Flame Length (feet)	Spread Rate (mph)	Fireline Intensity (Btu/ft/s)	Spot Fire (miles)
Scenario 1: Chaparral-Grasslands on north-facing,35% across slope; Southern Willow Scrub, 2% slope; Summer weather				
Southern Willow Scrub (Sh2)	6.4	0.2	324	0.3
Grasslands (Gr4)	13.1	1.9	1,512	0.5
Chaparral (FM4)	30.0	2.1	9,240	1.0
Scenario 2: Chaparral on north -facing, 39% across and downslope; Peak weather				
Chaparral (FM4) –sustained wind	45.6	4.6	22,947	1.6
Chaparral (FM4)- 50 mph gusts	69.4	11.6	57,188	3.3

Based on the results of BehavePlus analysis, wildfires with the most fire intensity will occur in the chaparral fuels during offshore wind patterns, especially during a Santa Ana wind event. Under such extreme weather conditions, flame lengths in the chaparral fuelbed will approach 69.4 feet with fire spread rates reaching approximately 3.3 mph due to high winds and very low fuel moistures. On the contrary, wildfires occurring during on-shore wind patterns are expected to be of low to moderate severity with flames lengths ranging from 6.4 to 30 feet and slower spread rates (less than 1.0 mph) due to higher fuel moisture content and reduced prevailing wind speeds.

The results presented in Table 4 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.

The results presented in Table 4 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.



DUDEK

9064

AERIAL SOURCE: SANGIS IMAGERY 2914

FIGURE 4

Fire Behave Analysis Map

WEST OAKS FIRE PROTECTION PLAN

INTENTIONALLY LEFT BLANK

3.2 On-Site Risk Assessment

Given the history of wildfire in the vicinity of the site, including the 2014 Poinsettia Fire that burned within 0.2 mile to the east of the Proposed Project site, combined with topography, vegetation, climate, nearby ignition sources, and anticipated fire behavior, the West Oaks site, in its current condition, is considered to be vulnerable to wildfire ignition and spread during extreme fire weather. Wildfires may 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 westerly, wind-driven fire front with embers landing in receptive fuels on the shrub-covered slopes behind the proposed project site that will remain in place post-development.

INTENTIONALLY LEFT BLANK

4 ANALYSIS OF PROJECT EFFECTS

4.1 Adequate Emergency Services

4.1.1 Emergency Response

The project is located within the jurisdiction of the CFD, which provides initial response to all structural fire, medical and associated emergencies within the 38 square miles of the City's boundaries. CFD has six fire stations, fully equipped with the latest firefighting apparatus and highly trained personnel, to cover the emergency calls generated by the city's population of approximately 115,000 persons. The CFD operates three Fire Stations that would likely be dispatched to an incident at the project site (Stations 4, 5, and 2) although primary response is expected to be from Station 4, with Stations 5 and 2 responding as necessary to round out the effective firefighting force. Table 5 presents a summary of the location, equipment, staffing levels, maximum travel distance, and travel time for the CFD stations most likely responding to the project site. Travel distances are derived from SANGIS Geographic Information System road data while travel times are calculated using the Insurance Services Office (ISO) formula that represents an average 35 mph response speed and considers average terrain, average traffic, weather, and slowing down for intersections. Response times do not include time for donning firefighter turnout gear.

Table 5
Carlsbad Fire Department Responding Stations Summary

Station	Location	Equipment	Staffing	Mid-point in development	Expected Travel Time (Mid-point)	Maximum Travel Distance[1]	Expected Travel Time (Maximum Distance)[2]
Station 2[3]	1906 Arenal Rd.	Type I engine Paramedic ambulance	On-duty: 5	3.5 mi	6.6 min. (6:36)	3.7 mi.	6.9 min. (6:56)
Station 4[4]	6885 Batiquitos Drive	Type I engine Heavy rescue	On-duty: 3	2.37	4.7 (4:42)	2.55 mi.	5.0 min.
Station 5 (Faraday)[3]	2540 Orion Way	Ladder truck Paramedic ambulance BC command	On-duty: 6	2.76 mi	5.34 min (5:20)	2.93 mi	5.63 min. (5:38)
Station 5 (Orion Way)[3]				2.36 mi	4.66 min (4:40)	2.53 mi	5.0 min

Notes:
1. Distance measured to the furthest point in development from the primary access via Palomar Oaks Way.
2. Assumes travel to the furthest point in the project and utilizes the ISO formula (T=0.65+1.7d) that represents an average 35mph response speed and considers average terrain, average traffic, weather, and slowing down for intersections (https://firechief.iso.com/FCWWeb/mitigation/ppc/3000/ppc3015.jsp).

3. Entrance into development from the east on Palomar Oaks Way.
4. Entrance into development from westerly gates. Two emergency access road gates to comply with Section 4.2.1.8 of this FPP.

Based on the project site location in relation to existing CFD stations, travel time to the site for the first responding engine from Station 4 is 5.0 minutes to the furthest portion of the project site, accessing the site via the secondary access road and reaching the furthest easterly structure. Secondary response is expected to arrive roughly the same timing, assuming response from Station 5 along the Orion Way path. If the response follows Faraday Road to take advantage of signaled intersections, the response travel time is calculated to be 5’38”. Based on these calculations, emergencies within the project can be responded to by primary and secondary response according to CFD’s established emergency response benchmarks for first unit on-scene of six minutes or less and second unit on scene within nine minutes[2].

In addition, the City has a signed automatic aid agreement on first alarm or greater with all surrounding communities. The boundary drop agreement utilizes automatic vehicle locators so that the fire dispatch center can determine the closest unit. The closest unit, regardless of agency, is dispatched as first in. The City is also part of both the San Diego County and State of California Master Mutual Aid Agreements.

4.1.1.1 Emergency Service Level

CFD’s annual call volume over the last three years has averaged about 10,000 total calls, most of which are emergency medical services responses (9,830 calls in FY 2013-14[2]). This equates to 27 calls per day, which would be distributed among the CFD’s six fire stations (calculated from annual call volume provided by –City’s 2015 Annual Report[2]). Individual fire station call volumes were not available at the time of this FPP’s preparation. Determination of individual fire station call volumes would enable a more accurate estimate of the project’s call load impact, but based on the Department wide numbers, the impact is considered small.

Using national statistics that correlates strongly with San Diego County fire agencies’ estimated per capita call volumes (82 annual calls per 1,000 population), the project’s estimated 491 residents (192 residences x 2.56 per household (U.S. Census Bureau 2015)) may generate up to 40 calls per year (approximately 3.4 calls per month or one call per week), most of which are expected to be medical-related calls.

Service level requirements for CFD are not expected to be significantly impacted with the increase of 40 calls per year, even if all of the calls are from the closest station. The department currently responds on the average to just over 27 calls per day in its entire service area or roughly 5 calls per

2 City of Carlsbad 2015 State of Effectiveness Report for Fire Protection and Emergency Services

day per fire station. For reference, a station that responds to 5 calls per day is considered average and 10 calls per day is considered busy. Therefore, the project is not expected to cause a decline in the CFD response times. The requirements described in this FPP are intended to aid firefighting personnel and minimize the demand placed on the existing emergency service system.

4.2 Buildings, Infrastructure and Defensible Space

The CFD adopted Fire and Building Codes govern the building, infrastructure, and defensible space requirements detailed in this FPP. The project will meet or exceed applicable codes or will provide alternative materials and/or methods. 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.

4.2.1 Roads

4.2.1.1 Access

Site ingress/egress will comply with the requirements of CFD (Chapter 17.04 Fire Prevention Code). The primary access to the project site will be via an existing private street (West Oaks Way) originating at the existing Palomar Oaks Way, approximately 200 feet south of its intersection with Palomar Airport Road (see Figure 2). Palomar Oaks Way is a 52 feet wide (curb-to-curb) roadway with two lanes demarcated on the northbound side and one southbound lane. Proposed private street, West Oaks Way, would be 32 feet in width without parking and unobstructed 24 feet roadway with parking for fire apparatus access. A roundabout is proposed at the intersection of Palomar Oaks Way and West Oaks Way. Private street "A" in the southeastern portion of the project would be a minimum of 24 feet wide with no parking along the 130 feet south of its intersection with West Oaks Way, and perpendicular and parallel parking on both sides beyond that point. The western end of West Oaks Way is the next project ingress/egress for emergency access occurring along Palomar Airport Road where a median cutout will be provided to allow travel in both directions along Palomar Airport Road. This emergency access road would have two gates that would be installed per Section 4.2.1.8 of this FPP (See Figure 2). These two ingress/egress points occur along Palomar Airport Road with the eastern ingress/egress point at Palomar Oaks Way being separated from the western ingress/egress point by approximately 0.32 miles (1,700 feet). No traffic calming measures (speed bumps, speed humps, and speed control dips), which may interfere with emergency apparatus, will be installed.

Private roadways within the proposed development will comply with applicable City of Carlsbad (i.e., Fire Department) roadway standards. To ensure that the roadways continue to meet requirements, road maintenance within the private portions of the development will be provided by a Homeowners Association (HOA) or similar funded entity. The entity will assess maintenance dues monthly, provide reserve funding, and maintain the site's roads.

4.2.1.2 Interior Circulation Roads

The on-site roadway (West Oaks Way) would include a looped turn through a parking lot along the south side of the easterly portion of the development that meets City requirements. The looped road through parking lot is approximately 1,350 feet in total length from West Oaks Way where egress in two separate directions on Palomar Oaks Way is possible.

A response map update, including roads and fire hydrant locations, in a format compatible with current City mapping shall be provided to CFD.

4.2.1.3 Width and Turning Radius

All proposed private streets will have a minimum paved width of 24 feet, with West Oaks Way at 32 feet. There are no private residential driveways. The horizontal inside radius of streets will be designed to a minimum of 28 feet, as measured from the inside edge of the improvement width. Turning radii for provided roadways will comply with the City's minimum 28-foot inside turning radius standard for residential areas.

4.2.1.4 Grade

Road and driveway grades comply with the City's maximum grade of 15% for sprinklered structures. Any grade sections exceeding 10% will be constructed with Portland cement concrete surface with a heavy broom finish perpendicular to the slope. The angle of departure or approach for all roads and driveways will be under 12%.

4.2.1.5 Surface

The primary fire access roadways will be of asphalt or concrete and designed and maintained to support the imposed loads of fire apparatus (not less than 75,000 pounds) that may respond, including engines, trucks, and potentially dozer transports. All fire access roadways will be maintained unobstructed and drivable by emergency vehicles throughout the construction process. A paved all-weather driving service, capable of supporting fire apparatus, will be installed before combustible construction materials are brought on the site. The Project proposes that the existing paved West Oaks Way meets this requirement without the loop road being paved. The first lift of asphalt paving will be installed at a minimum. The final lift of paving can be postponed until just before building final for roadway cosmetic purposes. Access roads shall be completed and paved prior to building final inspection.

4.2.1.6 Vertical Clearance

Minimum vertical clearance of 13 feet 6 inches will be maintained for the entire required width of fire access roads, including driveways that will require fire apparatus to travel to a residence.

4.2.1.7 Premises Identification

Identification of streets and structures will comply with CFD standards as follows:

- All structures shall be identified by a street address, which is visible from the street fronting the property from either direction of approach. Street numbers shall be 4 inches in height, .5-inch stroke, and contrast with their background for visibility.
- Street name signs will comply with the Carlsbad private road signage standards at all intersections. Street signs shall be displayed for both street names at the intersection.
- Illuminated directory maps will be installed at driveway entrances to all multi-family residential developments. Final location of directory maps and content shall be approved by CFD.

4.2.1.8 Gates

Two emergency access road gates are proposed at the west end of West Oaks Way (Refer to Figure 2 for location of gates). These emergency access road gates would comply with Appendix D, Section D103.5 of the California Fire Code. All fire apparatus access road gates shall be equipped with a Knox, emergency key-operated switch overriding all command functions and opening the gate(s). Additionally, an automatic gate accessing through on-site access roadways shall be equipped with approved emergency traffic control-activating strobe light sensor(s) or "Click to enter" which will activate the gate from both directions of travel on the approach of emergency apparatus. Any automatic gate will have a battery backup or manual mechanical disconnect in case of a power failure. Gates will have a magnetic loop system on the interior to allow for exiting without a key.

Pole gates, if any, or other structures or devices, which could obstruct fire access roadways or otherwise hinder emergency operations shall be equipped with an approved Knox padlock.

4.3 Water

Water service for the project will be provided by Carlsbad Municipal Water District and will be consistent with CFD requirements. CFD requires new development to meet a 2,500-gpm fire flow. The pressures on the project site will remain above 20 psi when meeting the fire requirements for the water district.

4.3.1 Hydrants

Hydrants shall be located along fire access roadways as determined by the CFD to meet operational needs, at intersections, at the beginning radius of cul-de-sacs, and at a minimum every 500 feet (on-center) of fire access roadways, pursuant to the CFD Fire Code. Hydrants will be consistent with CFD Design Standards.

A three-foot clear space (free of ornamental landscaping and retaining walls) shall be maintained around the circumference of all fire hydrants. Hydrants will be in place and serviceable prior to delivery of combustible materials to the site.

4.4 Ignition-Resistant Construction and Fire Protection Systems

The project will meet applicable building and fire codes for a residential community (see project description). Each of the proposed buildings will comply with the ignition-resistant construction standards of the latest Carlsbad Fire and Building Codes, Chapters 7A and 15, 2016 California Residential Code.

4.4.1 Fire Sprinklers

All shared wall residential structures and attached garages shall have automatic fire sprinkler system per CFD Fire Code. Each structure will include NFPA 13-R, Automatic Fire Sprinkler Systems. All sprinkler-building plans must be reviewed and approved by the CFD prior to building permit issuance.

4.4.2 Pre-Construction Requirements

Prior to combustible materials' presence on the site, utilities shall be in place, fire hydrants operational, an approved all-weather roadway (i.e., West Oaks Way) in place, and fuel modification zones established and approved.

4.5 Project Construction Design Features

All new structures will be constructed to CFD standards. Each of the proposed buildings will comply with the enhanced ignition-resistant construction standards of the 2016 or most current California Building Code (Chapter 7A). These requirements address roofs, eaves, exterior walls, vents, appendages, windows, and doors and result in hardened structures that have been proven to perform at high levels (resist ignition) during the typically short duration of exposure to burning vegetation from wildfires.

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 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 the West Oaks project are required by CFD, 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 2016 Building/Fire Code update), of extinguishing interior fires, should embers succeed in entering a structure (such as through a window inadvertently left open). 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 design features would be applied to this new development adjacent to WUI 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. 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
3. Ember resistant vents (recommend BrandGuard or similar vents)
4. Interior fire sprinklers to code for all occupancies
5. Modern infrastructure, access roads, and water delivery system
6. Carports will be constructed of non-combustible (e.g., metal) materials.

4.6 Defensible Space and General Fuel Modification

An important component of a fire protection system is the fuel modification area. Fuel modification zones (FMZ) are designed to gradually reduce fire intensity and flame lengths from advancing fire by placing irrigated zones and thinning zones adjacent to each other on the perimeter of all structures that are facing native vegetation. A typical landscape/fuel modification installation in Carlsbad consists of three 20-foot wide zones, totaling 60 feet. Fuel modification zones for this Project do not conform to the typical, individual zone dimensions, but they do comply with the fuel modification standards for Zones A-1, A-2, and B-3 as presented in the City's Landscape Manual (2016).

The West Oaks project is exposed to riparian forest-dominated vegetation in the northern and northwestern portion of the site and chaparral vegetation on the southern and eastern edges. Fuel modification zones for the western development area ranges from 13 to 20 feet wide along the northern edge and 60 to 81 feet wide along the southern edge (See Figure 5a). The western exposure receives the modified FMZ due to the existence of a large, paved parking lot directly west of the structure. The total defensible space width is up to 139 feet of separation from native fuels.

The eastern half of the development along the northern edge includes extended FMZ widths due to the positioning of paved parking areas and roadway between the structures and the native vegetation. Widths are a minimum of 50 feet, and up to 141 feet. Along the southern edge, FMZ ranges from 69 to 79 feet to the property boundary. This FMZ includes paved parking areas and roadways (See Figure 5b). The eastern edge includes a 166-foot wide FMZ with an access road and parking area.

The variation in defensible space widths for the entire project is based on consideration for avoidance of impacts to the riparian-upland buffer areas and available building footprints. It should be noted that the northwestern portion of the West Oaks property contains a sensitive riparian buffer area that occurs between the southern willow scrub habitat and proposed buildings, just outside of the Project's FMZs. Although not considered a FMZ, the riparian buffer area is restricted to planting oaks and low growing grasses and flowering annuals and perennials to create a upland oak habitat with an equivalency to a low fuel, low fire intensity landscape. This area will be planted and monitored in accordance with the West Oaks Conceptual Mitigation Plan (Dudek 2018b). The riparian buffer area will not be disturbed unless to remove dead trees, shrubs, and/or invasive weeds or annual grasses. As such, the riparian buffer does not conform to the standard FMZ vegetation management standards. Any vegetation management activities within the riparian buffer area will be conducted by the Preserve Manager.

DUDEK

9897

SOURCE: AERIAL - SANGIS IMAGERY 2017; SITE PLAN -FUSCOE ENGINEERING 2019

FIGURE 5A

Conceptual Fuel Modification Western Development

WEST OAKS FIRE PROTECTION PLAN

Path: Z:\Projects\j989701\MAPDOC\MAPS\FPP\Fig5a+b_FuelModZones 20190405.mxd

INTENTIONALLY LEFT BLANK

DUDEK

9897

SOURCE: AERIAL - SANGIS IMAGERY 2017; SITE PLAN -FUSCOE ENGINEERING 2019

FIGURE 5B

Conceptual Fuel Modification Eastern Development

WEST OAKS FIRE PROTECTION PLAN

INTENTIONALLY LEFT BLANK

The significance of the Project's FMZ's cannot be understated. Based on scientifically modeled fire behavior calculations customized for the site, flame lengths under the most extreme fire weather conditions within the natural open space areas could approach 69 feet in height. Under summer weather conditions, flame lengths could approach 30 feet in height along the southern and western edges of the Proposed Project site. While the north side of all structures in the western portion of the development area are unable to obtain 60 feet of fuel modification to the north, it is proposed to receive alternative materials and/or methods of fire protection, including dual-tempered pane windows on the exposed side and annual fuel modification inspection (Section 5.0). One structure in the eastern portion of the development that has less than 60 feet of defensible space will also receive upgraded windows and annual inspections as fire mitigation measures. Because this site will utilize non-combustible construction and will implement enhanced ignition resistant construction techniques, and given the predicted flame heights and intensity, the proposed fuel modification areas will provide adequate setback for the potential short duration wildfire that may be realized in adjacent open space areas to the south and north. All fuel modification will be fully contained within the project property.

4.6.1 Project Fuel Modification Zone Standards

Fuel modification zones will be implemented according to the following requirements. As previously stated, fuel modification zones do not conform to the typical zone dimensions, but they do comply with the general standards for Zones A-1, A-2, and B-3 as described in Chapter 5 of the City's Landscape Manual (2016). These zones are presented graphically in Figures 5a and 5b. Plantings used in the fuel modification Zones A-1 and A-2 will include drought-tolerant, fire resistive plant material. The planting list and spacing will be reviewed and approved by the CFD, included on submitted landscape plans and will be consistent with the Carlsbad West Oaks Project Plant List (Appendix D) prepared by GMP Landscape Architecture. The intent of the approved plant list is to provide examples of plants that are less prone to ignite or spread flames to other vegetation and/or combustible structures during a wildfire. Additional plants can be added to the landscape plant material palette with the approval from the CFD. An automatic irrigation system will be installed in Zones A-1 and A-2 to maintain hydrated plants without over-watering, allowing for run-off, or attracting nuisance pests. If native vegetation is present, Zone B-3 will consist of 50% thinning as described below or this zone could be planted with native plants as long as they are not listed in Appendix E, Undesirable Plants List.

4.6.1.1 Zone A-1 – Irrigated Next to Structure Zone

Zone A-1 is applicable site wide for the exterior sides of structures facing, native vegetation. The Homeowner's Association (HOA) or other appropriate, funded entity would manage and maintain Zone A-1 areas.

Zone A-1 includes the following key components:

- Zone A-11 occurs 5 to 20 feet outward for all structures when the exterior side is facing hazardous native vegetation.
- Planting within Zone A-1 consists of ground cover or low growing shrubs species (less than three (3) feet in height) known to have fire resistive qualities.

  Exception: Fire department-approved vine species may grow up to a height of 15 feet on a non-combustible (e.g., metal) trellis. Vines will be cleaned of all deadwood and maintained so that they do not block emergency-egress windows.
- Planting within Zone A-1 shall consist of shrubs, vines, and groundcovers from Appendix D.
- Trees may be allowed in Zone A-1 at the discretion of the Fire Marshal provided that, at maturity, tree canopies are no closer than 10 feet of a structure.
- Automatic irrigation system shall be required and maintained.
- All attachments to the structure shall be noncombustible.
- No solid fuel fire pits or outdoor fireplaces shall be permitted.

4.6.1.2 Zone A-2 – Irrigated Zone

Zone A-2 adjoins Zone A-1 on its outer edge and measures 35 to 70 feet along the southern edge of the development and 60 to 120 on the northern edge for eastern portion of the development. The western and eastern edges of the development have been provided 140 and 200 feet of fuel modification (Zone A-2), respectively. There is no Zone A-2 on the north side of the western development. Zone A-2 does occur between buildings for the entire site. The HOA or other appropriate, funded entity would manage and maintain Zone A-2 areas.

Zone A-2 includes the following key components:

- Planting within Zone A-2 shall consist of trees, shrubs, vines, and groundcovers from Appendix D.
- Vines are allowed within Zone A-2, if attached to a non-combustible trellis and maintained clean of deadwood. Additionally, vines attached to a trellis on an exterior wall of a structure will be maintained so that they do not block emergency-egress windows.
- Trees can be planted in Zone A-2 at the discretion of the Fire Marshal provided that, at maturity, tree canopies are no closer than 10 feet of a structure.

Exception: Fire department-approved tree species would be planted within Zone A-2 and adjacent to non-combustible (metal) carports. The tree canopies would be maintained to achieve a minimum 3-foot clearance between mature tree canopies' and the non-combustible structure.

- Trees can be planted in groups of three specimens or less as long as a 20-foot spacing can be maintained between the groupings of tree canopies. No horizontal spacing is required inside the group.
- Automatic irrigation system shall be required and maintained.
- No solid fuel fire pits or outdoor fireplaces shall be permitted.

4.6.1.3 Zone B-3 – Thinning or Native Planting Zone

Zone B-3 adjoins Zone A-2 on its outer edge and measures 20 feet in width. Zone B-3 primarily occurs within the 20-foot uplands buffer along the southern edge of the property. The HOA or other appropriate, funded entity would manage and maintain Zone B-3 areas.

For upland buffer areas that contain native vegetation, Zone B-3 requires a thinning or removal of plants to achieve an area with 50% no fuel with a focus on removing the most flammable species, and dead and dying plants while creating a mosaic of shrub groupings.

Under this scenario, Zone B-3 includes the following:

- Zone B-3 requires up to 50% of the volume of vegetation to be thinned. Shrubs may be retained provided that they are pruned to a maximum height of 4 feet.
- Grasses between shrub groupings would be cut to 4 inches in height. Native grasses can be cut after going to seed.
- Trees and tree-like shrubs, which can be retained, shall be pruned to provide clearance equal to three times the height of the surrounding understory plant material or six feet, whichever is higher. Dead and excessively twiggy growth shall be also be removed.
- Trees can be planted in Zone B-3 at the discretion of the Fire Marshal provided that, at maturity, tree canopies are no closer than 10 feet of a structure.

  Exception: Fire department-approved tree species would be planted within Zone B-3 and adjacent to non-combustible (metal) carports. The tree canopies would be maintained to achieve a minimum 3-foot clearance between mature tree canopies' and the non-combustible structure.

- Irrigation is not required.

Upland buffer areas that do not contain native habitat could be landscaped with native plants as follows:

- Planting within Zone B-3 shall consist of native shrubs and groundcovers that are found on Appendix D, Carlsbad West Oaks Plant List.
- Plant species introduced into Zone B-3 would not include prohibited or highly flammable species (Appendix E)
- Trees may be allowed in Zone B-3 at the discretion of the Fire Marshal provided that, at maturity, tree canopies are no closer than 10 feet of a structure.
- Trees can be planted in groups of three specimens or less as long as a 20-foot spacing can be maintained between the groupings of tree canopies. No horizontal spacing is required inside the group.
- Grasses between shrub groupings would be cut to 4 inches in height. Native grasses can be cut after going to seed
- Irrigation is not required, but should be considered for plant material establishment.

4.6.2 Other Vegetation Management

4.6.2.1 Roadside Fuel Modification Zones

- The western driveway to Palomar Airport Road will include thinning within the graded areas of the road and may be less than 20 total feet on either side.
- Canopies shall be interrupted to provide discontinuous fuels.
- Grass shall be mowed to 6-inch stubble height or lower.
- Single specimens of trees, ignition-resistive shrubs, or cultivated ground cover, such as green grass, succulents, or similar plants used as ground covers, may be used, provided they do not form a means of readily transmitting fire. Plant material will be selected from the Carlsbad West Oaks Plant List in Appendix D.

Trees may be placed within the Roadside Fuel Modification Zones. The following criteria must be followed:

- Tree spacing to be 20 feet between mature canopies. A grouping of two to three trees together can be considered as one large tree canopy from a wildfire flammability perspective.
- Trees must be limbed up one-third the height of the mature tree or 10 feet, whichever is greater.
- No tree canopies lower than 13 feet 6 inches over roadways.

- No trees shall be planted that are not on the approved plant list or provided approval by CFD during landscape plan review.
- Any vegetation under trees to be ignition resistive and kept to 2 feet in height or lower, and no more than one-third the height of the lowest limb/branch on the tree.
- No tree limbs/branches are permitted within 10 feet of a structure.

4.6.2.2 Detention Basins

Fire-safe vegetation management will be performed within the basins on a yearly basis in accordance with the following guidelines.

- The detention or retention basins will be re-vegetated with plant species that are found on the Project's Plant List (Appendix D).
- This area shall be maintained annually free of dying and dead vegetation.

4.6.2.3 Pre-Construction Structure Locations

- Perimeter fuel modification areas must be implemented prior to commencement of construction utilizing combustible materials.
- Mow grasses or weeds to six inches in height on vacant lots upon commencement of construction work.
- Dead fuel, ladder fuel (fuel which can spread fire from ground to trees), and downed fuel shall be removed and trees/shrubs shall be properly limbed, pruned, and spaced per this plan.
- The remainder of the Fuel Modification Zones required for the particular lot shall be installed and maintained prior to combustible materials being brought onto any lot under construction.

4.6.3 Undesirable Plants

Certain plants are considered undesirable in the landscape due to characteristics that make them highly flammable. These characteristics can be physical or chemical.

The plants included in the Undesirable Plant List (Appendix E) are unacceptable from a fire safety standpoint, and shall be removed or not be planted within all fuel modification Zones.

4.6.4 Fuel Modification Area Vegetation Maintenance

Provisions for continuous maintenance will be addressed in the West Oaks Homeowner Association's (HOA) Covenants, Conditions, and Restrictions for common areas and individual properties. Maintenance refers to any activity needed to maintain the fuel modification area in a fire-safe condition as required by CFD, including the periodical removal of undesirable, combustible vegetation; replacement of dead or dying fire-resistant plantings; maintenance of the operational integrity and programming of irrigation systems in Zone A-1; and preservation or enhancement of the riparian buffer area. The Preserve Manager will conduct vegetation management, including only the removal of dead branches and vegetation, within the riparian buffer area.

All fuel modification area vegetation maintenance shall be completed annually by June 1st of each year and more often as needed for fire safety, as determined by the CFD. This FPP requires that the HOA budget for and hire an approved third party fuel modification zone inspector annually to provide guidance and approval of the fuel modification zone maintenance, described further in the following section. Individual property owners will be responsible for all vegetation management on private property in compliance with the requirements detailed herein and CFD requirements. Enforcement of the provision of maintenance will be accomplished by the West Oaks HOA and CFD Prevention Bureau through any legal remedies available to both jurisdictions, including fees and liens.

5 ALTERNATIVE MATERIALS AND METHODS FOR NON-CONFORMING FUEL MODIFICATION

As previously mentioned, due to site constraints, it is not feasible to achieve the standard FMZ width for one building located within the western half and two buildings in the eastern half of the development area. As such, this FPP incorporates additional analysis and measures that will be implemented to compensate for potential fire related threats. These measures are customized for this site based on the analysis results and focus on providing functional equivalency as a CFD-defined, 60 feet wide, full fuel modification zone.

The specific buildings that are affected by this analysis are those that cannot provide at least 60 feet of structural setback from the property line. Figures 5a and 5b indicate those buildings with a northern or southern exterior wall that has less than 60 feet of fuel modification. The land uses adjacent to these three buildings (paved roads, riparian buffer) present reduced risk when compared to native shrub lands. The vegetative fuels off-site can ignite and burn completely during extreme weather conditions. However, they are expected to burn in a spotty manner due to the presence of heavy shading, open water, and higher plant moisture. Access to a fire burning in the riparian area will be aided by Palomar Airport Road on the north side and the project's access road on the south side.

5.1 Alternative Materials and Methods

The project will provide code-exceeding fire protection features to compensate for the reduced fuel modification adjacent to six structures in the project.

1. Windows upgrade to dual pane, both panes tempered on the northern or southern exposures.
2. Third party fuel modification zone inspections to be funded by the HOA annually.

5.1.1 Alternative Material and Method Justifications for Findings

As experienced in numerous wildfires, including the most recent firestorms in San Diego County (2003, 2007, 2010, and 2014), homes in the WUI are potential fuel. The 2014 Poinsettia Fire in Carlsbad caused the loss of eight homes with damage to additional homes and structures. 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 10–18 meters (roughly 32–60 feet) in southern California fires, 85–95% 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 2007).

These results support Cohen's (2000) findings that if a community's homes have a sufficiently low home ignitability (i.e., latest ignition resistant building and fire codes), the community can survive exposure to wildfire without major fire damage. 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 may require 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 to current codes. Fire behavior modeling conducted for this project indicates that fires in the off-site-adjacent fuels to the north would result in roughly 6-foot flame lengths during a summer fire. Extreme conditions may result in crown fire in riparian forest or chaparral fuels, where tree crowns burn and create more intense fire and longer flame lengths. Minimum fuel modification zone widths along the northern interface is 50 feet.

As indicated in this report, the FMZs and additional fire protection measures proposed for the eight structures with northerly exposures in the western half of the project provide equivalent wildfire buffer, but are not standard zones. Rather, they are based on a variety of analysis criteria including predicted flame length, fire intensity (Btu), site topography and vegetation, extreme and typical weather, position of structures on pads, position of roadways, adjacent fuels, fire history, current vs. proposed land use, neighboring land uses/roads relative to the proposed project, and type of construction. The fire intensity research conducted by Cohen (1995), Cohen and Butler (1996), and Cohen and Saveland (1997) and Tran et al. (1992) supports the fuel modification alternatives proposed for this project.

5.1.1.1 Exterior Windows

A potentially vulnerable structure component with regard to radiant or convective heat exposure is a structure's windows. A concern for the four structures on the west side and one structure on the east side of the project is the exterior glazing that could be subject to radiant or convective heat from a wildland fire and whether provision for a fuel modification zone slightly narrower is adequate. To address this issue, it is worthwhile to examine the structure ignitability modeling, independent ignition experiments, and case studies that support fuel treatments as low as roughly 35 feet from structures, and compare them with the project. Cohen's (1995) structure ignitability model (SIAM) assesses ignitability of bare wood when exposed to a continuous heat source. The model assumes a worst-case condition of a constant 1700 degrees (F). A constant, maximum heat source is typically not the case during a wildfire due to the movement of a fire, non-uniform vegetation distribution, and the lack of a uniform, constant flame front. Further, a flame temperature of 1700 degrees (F) is likely higher than would be experienced by the fuels adjacent this site, but is a valid temperature for testing, as Pyne et al. (1996) confirms that flaming combustion typically occurs in wildland fuels between flame temperatures of 1,466 to 2,186 degrees (F). For comparison, Dennison (2006) studied the heat signatures from a Southern California wildfire that was burning oak woodlands, dense chaparral, sparse chaparral, and grasslands. Results from this study indicate that the maximum temperature commonly observed was 2,200 degrees (F) and associated with the dense, higher fuel load oak and chaparral vegetation, while cooler (980–1340 degrees (F)) and smaller fires were associated with the mixed chaparral and grasslands. The analysis conducted for this report indicates that the structure setbacks that are 17% less than the typical 60-feet wide requirement, is adequate for separating the structures from the short-duration heat and flame associated with a fire burning toward the community in the fuels that occur adjacent this portion of the development.

The typical duration of large flames from burning vegetation is on the order of 1 minute and up to several minutes for larger fuels at a specific location (Cohen 1995; Butler et al. 2004, Ramsay and Rudolph 2003, Cohen and Quarles 2011). Tests of various glazing products indicate that single pane, tempered glass failure may occur between 120–185 seconds from exposure (University of California 2011; Manzello et al. 2007) but those tests include direct and constant heating that would not be experienced during a wildfire near the eight structures. Depending on the heat applied and the type of glass used in the various studies, the cracking/failure time varied. However, given the short duration of maximum heat (likely 60–90 seconds for the riparian forest leaf litter), the loss of heat over distance (50 feet minimum FMZ), and the fire-rated minimum 20-minute glazing specified for this project, the heat experienced by the windows from the wildland fire is not expected to be enough (in temperature or duration) to cause window failure. Quarles et al. (2010) provides strong endorsement for tempered (toughened) glass performance. His research and tests conclude that multi-pane (2–3 panes) with at least one pane tempered is well suited for wildfire exposures. He indicates that tempered glass is at least four times stronger and much more resistant to thermal exposures than normal annealed glass. The use of code required dual pane, one pane-tempered glass provides several benefits, with thermal exposure performance the most important for this study. This project would utilize dual pane, both panes tempered to increase the thermal and overall strength of the exposed windows for those structures that achieve less than 60 feet of fuel modification as depicted on Figures 5a and 5b.

5.1.1.2 Third Party Fuel Modification Zone Inspections

The HOA or similar funded entity will annually hire a third party fuel modification zone inspector to conduct an assessment of the community's fuel modification areas. The inspector will utilize this FPP along with the then current CFD fuel modification requirements for determining whether the fuel modification areas comply. Where maintenance is required, the inspector will notify the HOA/funded entity of the situation and will direct activities so that compliance is achieved. Once in compliance, the third party inspector will provide a certification letter to the HOA indicating that the fuel modification area meets the required conditions. This process will help ensure that the project's fuel modification zones continue to meet the intent of this FPP and provide an appropriately structured setback from native fuels.

6 CONCLUSION

This FPP is submitted in support of an application for project entitlement of the West Oaks development project. It is submitted in compliance with requirements of the Carlsbad Municipal Code- Fire Code. The requirements in this document meet Carlsbad fire safety, building design elements, intent of fuel management/modification, and landscaping recommendations. Where the project does not strictly comply with the Code, such as with fuel modification zone widths along a portion of the northern project edge, alternative materials and methods have been proposed that provide functional equivalency as the code intent.

Fire and Building Codes and other local, county, and state regulations in effect at the time of each building permit application supersede these recommendations unless the FPP recommendation is more restrictive.

The recommendations provided in this FPP have been designed specifically for the proposed project and the Wildland Urban Interface (WUI) zone at the West Oaks project site. The project site's fire protection system includes a redundant layering of protection methods that have been shown, through post-fire damage assessments, to reduce risk of structural ignition and compensate for fuel modification area reductions.

Modern infrastructure will be provided along with implementation of the latest ignition resistant construction methods and materials. Further, all structures are required to include interior sprinklers consistent with Carlsbad Fire and Building Codes. Fuel modification will occur on exposed edges and adjacent biological preserve areas of the project site. Fuel modification areas receive fuel reduction treatments initially, and then maintenance over time includes removing all dead and dying materials and maintaining appropriate horizontal and vertical spacing. In addition, plants that establish or are introduced to the fuel modification zone that are not on the approved plant list will be removed by the HOA and certified by a third party Fuel Modification Zone inspection.

Ultimately, it is the intent of this FPP to guide, through code and other project specific requirements, the construction of structures that are defensible from wildfire and, in turn, do not represent significant threat of ignition source for the adjacent native habitat. It must be noted that during extreme fire conditions, there are no guarantees that a given structure will not burn. Precautions and mitigating actions identified in this report are designed to reduce the likelihood that fire would impinge upon the proposed structures. There are no guarantees that fire will not occur in the area or that fire will not damage property or cause harm to persons or their property. Implementation of the required enhanced construction features provided by the applicable codes and the mitigating fuel modification requirements provided in this FPP will accomplish the goal of this FPP to assist firefighters in their efforts to defend these structures and reduce the risk associated with this project's WUI location. For maximum benefit, the developer, contractors, engineers, and architects are responsible for proper implementation of the concepts and requirements set forth in this report. Homeowners are responsible to maintain their structures and lots as required by this report, the applicable Fire Code and the CFD.

Although the proposed development and landscape will be significantly improved in terms of ignition resistance, it should not be considered a shelter-in-place community. It is recommended that the homeowners or other occupants who may reside within the West Oaks neighborhood adopt a conservative approach to fire safety. This approach must include maintaining the landscape and structural components according to the appropriate standards and embracing a "Ready, Set, Go![3]"approach to evacuation. Accordingly, occupants should evacuate the residence and the area as soon as they receive notice to evacuate, or sooner, if they feel threatened by wildfire or structure fire in a nearby residence. Fire is a dynamic and somewhat unpredictable occurrence and it is important for residents to educate themselves on practices that will improve their home survivability and their personal safety.

[3] International Fire Chiefs Association "Ready, Set, Go" website link: http://wildlandfirersg.org/

7 REFERENCES

Alexander, M.E.; Stocks, B.J.; Wotton, B.M.; Flannigan, M.D.; Todd, J.B.; Butler, B.W.; Lanoville, R.A. 1998. The international crown fire modelling experiment: an overview and progress report. In: Proceedings of the second symposium on fire and forest meteorology; 1998 January 12-14; Phoenix, AZ. Boston, MA: American Meteorological Society; 20–23.

Butler, B.W., J. Cohen, D.J. Latham, R.D. Schuette, P. Spoko, K.S. Shannon, D. Jimenez, and L.S. Bradshaw. 2004. Measurements of radiant emissive power and temperatures in crown fires. Canadian Journal of Forest Research. 34:1577–1587.

CAL FIRE. 2015. Fire and Resource Assessment Program. California Department of Forestry and Fire. Website access via http://frap.cdf.ca.gov/

City of Carlsbad (City). 2015. City of Carlsbad State of Effectiveness Report: Fire Protection and Emergency Medical Service.

City of Carlsbad. 2016. Landscape Manual Policies and Requirements. February 2016.

Cohen, Jack D. 1995. Structure ignition assessment model (SIAM). In: Weise, D.R.; Martin, R.E., technical coordinators. Proceedings of the Biswell symposium: fire issues and solutions in urban interface and wildland ecosystems. 1994 February 15–17; Walnut Creek, California. Gen. Tech. Rep. PSW-GTR-158. Albany, California: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 85–92.

Cohen, J.D. 2000. Preventing disaster: home ignitability in the wildland-urban interface. Journal of Forestry 98(3): 15–21.

Cohen, J.D. and Butler, B.W. [In press]. 1996. Modeling potential ignitions from flame radiation exposure with implications for wildland/urban interface fire management. In: Proceedings of the 13th conference on fire and forest meteorology. October 27–31; Lorne, Victoria, Australia. Fairfield, Washington: International Association of Wildland Fire.

Cohen, J.D. and Saveland, J. 1997. Structure Ignition Assessment Can Help Reduce Fire Damages in the W-UI. Fire Management Notes 57(4): 19–23.

Cohen, Jack and Steve Quarles. 2011. Structure Ignition Assessment Model; The Origins and Basis of SIAM. From presentation at the 2011 NFPA Wildland Fire - Backyard and Beyond Conference in October 2011.

Dudek. 2018a. Biological Resources Technical Report for the West Oaks Project, City of Carlsbad, California. August 2018.

Dudek. 2018b. Conceptual Mitigation Plan for the West Oaks Project, City of Carlsbad, California. August 2018.

Dennison, Phillip, Kraivut Charoensiri, Dar A. Roberts, Seth H. Peterson, and Robert O. Green. 2006. Wildfire Temperature and Land Cover Modeling Using Hyperspectral Data. Center for Natural & Technological Hazards, University of Utah, University of California Santa Barbara and Jet Propulsion Laboratory. 36 pp.

Foote, Ethan I.D.; Gilless, J. Keith. 1996. Structural survival. In: Slaughter, Rodney, ed. California's I-zone. Sacramento, California: CFESTES; 112–121.

Howard, Ronald A.; North, D. Warner; Offensend, Fred L.; Smart, Charles N. 1973. Decision analysis of fire protection strategy for the Santa Monica Mountains: an initial assessment. Menlo Park, California: Stanford Research Institute. 159 p.

Hunter, Cliff. 2007. Personal communication with Rancho Santa Fe Fire Protection District Fire Marshal following after-fire loss assessments.

Institute for Business and Home Safety (IBHS). 2008. Megafires: The Case for Mitigation. 48 pp.

Manzello, Samuel, R. Gann, S. Kukuck, K. Prasad, and W. Jones. 2007. An Experimental Determination of a Real Fire Performance of a Non-Load Bearing Glass Wall Assembly. National Institute of Standards and Technology. 13 pp.

NFPA 1144. Standard for Reducing Structure Ignition Hazards from Wildland Fire. 2008. Technical Committee on Forest and Rural Fire Protection. Issued by the Standards Council on June 4, 2007, with an effective date of June 24, 2007. Approved as an American National Standard on June 24, 2007.

Pyne, Stephen, Patricia Andrews, Richard Laven. 1996. Introduction to Wildland Fire, Second Edition. Chapter 1, Section 4. Pg. 21.

Quarles, Stephen, Yana Valachovic, Gary Nakamura, Glenn Nader, and Michael De Lasaux. 2010. Home Survival in Wildfire Prone Areas – Building Materials and Design Considerations. 22 pp.

Ramsay, Caird and Lisle Rudolph. 2003. Landscaping and Building Design for Bushfire Areas. Chapter 2.

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, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

Tran, H.C.; Cohen, J.D; Chase, R.A. 1992. Modeling ignition of structures in wildland/urban interface fires. In: Proceedings of the 1st international fire and materials conference; 1992 September 24–25; Arlington, Virginia. London, United Kingdom: Inter Science Communications Limited; 253–262.

University of California Agriculture and Natural Resources. 2011. Web Site: Builders Wildfire Mitigation Guide. http://firecenter.berkeley.edu/bwmg/windows-1.htmlUSDA and NRCS (U.S. Department of Agriculture and Natural Resources Conservation Services). 2014a. Web Soil Survey [web application]. Accessed February 2014. http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm.

Ventura County Fire Protection District. 2011. Ventura Unit Strategic Fire Plan.

INTENTIONALLY LEFT BLANK

8 LIST OF PREPARERS

Project Manager/Lead Fire Protection Planner:

Michael Huff
Fire Protection Planner; San Diego County California Environmental Quality Act Consultant List
Dudek

Fire Protection Planner:

Mike Scott
Urban Forester; BehavePlus Fire Modeling
Dudek

GIS Fire Behavior Modeling:

Scott Eckardt
Registered Professional Forester, GIS fire modeling and exhibit preparation
Dudek

INTENTIONALLY LEFT BLANK

APPENDIX A

Representative Site Photographs

WEST OAKS

REPRESENTATIVE PHOTOGRAPHS

Photograph 1. View looking east at the end of Palomar Oaks Way. Note vegetated slopes and existing development.

Photograph 2. View to the north along Palomar Oaks Way. Road is 52 feet wide and includes a left turn lane on northbound side.

Photograph 3. View to the south at eastern end of project and adjacent slopes.

Photograph 4. View to the west along existing West Oaks Way.

Photograph 5. View to the southeast at existing vegetation on off-site slopes.

Photograph 6. View of off-site slopes from the mid-section of the project.

Photograph 7. View to the south across proposed development area at slopes with grass, chaparral, and oaks.

Photograph 8. View to the south at chaparral vegetation along southern project boundary.

Photograph 9. View to the west of riparian vegetation along the northern project boundary.

Photograph 10. View along existing West Oaks Way at electrical transmission lines, lighting, and hydrants.

Photograph 11. View to the south of existing slopes, oak trees, and chaparral with neighboring development at top of slope.

Photograph 12. View to the west at flat graded pad areas and adjacent slopes.

Photograph 13. View to the east at existing SDG&E easement road that will be improved and designated for emergency secondary access.

Photograph 14. View to the southeast at off-site slopes.

Photograph 15. View of existing SDG&E access road that will be improved and used for secondary emergency access to Palomar Airport Road.

Photograph 16. View of vegetation along northern project boundary and electrical transmission lines.

Photograph 17. View to the west along existing West Oaks Way.

Photograph 18. View to the southeast at chaparral covered slopes.

Photograph 19. View of chaparral on slopes to the south of the project.

Photograph 20. View of chaparral on the slopes to the south of the project.

Photograph 21. View of chaparral species south of the project.

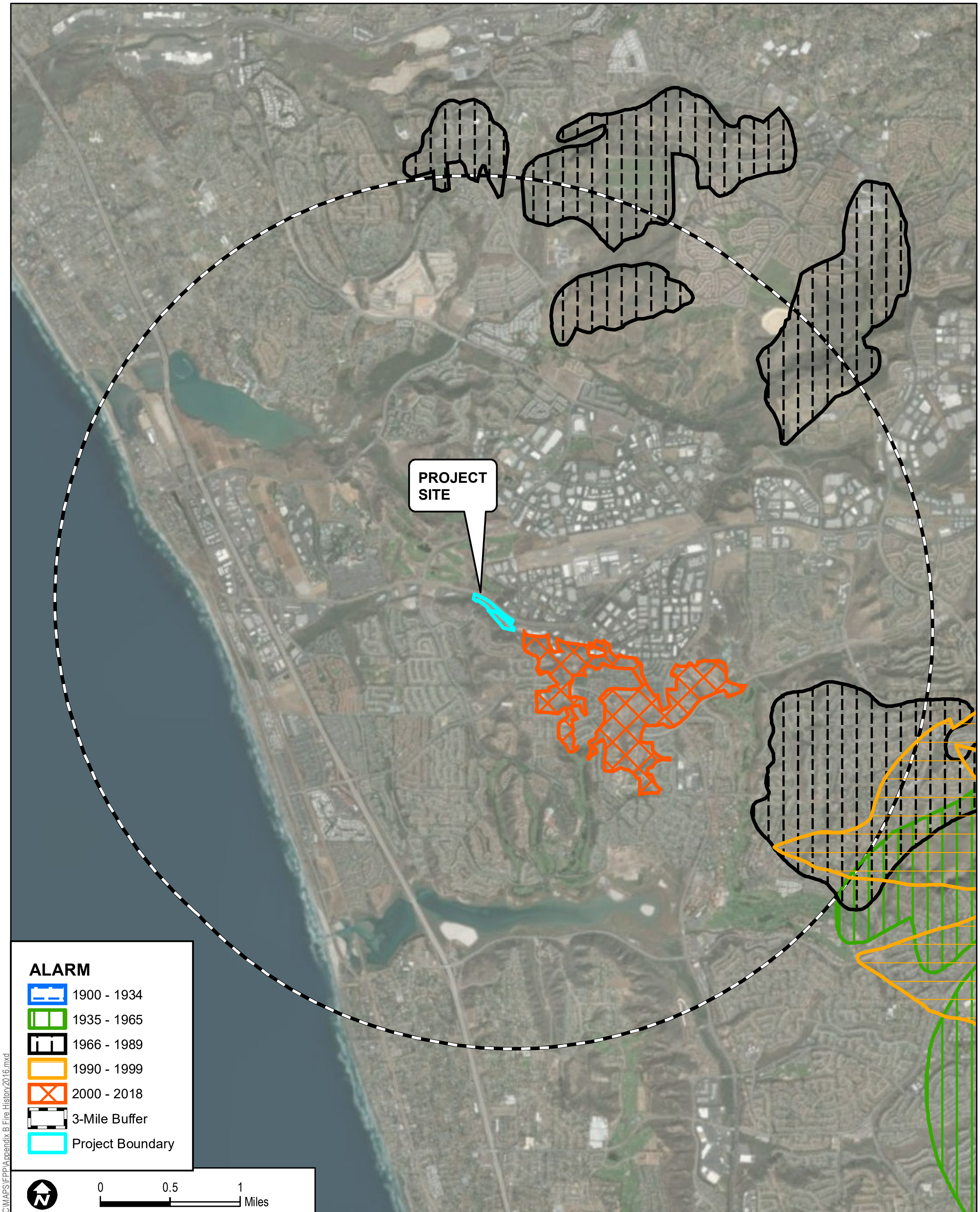
Photograph 22. View of project area – central portion of project.

Photograph 23. View along the southern project boundary in the eastern portion of the project.

Photograph 24. View to the east at Poinsettia Fire scar on hillside.

APPENDIX B

Fire History Exhibit



Path: Z:\Projects\j989701\MAPDOC\MAPS\FPP\Appendix B Fire History2016.mxd

DUDEK

9897

SOURCE: ESRI; CAL FIRE 2017

Appendix B

Fire History Exhibit

WEST OAKS FIRE PROTECTION PLAN

APPENDIX C

BehavePlus Fire Behavior Analysis

APPENDIX C
BehavePlus Fire Behavior Analysis

BEHAVEPLUS FIRE BEHAVIOR MODELING

Fire behavior modeling includes a high level of analysis and information detail to arrive at reasonably accurate representations of how wildfire would move through available fuels on a given site. 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, the BehavePlus 5.0.5 fire behavior modeling system was applied using predominant fuel characteristics, slope percentages, and extreme weather variables for the 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 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 models (Anderson 1982) and the more recent custom fuel models developed for southern California (Weise and Regelbrugge 1997). 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 models (Scott and Burgan 2005) 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:

- Non-Burnable Models NB1, NB2, NB3, NB8, NB9
- Grass Models GR1 through GR9
- Grass-shrub Models GS1 through GS4
- 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 protection plan (FPP) 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.

BEHAVEPLUS FIRE BEHAVIOR MODELING INPUTS

Dudek utilized BehavePlus software to evaluate fire behavior potential for the project site. Two weather scenarios were evaluated, including a summer, onshore weather condition and an extreme fall, offshore weather condition. 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 flame length (feet), rate of spread (feet/minute), and fireline intensity (BTU/feet/second). The following provides a description of the input variables used in processing the BehavePlus models for the project site. In addition, data sources are cited and any assumptions made during the modeling process are described.

Vegetation/Fuels

To support the fire behavior modeling efforts conducted for this FPP, the different vegetation types observed adjacent to the site were classified into the aforementioned numeric fuel models. Vegetation types were derived from vegetation mapping conducted by Dudek for the project site. The off-site vegetation is dominated primarily by Southern Mixed chaparral (Fuel Model 4) with patches of short grasses (Fuel Model Gr4). Southern willow scrub (Fuel Model Sh2) occurs on either side of the creek bed. A total of two model runs was completed for the Project area. These sites were selected based on the strong likelihood of fire approaching from these directions during an on-shore weather pattern (Fire Scenario 1) and during a Santa Ana wind-driven fire event (Fire Scenario 2).

Topography

The topography of the site is discussed in greater detail in the FPP. 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 down hill as uphill vegetation is pre-heated and dried in advance of the flaming front, resulting in faster ignition rates. Slope values for this site were measured from site topographic maps and are presented in units of percent.

Weather

Fire behavior modeling conducted in support of this FPP utilized the guidelines and standards presented by the County of San Diego, Department of Planning and Land Use[1]. These guidelines identify acceptable fire weather inputs for extreme fire conditions during summer months and Santa Ana fire weather patterns. The County analyzed and processed fire weather from Remote Automated Weather Stations (RAWS) between April 15 to December 31 in order to represent the

[1] County of San Diego Report Format and Content Requirements – Wildland Fire and Fire Protection (August 31, 2010). On-line at http://www.sdcounty.ca.gov/dplu/docs/Fire-Report-Format.pdf

general limits of the fire season. Data provided by the County's analysis included temperature, relative humidity, and sustained wind speed and is categorized by weather zone, including Maritime, Coastal, Transitional, Interior, and Desert.

To evaluate potential fire behavior for the project site, Dudek utilized the BehavePlus (v. 5.0.5) fire behavior modeling software package to determine fuel moisture values and expected fire behavior for the site. The temperature, relative humidity, and wind speed data for the Coastal[2] weather zone were utilized for this FPP based on the project location. Reference fuel moistures were calculated in BehavePlus and were based on site-specific topographic data inputs. Table 1 summarizes the weather and wind input variables used for all fire behavior modeling calculations utilized for this FPP.

Table 1
BehavePlus Fire Behavior Modeling Inputs

Variable	Summer Weather (Onshore Flow)	Peak Weather (offshore/Santa Ana Condition)
1h Moisture	3%	2%
10h Moisture	5%	3%
100h Moisture	7%	5%
Live Herbaceous Moisture	60%	30%
Live Woody Moisture	90%	60%
20-foot Wind Speed (upslope/downslope)	19 mph	26 mph (50 mph gusts)
Wind Adjustment Factor	0.4	0.4
Slope Steepness	2-35%	39%

Fire Modeling Scenarios

Focused fire behavior modeling utilizing BehavePlus 5.0.5 was conducted for the Project. Based on slope and fuel conditions, two different fire scenarios were evaluated for the project site, including:

- **Scenario 1:** Weather conditions with prevailing on-shore wind and a summer fire burning in chaparral with patches of grasslands along the western edge of the Project site. Fire would also burn along the creek bed through the Southern willow scrub. This area is relatively flat (2% slope) along the creek bed to moderately to steep slopes (20-35%) that rise uphill away from the proposed development. Potential ignition sources could originate from adjacent residential areas or a transmission line that traverses through the Project area. Fire in this area would be moving slightly across slope toward the proposed Project.

[2] SANGIS 2011 (http://www.sangis.org/)

- **Scenario 2:** Weather conditions with prevailing off-shore winds and a fall fire burning in chaparral in rugged, steep terrain along the eastern edge of the Project site. This area is very steep (39% slope), with potential ignition sources from adjacent residential or commercial areas or a transmission line that traverses through the Project area. Fire in this area would be moving across the slope and downhill toward the proposed Project.

BEHAVEPLUS FIRE BEHAVIOR MODELING RESULTS

Three fire behavior variables were selected as outputs from the BehavePlus analysis conducted for the project site, and include flame length (feet), rate of spread (mph), and fireline intensity (BTU/feet/second). 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 2004). It is a somewhat subjective and non-scientific measure of fire behavior, but is extremely important to fireline personnel in evaluating fireline intensity and is worth considering as an important fire variable (Rothermel 1983). 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. The information in Table 2 presents an interpretation of these fire behavior variables as related to fire suppression efforts. The results of fire behavior modeling efforts are presented in Table 3. Additionally, identification of modeling run locations is presented graphically in Figure 4 of the FPP.

Table 2
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.

Source: BehavePlus 5.0.5 fire behavior modeling program (Andrews, Bevins, and Seli 2004)

Table 3
BehavePlus Fire Behavior Modeling Results

Fire Scenario	Flame Length (feet)	Spread Rate (mph)	Fireline Intensity (Btu/ft/s)	Spot Fire (miles)
Scenario 1: Chaparral-Grasslands on north-facing,35% across slope; Southern Willow Scrub, 2% slope; Summer weather				
Southern Willow Scrub (Sh2)	6.4	0.2	324	0.3
Grasslands (Gr4)	13.1	1.9	1,512	0.5
Chaparral (FM4)	30.0	2.1	9,240	1.0
Scenario 2: Chaparral on north -facing, 39% across and downslope; Peak weather				
Chaparral (FM4) –sustained wind	45.6	4.6	22,947	1.6
Chaparral (FM4)- 50 mph gusts	69.4	11.6	57,188	3.3

Note: The results presented in Table 5 depict values based on inputs to the BehavePlus software. Changes in slope, weather, or pockets of different fuel types are not accounted for in this analysis. 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.

REFERENCES

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, Utah.

Andrews, Patricia L., Collin D. Bevins, and Robert C. Seli. 2004. BehavePlus fire modeling system, version 3.0: User's Guide. Gen. Tech. Rep. RMRS-GTR-106 Ogden, Utah: Department of Agriculture, Forest Service, Rocky Mountain Research Station. 132p.

Rothermel, R.C. 1983. How to Predict the Spread and Intensity of Forest and Range Fires. USDA Forest Service Gen. Tech. Report INT-143. Intermountain Forest and Range Experiment, Ogden, Utah.

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, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

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.

APPENDIX D

Carlsbad West Oaks Plant List

Carlsbad West Oaks Plant List

Prepared by GMP Landscape Architecture

March 26, 2019

Large Evergreen Site Trees

Lophostemon confertus / Brisbane Box
Metrosideros excelsus / New Zealand Christmas Tree
Umbellularia californica / California Bay

Medium Evergreen Site Trees

Arbutus 'marina' / Arbutus Marina
Magnolia grandiflora 'Little Gem' / Magnolia Grandiflora
Olea europea 'swan hill' / Olea Europea 'Swan Hill'

Large Deciduous Site Trees

Jacaranda mimosifolia / Jacaranda
Platanus racemosa / California Sycamore

Medium Deciduous Site Trees

**Magnolia stellate / Star Magnolia
**Cercis occidentalis / Western Redbud
**Prunus campanulata / Taiwan Flowing Cherry

Street and Parking Lot Trees

**Lagerstroemia i. 'muskogee' / Crape Myrtle
*Arbutus unedo 'Marina' / Strawberry Tree
*Cinnamomum camphora / Camphor Tree
*Quercus Ilex / Holly Oak

Small Vertical Accent Shrubs

Pittosporum tenuifolium 'Silver Sheen' / Pittosporum 'Silver Sheen'
Prunus 'bright & tight' / Carolina Cherry
Rhaphiolepis indica / Indian Hawthorn

Mitigation Tree

*Quercus agrifolia / Coast Live Oak
*Quercus ilex / Holly Oak
*Quercus virginiana / Southern Live Oak
*Umbellularia California / California Bay
*Cinnamomum camphora / Camphor Tree

Site Shrubs

Agave parryi / Parry’s Century
Agave vilmoriniana / Octopus Agave
Aloe sp. / Aloe
Aloe arborescens / Torch Aloe
Anigozanthos sp. / Kangaroo Paw
Arctostaphylos hookeri / Monterey Carpet Manzanita
*Castilleja exserta / Owl’s Clover
Cistus sp. / Rock Rose
Dianella tasmanica ‘Variegata’/ White Striped Tasman Flax Lily
Dietes Bicolor/Fortnight Lily
*Eriophyllum confertiflorum / Golden Yarrow
Escallonia fradesii / Escallonia
*Eschschlozia californica / California Poppy
Hesperaloe parvifolia / Red Yucca
Lantana sp. / Trailing Lantana
Lantana montevidensis / Lantana
Leptospermum sp. / Tea Tree
*Lupinus succulentus / Arroyo Lupine
*Nassella (Stipa) pulchra / Purple needlegrass
Phormium tenax / New Zealand Flax
**Photinia fraseri / Photinia
**Rhaphiolepis 'majestic beauty' / Majestic Beauty
*Sisyrinchium bellum / Blue-Eyed Grass
Westringia fruticose / Coast Rosemary
Yucca whipplei 'rbg' / Foothill Yucca

Site Vines

Ficus Pumila/ Creeping Fig
Ficus Pumila Variegata / Variegated Creeping Fig
Japonica ‘Halliana’ / Hall’s Honeysuckle
Jasminoides / Potato Vine

Site Groundcover

Baccharis pilularis / Baccharis pilularis “Pigeon Point”

Detention Basin Groundcover

Carex subfusca / Rusty Sedge

NOTES:

1. *TREES/SHRUBS ALLOWED PER COMMMUNITY FOREST MANAGEMENT PLAN
2. **TREES/SHRUBS ALLOWED PER SDG&E EASEMENT
3. FUEL MODIFICATION IS WITHIN 60 FEET OF STRUCTURES OR 20 FEET ON EACH SIDE OF ROADWAYS.
4. REMOVAL OF DEAD PLANT IS REQUIRED TO REDUCE FIRE HAZARD.
5. Homeowners Association to maintain a 3 feet clearance between trees at maturity and adjacent carports in Fuel Modification Zones 2 and 3.

APPENDIX E

Undesirable Plant List

APPENDIX E
Undesirable Plants List

Botanical Name	Common Name	Comment*
Trees		
Abies species	Fir	H
Acacia species (numerous)	Acacia	H
Agonis juniperina	Juniper Myrtle	H
Araucaria species (A. heterophylla, A. araucana, A. bidwillii)	Araucaria (Norfolk Island Pine, Monkey Puzzle Tree, Bunya Bunya)	H
Cedrus species (C. atlantica, C. deodara)	Cedar (Atlas, Deodar)	H
Chamaecyparis species	False Cypress	H
Cryptomeria japonica	Japanese Cryptomeria	H
Cupressocyparis leylandii	Leyland Cypress	H
Cupressus species (C. fobesii, C. glabra, C. sempervirens,)	Cypress (Tecate, Arizona, Italian, others)	H,Tecate=SDC
Eucalyptus species (numerous)	Eucalyptus	H
Juniperus species (numerous)	Juniper	H
Larix species (L. decidua, L. occidentalis, L. kaempferi)	Larch (European, Japanese, Western)	H
Palm species	Palms	H
Picea (numerous)	Spruce	H
Pinus species (P. brutia, P. canariensis, P. b. eldarica, P. halepensis, P. pinea, P. radiata, numerous others)	Pine (Calabrian, Canary Island, Mondell, Aleppo, Italian Stone, Monterey)	H
Platycladus orientalis	Oriental arborvitae	H
Podocarpus gracilior	Fern Pine	H
Pseudotsuga menziesii	Douglas Fir	H
Taxodium species (T. ascendens, T. distichum, T. mucronatum)	Cypress (Pond, Bald, Monarch, Montezuma)	H
Taxus species (T. baccata, T. brevifolia, T. cuspidata)	Yew (English, Western, Japanese)	H
Thuja species (T. occidentalis, T. plicata)	Arborvitae/Red Cedar	H
Tsuga species (T. heterophylla, T. mertensiana)	Hemlock (Western, Mountain)	H
Groundcovers & Shrubs		
Acacia species	Acacia	H
Adenostoma fasciculatum	Chamise	H,SDC
Adenostoma sparsifolium	Red Shanks	H,SDC
Artemisia species (A. abrotanium, A. absinthium, A. californica, A. caucasica, A. dracunculus, A. tridentata, A. pynocephala)	Sagebrush (Southernwood, Wormwood, California, Silver, True tarragon, Big, Sandhill)	H,SDC
Bambusa species	Bamboo	H
Dodonaea viscosa	Hopseed Bush	H
Eriogonum fasciculatum	Common Buckwheat	H,SDC
Heteromeles arbutifolia	Toyon	M
Heterotheca grandiflora	Telegraph Plant	H,SDC
Juniperus species	Juniper	H
Lonicera japonica	Japanese Honeysuckle	H
Malosoma Laurina	Laurel Sumac	M
Miscanthus species	Eulalie Grass	H
Muehlenbergia species	Deer Grass	H,SDC

Botanical Name	Common Name	Comment*
Groundcovers & Shrubs (cont.)		
Pennisetum setaceum	Fountain Grass	H
Pickeringia montana	Chaparral Pea	H,SDC
Quercus dumosa	Scrub Oak	M
Rosmarinus species	Rosemary	H
Rhus integrifolia	Lemonade Berry	M
Salvia mellifera	Black Sage	H,SDC
Thuja species	Arborvitae	H
Urtica urens	Burning Nettle	H,SDC
Xylococcus bicolor	Mission Manzanita	M

*H = High Fuel Plants, M = Moderate Fuel Plants, SDC = San Diego County native species

Notes:

1. This list was prepared by Dudek for West Oaks Project. Certain plants are considered to be undesirable in the landscape due to characteristic 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. City of Carlsbad refers to target species as High or Moderate Fuel Plants. High Fuel Plants are highly flammable and should not be planted within 50 feet of a structure. Moderate Fuel Plants are considered moderately flammable and should be avoided when only slow burning/low fuel species are permitted within a given fuel modification zone. Many of these species, if existing on the property and adequately maintained (e.g., pruning, thinning, irrigated, litter removal and weeding), could remain as long as the potential for spreading a fire has been reduced or eliminated.
2. 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.
3. The absence of a particular plant, shrub, groundcover, or tree, from this list does not necessarily mean it is fire resistive.
4. All vegetation used in Vegetation Management Zones and elsewhere in this development shall be subject to approval of the City’s Fire Code Official and Landscape Architect.
5. Landscape architects may submit proposals for use of certain vegetation on a project specific basis. They shall also submit justifications as to the fire resistivity of the proposed vegetation.

References:

City of Carlsbad. 2016. Landscape Manual Policies and Requirments. Appendix C High and Moderate Fuel Plants. February 2016.

County of San Diego. 2004. Department of Planning and Land Use, Building Division. Fire, Plants, Defensible Space and You (DPLU #199). June 2004.

Willis, E. 1997. San Diego County Fire Chief’s Association. Wildland/Urban Interface Development Standards. August 1997.