APPENDIX K

Fire Fuel Load Modeling Report

DRAFT

Fire Fuel Load Modeling Report

Fairmount Avenue Fire Station Project

SEPTEMBER 2024

Prepared for:

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1 Introduction

In accordance with Section 142.0412 of the San Diego Municipal Code (Brush Management) and Section 104.9 of the 2022 California Fire Code, an alternate method of providing fire protection for The Fairmount Avenue Fire Station Project (project) in the eastern section of the City of San Diego (City) is provided in this report. The project study area is bordered by Fairmount Avenue to the southwest, 47th Street to the north and east, and Chollas Creek to the northwest and is within the Mid-City: City Heights Community Planning area in the City, an area currently designated as a Local Responsibility Area (LRA) non-Very High Fire Hazard Severity Zone (VHFHSZ), as designated by the California Department of Forestry and Fire Protection (CAL FIRE) and the City of San Diego.[1] Finally, the project is within the City of San Diego's Subarea Plan (City of San Diego 1997).

The project proposes construction of a new 22,443 square-foot four-story fire station on a 1.28-acre site situated at the top of a canyon west of 47th Street in the city. Access to the project site would be via one standard driveway off 47th Street to accommodate passenger vehicles and one larger driveway, also off 47th Street, to accommodate fire vehicles and equipment. Vegetation removal, artificial slope creation and grading would be required to create a pad level with 47th Street for construction access. Construction activities would include ground clearing, grading, and foundation preparation, utility installation/trenching, framing and assembly of the building and associated apparatus bay, paving of parking and driveway areas, and landscaping. During construction activities, construction equipment and materials would be staged on site and at an off-site location, approximately 0.40-mile southwest of the project site. The approximate 0.52-acre off-site staging area is a City-owned property located adjacent to Sunshine Berardini Park and Federal Boulevard.

The project impact area and boundary include the proposed fire station building, parking lot, and associated Brush Management areas. Impacts to any areas of natural vegetation or habitat potentially suitable for special-status plant species would be avoided. The project site is currently vacant and undeveloped and is primarily characterized by undeveloped land which gently slopes down to a flat basin bottom from the north, east, and south, with steep hillsides present on the east side. A variety of native and non-native vegetation communities including coastal sage scrub and mixed chaparral, with a small area of disturbed land are present on the site. The land uses in the vicinity are characterized by a mix of residential development to the east and north, open spaces to the south, north, and west, and an industrial area and a school situated farther to the south of the project site. Within close proximity, a truck company operates approximately 300 feet to the southwest, while an elementary school is located about 450 feet to the southeast of the project site. The existing developed uses include Leisureland mobile home park an age-restricted community to the north, northeast, and single-family residential development to the east. Undeveloped open space lands associated with the Chollas Parkway Open Space are adjacent to the south and west intertwined with open space within a canyon to the west, providing a natural break in the developed landscape. To the south of the project site, along 47th Street, there is an array of industrial areas that include a mix of uses.

This Fire Fuel Load Modeling Report (FFLMR) evaluates a larger study area that encompasses the surrounding open space areas adjacent to the project site through the canyon to the northeast, the 0.52-acre off-site City-owned staging area site located adjacent to Sunshine Berardini Park and Federal Boulevard, the open space areas in the north and northwest, as well as including the 500-foot biological survey area buffer. Portions of the FFLMR's study area are located within a Multiple Habitat Preservation Area (MHPA), which occurs within the undeveloped urban canyon to the west of

1 Cal Fire – Fire Hazard Severity Zone Viewer (https://experience.arcgis.com/experience/03beab8511814e79a0e4eabf0d3e7247/) and City of San Diego Very High Fire Hazard Severity Zone Map (https://www.sandiego.gov/fire/services/brush/severityzones)

the project that extends north to Sunshine Berardini Field at Federal Boulevard on the southwest end of the canyon to just northeast of 54^{th} street.

An important component of a fire protection system is the Brush Management Zone (BMZ). BMZs are typically designed to gradually reduce fire intensity and flame lengths from advancing fire by strategically placing thinning zones and irrigated zones adjacent to each other along the perimeter of a Wildland Urban Interface (WUI) area and exposed structures. The project is designed to incorporate two BMZs totaling 100 feet; typically Zone 1 would extend 35 feet from any habitable structure towards flammable vegetation, and occur on all level portions of the property, and Zone 2 would include the remaining 65 feet that extends beyond Zone 1. For this project, Zone 1 extends up to 43 feet beyond the northern side of the fire station structure and between 10 and 15 feet beyond the western and southern sides of the fire station where a 6- to 25-foot-tall above ground retaining wall would function as an alternative construction measure to compensate for the reduced Zone 1 Defensible Space in this area. The Zone 2 Brush Management area (thinning zone) varies in width and would extend beyond Zone 1.

This FFLMR was prepared as a stand-alone document that assesses the site, the project development footprint, off-site adjacent fuels, and the area's fire history and weather. This FFLMR also discusses the project site and its fire environment, fire risk assessment, including fire behavior modeling, and based on the results from this study, requests a variance from the City's standard BMZ specifications with regard to the width of Zone 1 and Zone 2 for specific locations adjacent to the proposed fire station. The existing conditions within and around the 1.28-acre project site include sensitive coastal sage scrub habitat to the west and south and lands within the MHPA to the west, northwest, and south. These sensitive areas create a condition where it is not possible to achieve a standard BMZ that meets Section 142.0412 of the City's Municipal Code. The FFLMR provides an alternative approach for a modified Zone 1 within the area of disturbance and a modified Zone 2 thinning BMZ area that includes significant vertical separation of the developed area from off-site fuels. Per Section 142.0412 of the City's Municipal Code, the Fire Chief may modify standard requirements in consideration of existing topography, existing and potential fuel load, and other characteristics of a site related to fire protection. Per Municipal Code Section 142.0412(i), an applicant may request approval of alternative compliance for brush management in accordance with Process One if all of the following conditions exist:

1. The proposed alternative compliance provides sufficient defensible space between all structures on the premises and contiguous areas of native or naturalized vegetation as demonstrated to the satisfaction of the Fire Chief based on documentation that addresses the topography of the site, existing and potential fuel load, and other characteristics related to fire protection and the context of the proposed development.
2. The proposed alternative compliance minimizes impacts to undisturbed native or naturalized vegetation where possible, while still meeting the purpose and intent of Section 142.0412 to reduce fire hazards around structures and providing a fire break with at least the same functional equivalency.
3. The proposed alternative compliance is not detrimental to the public health, safety, and welfare of persons residing or working in the area.

This report provides project information, a request for modification of the BMZ, and justifications for the requested modification.

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2 Project Information

The project proposes construction of a new four-story fire station on a 1.28-acre vacant parcel of land at the top of the canyon on the westside of 47th Street, north of Fairmount Avenue located in the City Heights Community Planning Area, Council District 9, in the City of San Diego (City), California (see Figure 1, *Project Location Map and* Figure 2, *Project Area Map*). The fire station project site is located approximately 0.5 miles east of Interstate 805 and 0.5 miles north of Highway 94 within the Chollas Creek watershed. The approximately 25.51-acre study area is comprised of the 1.28-acre project site, which includes a 0.59-acre project impact footprint and a 500-foot buffer zone surrounding that impact footprint (see Figure 3, *Project Site Plan)*. The study area is bounded by Fairmount Avenue to the southwest, 47th Street to the north and east, and Chollas Parkway Open Space and Creek to the northwest (see Figure 1 and Figure 2). The location of the proposed fire station occurs just north of the intersection of Fairmount Avenue and 47th Street. The proposed impact area is bounded to the east by 47th Street and on the north, south and west by open space connected to the Chollas Parkway Open Space. The project site is located within Section of Township 17 South, Range 2 West and Section 4 of the San Diego, California U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle. During construction activities, construction equipment and materials would be staged on site and at an off-site location, approximately 0.40-mile southwest of the project site. The approximate 0.52-acre off-site staging area is a City-owned property located adjacent to Sunshine Berardini Park and Federal Boulevard (see Figure 4, *Off-site Construction Staging*).

Site Address: Fairmount Avenue Fire Station Project
Corner of Fairmount Avenue and 47th Street
San Diego, California 92102

Contact: **City of San Diego – Public Works Department**
Juan Baligad, Senior Planner, Program and Project Development Division
(619) 533-5473

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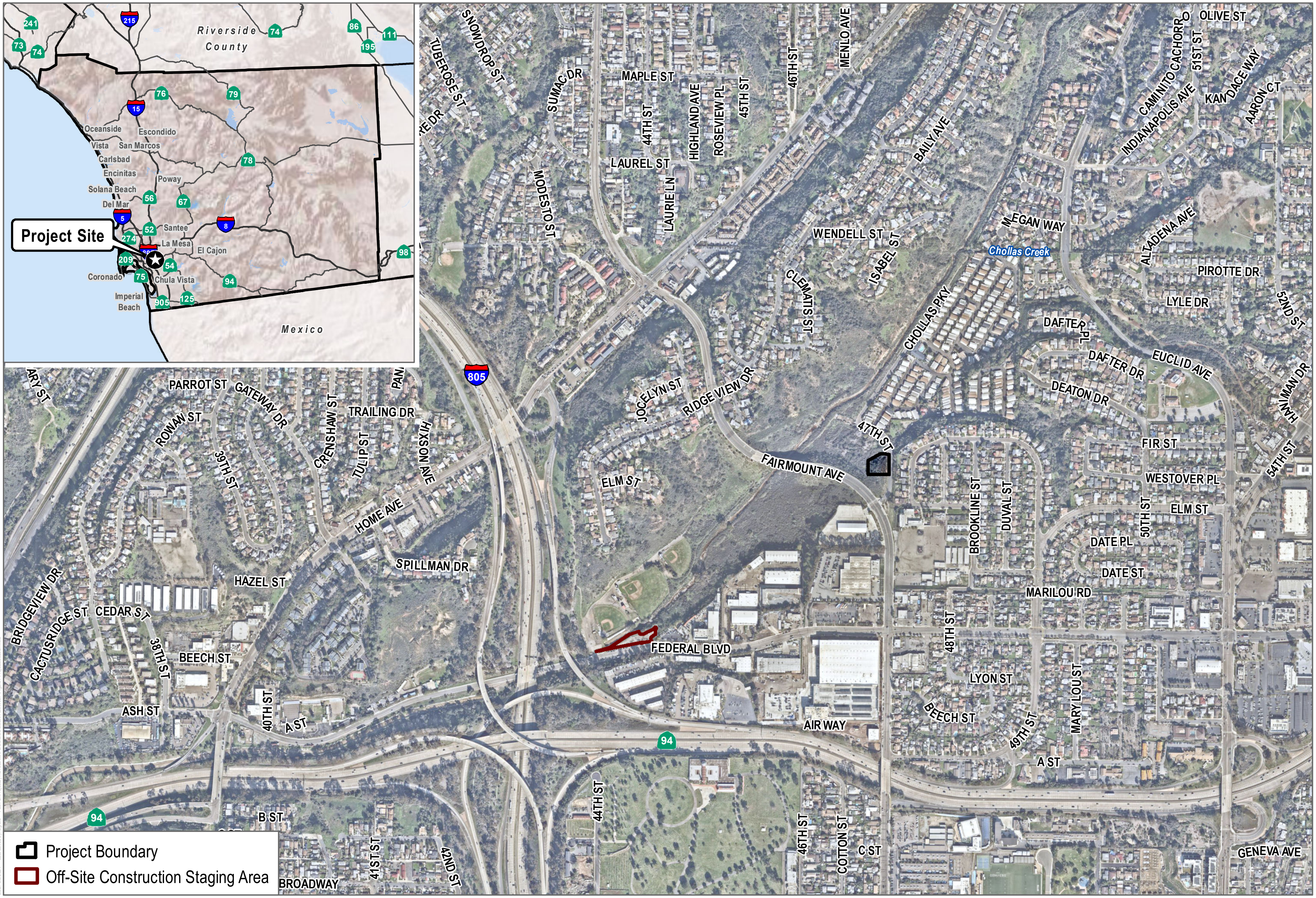

SOURCE: FEMA; SANGIS 2023

DUDEK

0 500 1,000 Feet

FIGURE 1

Project Location

Fairmount Avenue Fire Station - Fire Fuel Load Modeling Report

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SOURCE: RRM Design 2024; SANGIS 2023, 2024

DUDEK

0 250 500 Feet

FIGURE 2

Project Area Map

Fairmount Avenue Fire Station - Fire Fuel Load Modeling Report

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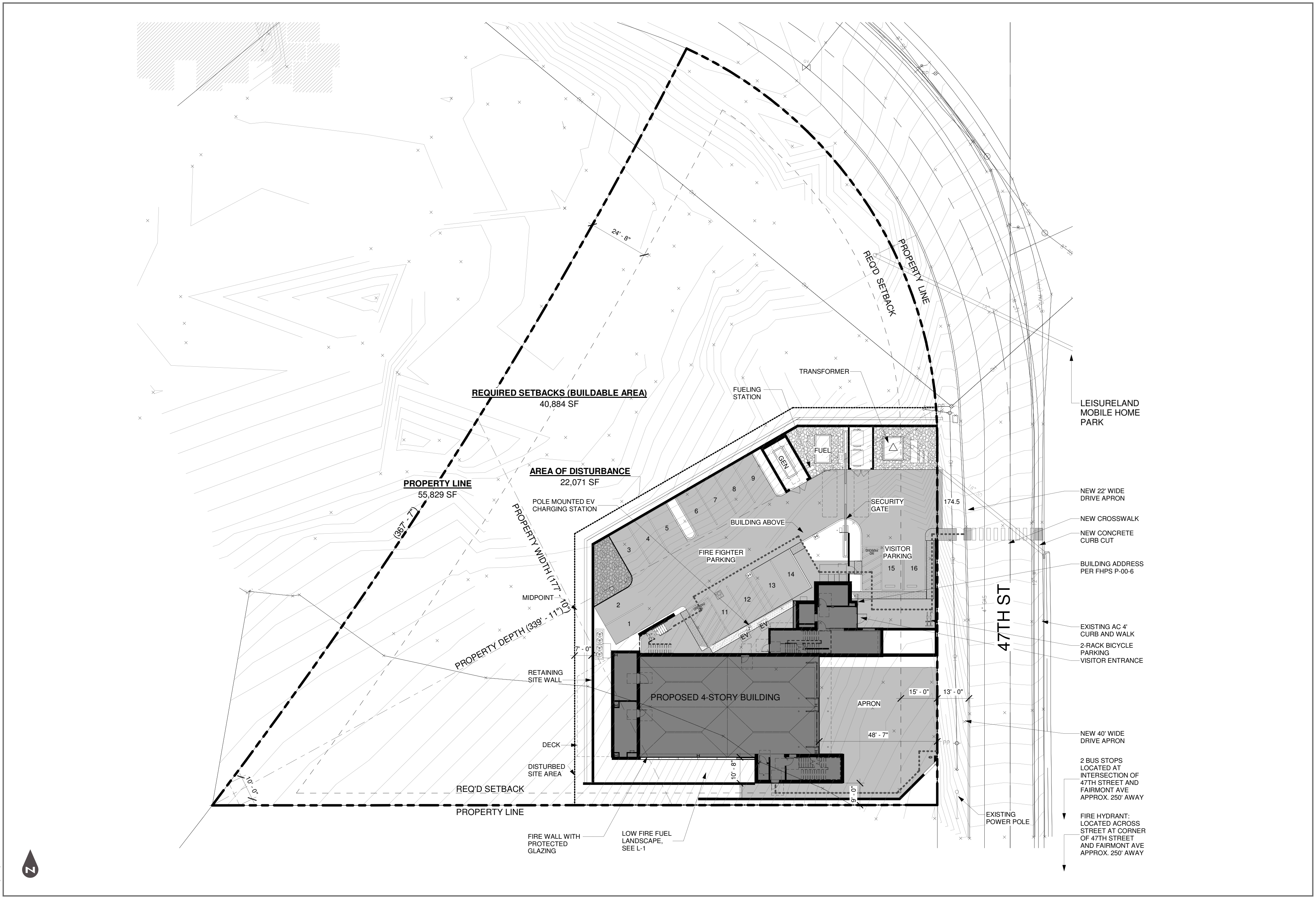

SOURCE: City of San Diego 2024; RRM Design Group, 2024

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FIGURE 3

Project Site Plan

Fairmount Avenue Fire Station

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SOURCE: RRM Design 2024; SANGIS 2023, 2024

FIGURE 4

Off-Site Construction Staging

Fairmount Avenue Fire Station

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3 Project Description

The project proposes construction of a new 22,443 square-foot four-story fire station, which features one garage and two apparatus bays, an exercise room, a kitchen, and 10 bunk rooms. The proposed project also includes a 15-stall parking lot, trash enclosure, an emergency generator, retaining walls providing between 6 and 25 feet of vertical separation, and a 1,000-gallon diesel fuel tank, along with associated BMZs. The new fire station would add additional emergency and medical response services to the surrounding community. Access to the project site would be from 47th Street via two entrances, one standard driveway off 47th Street to accommodate passenger vehicles, and one larger driveway connected to the apparatus bay, also off 47th Street, to accommodate fire vehicles and equipment. Vegetation removal, artificial slope creation and grading would be required to create a pad level with 47th Street for project access and construction. Construction activities would include ground clearing, grading, and foundation preparation, utility installation/trenching, framing and assembly of the building and associated apparatus bay, paving of parking and driveway areas, and landscaping. The fire station would be located in the southeast corner of the site and would occupy a 0.59-acre footprint (see Figure 3). Relevant project information is provided below.

Building and Site Design

The proposed building includes a concrete and steel structural design with a series of free standing and building integrated retaining walls with several terraces. The building architectural style would be modern, with concrete, metal panels, composite panels, and curtain wall glass. The primary terrace would overhang the two proposed apparatus bays.

To minimize site grading and to incorporate the existing site topography, a portion of the building would be constructed using the existing hillside. This would be the basement level that would include the main lobby and office space. The second through fourth floors would the garage for fire apparatus parking, an operational support shop, and storage and cleaning facilities, fitness and support rooms and firefighter bunk rooms, living area, kitchen, and restrooms. This station would house an engine, a truck, and an ambulance (or two engines and an ambulance).

Parking and Access Improvements

Access to the project site would be provided via one standard driveway off 47th Street to accommodate passenger vehicles, and one larger driveway connected to the apparatus bay, also off 47th Street, to accommodate fire vehicles and equipment. Both vehicle access points are located on the east side of the project site.

Landscaping, Brush Management, and Revegetation

Landscaping

The proposed landscape plan would include drought-tolerant native vegetation and low water use plants. The landscape scheme would include shrubs of varying heights, a wide selection of cactus and succulents, as well as three (3) shade trees. Native vegetation including California Sagebrush and California Encelia would be used to revegetate graded areas. The proposed landscaping plan has been designed in accordance with the City's Municipal Code Section 142.0402, Land Development Manual, Landscape Standards, and other applicable city and regional standards for landscape installation and maintenance as identified in the Design Guidelines. A detailed landscape plan and plant palette would be submitted to the San Diego Fire Department for review and approval prior to the issuance of building permits. As required through conditions of approval, no highly flammable plant species shall be allowed within the project's landscaping plan.

Brush Management

The City's Land Development Manual and Municipal Code includes requirements for brush management for fire safety in areas with structures that are within 100 feet of any highly flammable area of native or naturalized vegetation. The project site is located adjacent to undeveloped land to the north, south and west that contains native and non-native vegetation. Fire hazard conditions currently exist in the areas to the north, west, and east of the project site. The project would implement the City's Brush Management Regulations found in Section 142.0412 of the Land Development Code, which establishes a means of providing fire safety in the landscape.

Two distinct brush management areas referred to as "Zone One" and "Zone Two" are included to reduce fire hazards around structures by providing an effective fire break and contiguous areas of native or naturalized vegetation. Brush management Zone One is the area adjacent to the proposed fire station and shall be the least flammable. It shall consist of pavement and permanently irrigated ornamental planting and tree canopies no closer than 10 feet from the fire station. Brush management Zone One shall not be allowed on slopes with a gradient greater than 4:1. Brush management Zone Two is the area between Zone One and any area of native or naturalized vegetation and would consist of thinned, native, or naturalized non-irrigated vegetation. Zone One is 10 feet in width and contains an added 6-foot-tall fire wall constructed of masonry block. Zone Two currently consists of coastal sage scrub/mixed chapparal, and riparian forest. Brush management activities are prohibited within coastal sage scrub, maritime succulent scrub, and coastal sage-chaparral habitats from March 1 through August 15, except when documented to the satisfaction of the City manager that the thinning would be consistent with conditions of species coverage described in the city of San Diego's Multiple Species Conservation Program (MSCP) subarea plan. Management and maintenance of brush management zones in areas adjacent to the project site would be the responsibility of the City and shall be completed in accordance with the City's Land Development Manual and Municipal Code.

Revegetation

The City's Land Development Manual includes landscape standards, guidelines, and criteria for both public and private projects including requirements for revegetating disturbed areas adjacent to native vegetation to restore native and naturalized vegetation types into the surrounding existing landscape to establish and maintain open space. Revegetation areas consist of the areas disturbed by the proposed project. The proposed revegetation plants primarily consist of coastal sage scrub, included in an ornamental native and erosion control hydroseed mix. Hydroseeding of disturbed areas with a mixture of native shrubs would provide surface cover and erosion control. No brush management would occur within the City's Multi-Habitat Planning Area. Graded slopes would be revegetated in compliance with the project's Landscape Development Plan, in compliance with Section 142.0411 of the City's Municipal Code, Section III of the Steep Hillside Guidelines in the Land Development Manual, and other applicable City requirements.

Utilities

The project would tie into the City's existing 8-inch water main located in 47th Street with a measured pressure of 104 pounds per second (psi), as required by the City's Public Utilities Department. On-site domestic and irrigation water would be provided by a 2-inch water service line and meter, along with a 2.5-inch Reduced Pressure Backflow Device. Fire service would be equipped with a 6-inch water service line and a 6-inch Reduced Pressure Backflow Device and Lateral.

An emergency generator would be provided. The emergency generator would be located just northeast of the fire station along with a 1,000-gallon diesel fuel tank.

Study Area Conditions

The approximately 25.51-acre study area is comprised of the 1.28-acre project site, which includes a 0.59-acre project impact footprint, an approximately 0.52-acre City-owned off-site staging area located adjacent to Sunshine Berardini Park and Federal Boulevard, and a 500-foot buffer zone surrounding that impact footprint. As part of this project, the City is a participant in the San Diego Multiple Species Conservation Program (MSCP), a comprehensive, regional long-term habitat conservation program designed to provide permit issuance authority for take of covered species to the local regulatory agencies. The MSCP addresses habitat and species conservation within approximately 900 square miles in the southwestern portion of San Diego County (County of San Diego 1998). It serves as an approved habitat conservation plan pursuant to an approved Natural Communities Conservation Plan in accordance with the state Natural Communities Conservation Planning Act (County of San Diego 1998). The MSCP identifies 85 plants and animals to be “covered” under the plan (“Covered Species”). Within the City of San Diego, the MSCP is implemented through the City of San Diego MSCP Subarea Plan (Subarea Plan) (City of San Diego 1997), which applies within 6,501 acres. Portions of the North City Project are located within and adjacent to Multiple Habitat Preservation Areas (MHPAs) (City of San Diego 1997).

The project study area is located within the eastern area of the Subarea Plan. The Subarea Plan is characterized by urban land uses with approximately three-quarters either built out or retained as open space/park system. As mentioned previously, the project site is directly adjacent to the City’s MHPA and the project study area overlaps with the MHPA. The City’s MHPA is a “hard line” preserve developed by the City in cooperation with the wildlife agencies, property owners, developers, and environmental groups. The MHPA identifies biological core resource areas and corridors targeted for conservation, in which only limited development may occur (City of San Diego 1997). The MHPA is considered an urban preserve that is constrained by existing or approved development and is comprised of habitat linkages connecting several large core areas of habitat.

The MHPA occurs within the undeveloped canyon to the west of the project (Chollas Parkway Open Space) that extends north from Sunshine Berardini Field at Federal Boulevard on the southwest end of the canyon to just northeast of 54th Street. The project impact area and boundary include the 0.59-acre impact footprint of the fire station and an associated Zone 1 Defensible Space area and would be situated outside of the MHPA boundary. A 0.52-acre Zone 2 Brush Management area extends beyond the project impact footprint and has a small overlap with the MHPA boundary; however, Zone 2 Brush Management is considered “impact neutral” and not part of the development area by the San Diego Land Development Manual - Biology Guidelines (Biology Guidelines; City of San Diego 2018a). In addition, no non-covered species would have the potential to be impacted by the Zone 2 brush management activities, therefore no impacts would occur within the MHPA. Zone 1 extends up to 43 feet beyond the northern side of the fire station and between 10 and 15 feet beyond the western and southern sides of the fire station where a 6- to 25-foot-tall retaining wall would function as an alternative construction measure to compensate for the reduced Zone 1 Defensible Space. A Zone 2 Brush Management area, varying from approximately 53 feet in the northwest portion of the project area up to approximately 90 feet in the western portion of the project area, would extend beyond Zone 1 (see Appendix E, *Brush Management Zone Plan Maps in this FFLMR*). The extended Zone 2 BMZ along the western portion of the project boundary would create additional defensible space to the fire station where a full 35-foot Zone 1 cannot be achieved.

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4 Fire Risk Analysis

4.1 Field Assessment

A fire field assessment of the project area, including on-site and off-site adjacent areas, was conducted by Dudek on April 1, 2020,[2] in order to document existing site conditions and determine potential actions for addressing the protection of the proposed fire station. Assessments of the area's topography, natural vegetation and fuel loading, proposed project impact areas, Zone 1 and Zone 2 BMZ areas, assets, fire history, and general susceptibility to wildfire formed the basis of the site risk assessment. Field tasks that were completed include the following:

- Vegetation measurements and mapping refinements.
- Fuel load analysis.
- Topographic features documentation.
- Photograph documentation.
- Confirmation/Verification of office-based hazard assumptions.

Site photographs were collected (Appendix A, *Photograph Log*) and the existing vegetation (fuel) communities and their impacts were mapped (Figure 5, *Vegetation Community Map*) using 200-scale aerial images and project vegetation maps. Field observations were utilized to augment existing site data in generating the fire behavior models and formulating the recommendations detailed in this report.

4.2 Fire Environment

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

2 It should be noted that biological field surveys for the project were conducted in 2018, 2019, 2023, and again in 2024 by Dudek biologists.

4.3 Vegetation (Fuels)

Based on species composition and general physiognomy, the existing vegetation communities and land covers within the study area supports a total of 12 vegetation communities, including four (4) native vegetation communities, four (4) non-native vegetation communities/land cover types, and four (4) native wetlands (including non-wetland waters). The vegetation communities and land covers were mapped according to Holland (1986) and Oberbauer et al. (2008), with a few exceptions. Some vegetation communities were given additional descriptions to identify highly dominant species within the community. These habitats were then cross walked to their corresponding community listed in the City's Biology Guidelines (City of San Diego 2018a). These vegetation communities and land cover types are described in detail in the Biological Technical Report (Dudek, 2024) prepared for the project. In summary, the vegetation communities and land cover types include coastal sage scrub (including disturbed variety), coastal sage scrub (*Baccharis*-dominated), coastal sage scrub (*Rhus*-dominated), mixed chaparral, ornamental plantings, eucalyptus woodland, disturbed land, urban/developed land, southern willow forest, riparian scrub (mulefat scrub), southern riparian forest, and natural flood channel (Refer to Table 1 and Figure 5, *Vegetation Community Map*). The site's vegetation fire risk is primarily determined by project-adjacent vegetation that would be preserved in the open space directly adjacent to the site's brush management zones. The growth of vegetation types/fuel models is influenced by aspect (orientation), soil constituents, soil depth, soil moisture, and weather. The vegetation occurring on the slopes adjacent the site represents the site's fuel load, an important component of the site's wildfire risk assessment. The photographs in Appendix A display the fuels on and adjacent the property.

Table 1 shows the acreages of the vegetation communities and land cover types recorded in the study area which make up the entire project area, encompassing 24.51 acres.

Table 1. Vegetation Communities and Land Cover Types in the Project Area

Vegetation Community/ Land Cover Type	City of San Diego Biology Guidelines Vegetation Community	City Right-of-Way Acreage	Project Parcel Acreage	Study Area Acreage
Uplands				
Coastal Sage Scrub	Coastal Sage Scrub	-	0.66	3.97
Coastal Sage Scrub (disturbed)	Coastal Sage Scrub	0.04	0.1	0.1
Coastal Sage Scrub (*Baccharis*-dominated)	Coastal Sage Scrub	-	-	2.18
Coastal Sage Scrub (*Rhus*-dominated)	Coastal Sage Scrub	-	-	1.02
Mixed Chaparral	Mixed Chaparral	-	0.23	0.37
Disturbed Land	Disturbed Land	0.01	0.16	1
Ornamental Plantings	Ornamental Plantings	0.01	0.03	0.64
Eucalyptus Woodland	Eucalyptus Woodland	-	-	0.10
Urban/Developed Land	Disturbed Land	0.02	-	14
Wetlands				
Riparian Forest (Southern Willow Forest)	Riparian Forest	-	0.04	0.42
Riparian Forest (Southern Riparian Forest	Riparian Forest	-	0.06	0.04
Riparian Scrub (Mulefat Scrub)	Riparian Scrub	-	-	0.05
Natural Flood Channel	Natural Flood Channel	-	-	0.26
	Grand Total[1]	**0.08**	**1.28**	**24.15**

Note:
1 Totals may not sum due to rounding.
Source: Dudek 2024.

4.3.1 Coastal Sage Scrub (including disturbed)

Coastal sage scrub is a native vegetation community that, according to Oberbauer et al. (2008), is composed of a variety of soft, low, aromatic shrubs, characteristically dominated by drought-deciduous species—such as California sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), and sages (*Salvia* spp.)—with scattered evergreen shrubs, including lemonade sumac (*Rhus integrifolia*) and laurel sumac (*Malosma laurina*).

Coastal sage scrub is the dominant vegetation community and makes up a large portion of the habitat on the northern facing slope of the canyon within and adjacent to the proposed project impact footprint. The disturbed variety is found along the edges of residential development at the bottom of the canyon.

4.3.2 Coastal Sage Scrub (Baccharis-dominated)

Coastal sage scrub (*Baccharis*-dominated) is a native vegetation community that, according to Oberbauer et al. (2008), typically occurs in nutrient-poor soils and is composed primarily of broom 20 baccharis (*Baccharis sarothroides*) or coyote bush (*Baccharis pilularis*). Other drought-deciduous species may also be sparsely intermixed—such as California sagebrush, California buckwheat, and saw toothed goldenbush (*Hazardia squarrosa*).

Coastal sage scrub (*Baccharis*-dominated) is primarily situated along the flat bottom of the site in the northwestern section of the study area.

4.3.3 Coastal Sage Scrub (Rhus-dominated)

Coastal sage scrub (*Rhus*-dominated) is a native vegetation community that is a variety of general coastal sage scrub previously described in Section 4.2.1.1. This variety typically occurs in nutrient-poor soils and is composed primarily of lemonadeberry. Other drought-deciduous species may also be sparsely intermixed—such as California sagebrush, California buckwheat, broom baccharis, and laurel sumac.

Coastal sage scrub (*Rhus*-dominated) is primarily situated on slopes in the northeast portion of the study area.

4.3.4 Mixed chaparral

Mixed chaparral is a native vegetation community supporting dense stands of broad-leaved sclerophyll shrubs, typically deep-rooted and about 1.5-3 meters tall. There is typically little to no understory vegetation, but often substantial leaf litter. This community is commonly dominated by chamise (*Adenostoma fasciculatum*), manzanitas (*Arctostaphylos* spp.), and blue-colored lilacs (*Ceanothus* spp.) (Holland 1986).

Mixed chaparral is located in the central section of the study area and slightly overlaps with the northwest boundary of the project impact footprint. This habitat is dominated primarily by felt leaved yerba santa (*Eriodictyon crassifolium*).

4.3.5 Disturbed Land

Disturbed Land includes areas which have experienced physical anthropogenic disturbance and as a result cannot be identified as a native or naturalized vegetation association. However, these areas do have a recognizable soil substrate. The existing vegetation is typically composed of non-native ornamental or exotic species (Oberbauer et al. 2008).

This land cover consists of dirt access paths and areas of non-native annual species. Where present, vegetation in this community consists primarily of wild mustard (*Hirshfeldia incana*) and crown daisy (*Glebionis coronaria*).

4.3.6 Ornamental Planting

Ornamental plantings refers to areas where non-native ornamental species and landscaping schemes have been installed and maintained, usually as part of commercial or residential property. This habitat type supports myriad ornamental species, including, not limited to, hottentot fig (*Carpobrotus edulis*), Peruvian pepper tree (*Schinus molle*), Brazilian pepper tree (*Schinus terebinthifolius*), and red apple iceplant (*Aptenia cordifolia*) (Holland 1986).

This vegetation community occurs within the study area, primarily along the edges of the 47th Street and residential development to the northeast and east. The dominant species in this vegetation community is Brazilian peppertree (*Schinus terebinthifolius*).

4.3.7 Eucalyptus Woodland

Eucalyptus Woodland, according to Oberbauer et al. (2008), includes eucalyptus species (*Eucalyptus globulus*, *E. camaldulensis*, or *E. spp.*) planted as trees, groves, and windbreaks that form thickets with minimal shrubby understory to scattered trees with a well-developed understory. In most cases however, eucalyptus trees form dense stands with closed canopies where the understory is either depauperate or absent owing to shade and the possible allelopathic (toxic) properties of the eucalyptus leaf litter. Although eucalyptus woodlands are of limited value to most native plants and animals, they frequently provide nesting and perching sites for several raptor species.

Eucalyptus woodland occurs within the study area in limited patches along the east edge of 47th Street.

4.3.8 Urban/Developed Land

According to Oberbauer et al. 2008, urban/developed land represents areas that have been constructed upon or otherwise physically altered to an extent that native vegetation communities are not supported. This land cover type generally consists of semi-permanent structures, homes, parking lots, pavement or hardscape, and landscaped areas that require maintenance and irrigation (e.g., ornamental greenbelts). Typically, this land cover type is unvegetated or supports a variety of ornamental plants and landscaping.

Within the study area, this land cover type predominantly consists of residential development and paved streets to the south, east, and north.

4.3.9 Riparian Forest (Southern Willow Forest)

Riparian forest (southern willow forest) is a vegetation community dominated by broad-leafed willow trees, often tall, with a closed, or nearly closed canopy, and may have an understory of shrubby willows (Oberbauer et al. 2008). Dominant species are often arroyo willow (*Salix lasiolepis*) and Gooding's willow (*Salix goodingii*). Other species besides willows that might also found in riparian forest (southern willow forest) communities include Douglas' sagewort (*Artemisia douglasiana*), mulefat (*Baccharis salicifolia*), manroot (*Marah macrocarpus*), California sycamore, Fremont cottonwood, black cottonwood (*Populus trichocarpa*), Goodding's willow (*Salix gooddingii*), and narrowleaf willow (*Salix exigua*), (Oberbauer et al. 2008).

The area mapped as southern willow forest occurs northwest of the project impact area. Within the study area, this vegetation community is dominated by Goodding's willow (*Salix gooddingii*) and arroyo willow (*Salix lasiolepis*).

4.3.10 Riparian Forest (Southern Riparian Forest)

Riparian forest (southern riparian forest) is a vegetation community that, according to Oberbauer et al. (2008), is comprised of dense stands of riparian vegetation with a closed or nearly closed canopy, found in areas along rivers, streams, bottomlands, and sub-irrigated or frequently overflowed lands. California sycamore, Fremont cottonwood, and various willows (*Salix* spp.) constitute the dominant species, often in proportional densities. Other species that might also found in southern riparian forest communities include Douglas' sagewort (*Artemisia douglasiana*), mulefat, manroot, and black cottonwood (Oberbauer et al. 2008).

The area mapped as southern riparian forest occurs northwest of the project impact area. Within the study area, this vegetation community is dominated by Fremont cottonwood.

4.3.11 Riparian Scrub (Mulefat Scrub)

According to Oberbauer et al. (2008), riparian scrub (mulefat scrub) is a vegetation community reliant on frequent flooding, dominated by mulefat, with other characteristic species being primarily willows, which may occur sparsely intermixed.

The area mapped as mulefat scrub occurs in the northwestern section of the study area. This vegetation community is dominated by mulefat with some broom baccharis sparsely intermixed.

4.3.12 Natural Flood Channel

Natural flood channel is a wetland habitat type which Oberbauer et al. (2008) describes as “Non-Vegetated Floodplain or Channel.” Sandy, gravelly, or rocky bottoms and fringes of waterways/flood channels dominate this habitat. Total vegetation cover is usually less than 10%, since variable water lines inhibit growth and only allow the presence of weedy species and grasses along the outer edges of the wash.

The natural flood channel mapped on-site occurs in the far northwest section of the study area. It is a wash-like habitat dominated by sandy substrate. The City’s Biology Guidelines (City of San Diego 2018a) classify natural flood channel as a wetland habitat; therefore, impacts to this community would be considered significant.

It should be noted, each vegetation community corresponds to a designated fuel model (pre-determined vegetation type, densities, and structural characteristics) for fire behavior modeling purposes. Dudek has classified each of the cover types that would remain off-site and/or adjacent to the building footprints into fuel models, as discussed below. Site-adjacent vegetation is important relative to wildfire as some vegetation, such as brush and grassland habitats are highly flammable while other vegetation, such as wetland communities or forest understory, are less flammable due to their higher plant moisture content, compact structure, and available shading from overstory tree canopies. The off-site, adjacent areas that would not be converted would represent a potential fire threat and were modeled (see section 5.7: Fire Behavior Modeling) to aid in fire protection planning for this site.

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SOURCE: RRM Design Group 2024; USFWS 2020; SANGIS 2023, 2024

DUDEK

FIGURE 5

Vegetation Community Map

Fairmount Avenue Fire Station

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4.4 Climate

Southern San Diego and the study 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 San Diego area is approximately 70°F, with average highs in the summer and early fall months (July–October) reaching 76°F. The average precipitation for the area is approximately 10.4 inches per year, with the majority of rainfall concentrated in the months of December (1.5 inches), January (2.1 inches), February (1.7 inches), and March (2.0 inches), while smaller amounts of rain are experienced during the other months of the year (Weather Atlas, 2020).

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 2 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. Sustained wind speeds recorded during recent major fires in San Diego County exceeded 30 miles per hour (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 or mesas. Santa Ana winds generally coincide with the regional drought period and the period of highest fire danger. The project site is affected by Santa Ana winds. Winds funneled through mountains and onto the flat mesas dissipate and produce lower average wind conditions. The wind information used for fire behavior modeling for this site includes actual data from a Remote Automated Weather Station (RAWS) located in a similar inland location (latitude: 32.793086, longitude: -117.137327, elevation: 425 ft.) in San Diego County (San Miguel RAWS Station).

4.5 Topography

Within the study area, the topography in and near the project footprint slopes down to a flat basin bottom from the north, east and south with steeper hillsides identified on the east side of the study area that intersect the project footprint. The elevation in the study area ranges from approximately 135 feet to 200 feet above mean sea level (AMSL). Portions of the project site is located within and adjacent to the MHPA. The project is not within the City's Coastal Zone (City of San Diego 2008).

Topography affects wildfire movement and spread. Steep terrain typically results in faster fire spread due to pre-heating (and drying) of uphill vegetation. Flat areas typically result in slower fire spread, absent of windy conditions. Topography may form unique conditions which result in concentrated winds or localized fire funneling, such as saddles, canyons, and chimneys (land formations that collect and funnel heated air upward along a slope). Similarly, terrain may slow the spread of fire. For example, fire generally moves slower downslope than upslope. Terrain may buffer or redirect winds away from some areas based on canyons or formations on the landscape. The occurrences of terrain features that may affect fire behavior on the project site were analyzed and incorporated into the risk assessment and in development of fire protection features.

4.6 Fire History

Fire history data provides valuable information regarding fire spread, fire frequency, ignition sources, and vegetation/fuel mosaics across a given landscape. 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 pre-planning. It is advantageous to know which areas may have burned recently and, therefore, may provide a tactical defense position, or, what type of fire burned on the site, and how a fire may spread. According to available data from the California Department of Forestry and Fire Protection's (CAL FIRE) Fire and Resource Assessment Program (FRAP 2018), approximately three (3) fires have burned within 5 miles of the study area since the beginning of the historical fire data record (Refer to Appendix B, *Fire History Map*). These fires occurred between 1944 and 1985. There have been no fires in the historical record that burned the project site. The San Diego Fire and Rescue Department (SDFRD) may have data regarding smaller fires (less than 10 acres) that have occurred near the project site that are not included in CAL FIRE's dataset.

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 5-mile radius of the study area was calculated to be approximately 25 years with intervals ranging between 4 and 37 years. Based on this analysis, along with changes in the watershed over the last few decades that resulted in conversion of fuels to lower flammability urbanization, the project site is expected to be subject to wildfire that may include smaller fires during typical weather conditions and has the potential to be impacted by larger wildfires during extreme weather conditions, but lacks consistent fuel beds to result in a large flaming front on the project site.

4.7 Fire Behavior Modeling

4.7.1 Fire Behavior Modeling Background

Fire behavior modeling has been used by researchers for approximately 50+ years to predict how a fire will move through a landscape given specified fuels, terrain, and weather (Linn 2003). The models have had varied complexities and applications throughout the years. One model has become the most widely used for predicting fire behavior on a given landscape. That model, known as "Behave," (model) was developed by the U.S. Government (USDA Forest Service, Rocky Mountain Research Station) and has been in use since 1984. Since that time, it has undergone continued research, improvements, and refinement. The current version, BehavePlus 6.0, includes the latest updates incorporating years of research and testing. Numerous studies have been completed testing the validity of the fire behavior models' ability to predict fire behavior given site-specific inputs. One of the most successful ways the model has been improved has been through post-wildfire modeling (Brown 1972; Lawson 1972; Sneeuwjagt and Frandsen 1977; Andrews 2005; Brown 1982; Rothermel and Rinehart 1983; Bushey 1985; McAlpine and Xanthopoulos 1989; Grabner et al. 1994; Marsden-Smedley and Catchpole 1995; Grabner 1996; Alexander 1998; Granber et al. 2001; Arca et al. 2005). In this type of study, the BehavePlus modeling software is used to model fire behavior based on pre-fire conditions in an area that has recently burned. Real-world fire behavior, documented during the wildfire, can then be compared to the prediction results of the model and refinements to the fuel models incorporated, retested, and so on.

Fire behavior modeling conducted on this site includes a relatively high-level of detail and analysis which results in reasonably accurate representations of how wildfire may move through available fuels on and adjacent the property. Fire behavior calculations are based on site-specific fuel characteristics supported by fire science research that analyzes heat transfer related to specific fire behavior. To objectively predict flame lengths, spread rates, and fireline intensities, this analysis incorporated predominant fuel characteristics, slope percentages, and representative fuel models observed on site. The BehavePlus fire behavior fuel modeling system was used to analyze anticipated fire behavior within and adjacent to key areas just outside of the proposed BMZs.

As Rothermel summarized, 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 fire prevention and protection planning information. To be used effectively, the basic assumptions and limitations of the BehavePlus model must be understood.

- First, it must be realized that the fire model describes fire behavior only in the flaming front. The primary driving force in the predictive calculations is dead fuels less than one-quarter inch in diameter. These are the fine fuels that carry fire. Fuels greater than one inch have little effect while fuels greater than three inches have no effect on fire behavior.
- Second, the model bases calculations and descriptions on a wildfire spreading through surface fuels that are within six feet of the ground and contiguous to the ground. Surface fuels are often classified as grass, brush, litter, or slash.
- Third, the software assumes that weather and topography are uniform. However, because wildfires almost always burn under non-uniform conditions, length of projection period and choice of fuel model must be carefully considered to obtain useful predictions.
- Fourth, the BehavePlus fire behavior computer modeling system was not intended for determining sufficient fuel modification zone/defensible space widths. However, it does provide the average length of the flames, which is a key element for determining “defensible space” distances for minimizing structure ignition.

Although the model 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[3] and the five more recent custom fuel models developed for Southern California[4]. 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 modeling efforts. 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 (SCAL):

- 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 development of 40 new fire behavior fuel models[5] developed for use in BehavePlus modeling efforts. These new models attempt to improve the accuracy of the standard 13 fuel models outside of severe fire season conditions, and to allow for the simulation of fuel treatment prescriptions. The following describes the distribution of fuel models among general vegetation types for the new 40 fuel models:

- Grass — Models GR1 through GR9
- Grass Shrub — Models GS1 through GS4
- 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 report 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.

4.7.2 Fire Behavior Modeling Approach

Dudek utilized the BehavePlus software package to analyze fire behavior potential in the vicinity of the project site. Refer to Figure 6, *Fire Behavior Modeling Map* for fire modeling scenario locations and Appendices D and E for pre and post BMZ modeling results. As is customary for this type of analysis, three fire scenarios were evaluated, including one summer, onshore weather condition (southwest of project site) and two extreme fall, offshore weather condition (west and north of the project site). Fuels and terrain beyond that distance can produce flying embers

3 Anderson, Hal E. 1982. Aids to Determining Fuel Models for Estimating Fire Behavior. USDA Forest Service Gen. Tech. Report INT-122. Intermountain Forest and Range Experiment Station, Ogden, UT.
4 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.
5 Scott, Joe H. and Robert E. Burgan. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. Gen. Tech. Rep. RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

that may affect the project, but the fire station and surrounding on-site landscape would be designed and built to meet extreme ignition and ember resistant standards which would minimize the possibility of ignition. It is the fuels next to the BMZs and within the BMZs that would have the potential to affect the proposed fire station from a radiant and convective heat perspective as well as from direct flame impingement but based on the site's terrain and the planned retaining walls, the vertical separation between vegetative fuels and the site's fire station is significant.

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), fireline intensity (BTU/feet/second), and spotting distance (miles). 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.

4.7.2.1 Vegetation (Fuels)

To support the fire behavior modeling efforts conducted for this report, the different vegetation types observed adjacent to the site were classified into the aforementioned numeric fuel models. As is customary for this type of analysis, the terrain and fuels directly adjacent to the property are used for determining flame lengths and fire spread. It is these fuels that would have the potential to affect the proposed fire station from a radiant and convective heat perspective as well as from direct flame impingement.

Vegetation types were derived from The Biological Technical Report (Dudek, 2024) and a site visit that was conducted on April 1, 2020, by a Dudek Fire Protection Planner. Based on the site visit, six different fuel models were used in the fire behavior modeling effort to model pre- and-post BMZ fuels presented herein. Fuel model attributes are summarized in Table 2. Modeled areas include Coast live oak, Southern Willow Scrub, and western sycamore Riparian with non-native chaparral and shrub understory (Fuel Model 9 and SH4 = Riparian Habitat [Timber-Shrub]) occur in the riparian forest located approximately 160 feet north/northwest of the study area. Mature tree canopies for of the Southern Willow and Eucalyptus riparian trees are assumed to have a canopy base height of approximately 25 feet off the ground. Canopy bulk density, the weight of canopy fuels per cubic foot of volume, is assumed to be the maximum allowable value in the model to represent broadleaf trees which, given canopy density and leaf size, have more weight per area than conifer trees (the standard for this value in the model (Heinsch and Andrews 2010). Foliar moisture, the moisture content of canopy foliage, is assumed to be 100%, a reasonable estimate in lieu of site-specific data (Scott and Reinhardt 2001).

Table 2. Existing Fuel Model Characteristics

Fuel Model Assignment	Vegetation Description	Location	Fuel Bed Depth (Feet)
SH1	Low Load, Dry Climate Shrub	Fuel type post development within Zone 1 BMZ thinning zone	<1.0 ft.
SH2	Moderate Load, Dry Climate Shrub	Vegetation communities located throughout the adjacent open space without maintenance.	<2.0 ft.
SH4	Southern Willow Scrub (Riparian Habitat)	Riparian forest that exists approximately 160 feet north/northwest of the study area.	>8.0 ft.
SH5	High Load Dry Climate Shrub	Vegetation communities located throughout the adjacent open space without maintenance	>4.0 ft.
8	Irrigated Landscape	Fuel type post development within Zone 1 BMZ.	<1.0 ft.
9	Southern Willow Scrub (Riparian Habitat)	Riparian forest that exists approximately 160 feet north/northwest of the study area.	>8.0 ft.

Source: Dudek 2024.

The results of this analysis were utilized in generating the Brush Management Zone map presented in Appendices C and D. This analysis models fire behavior outside of proposed BMZs (off-site) as these areas would be the influencing wildfire areas post-development of the site. The following section presents the fire weather and fuel moisture inputs utilized for the fire behavior modeling conducted for this project.

4.7.2.2 Topography

Slope is a measure of angle in degrees from horizontal and can be presented in units of degrees or percent. Slope is important in fire behavior analysis as it affects the exposure of fuel beds. Additionally, fire burning uphill spreads faster than those burning on flat terrain or downhill as uphill vegetation is pre-heated and dried in advance of the flaming front, resulting in faster ignition rates. Slope values ranging from 7 to 12% were measured around the perimeter of the project site from U.S. Geological Survey (USGS) topographic maps. The slope on the west side of the project site would influence fire behavior, but would not be considered the primary wildfire factor; the adjacent fuels and current weather conditions would have a bigger influence on fire spread and flame lengths.

4.7.2.3 Weather Analysis

Historical weather data for the southern San Diego area was utilized in determining appropriate fire behavior modeling inputs for the study area fire behavior evaluations. To evaluate different scenarios, data from both the 50th and 97th percentile moisture values were derived from Remote Automated Weather Station (RAWS) and utilized in the fire behavior modeling efforts conducted in support of this report. Weather data sets from the San Miguel RAWS[6] Station were used in the fire modeling runs.

RAWS fuel moisture and wind speed data were processed using the Fire Family Plus software package to determine atypical (97th percentile) and typical (50th percentile) weather conditions. Data from the RAWS was

6 https://raws.dri.edu/cgi-bin/rawMAIN.pl?caCSMI

evaluated from August 1 through November 30 for each year between 1994 and 2018 (extent of available data record) for 97th percentile weather conditions and from June 1 through September 30 for each year between 2015 and 2019 for 50th percentile weather conditions.

Following the analysis in Fire Family Plus, fuel moisture information was incorporated into the Initial Fuel Moisture file used as an input in BehavePlus. Wind speed data resulting from the Fire Family Plus analysis was also determined. Initial wind direction and wind speed values for the three BehavePlus runs were manually entered during the data input phase. The input wind speed and direction is roughly an average surface wind at 20 feet above the vegetation over the analysis area. Table 3 summarizes the wind and weather input variables used in the Fire BehavePlus modeling efforts.

Table 3. BehavePlus Fire Behavior Inputs

Input Name	50th Percentile	97th Percentile
1 h fuel moisture	8%	2%
10 h fuel moisture	9%	3%
100 h fuel moisture	15%	7%
Live herbaceous moisture	60%	30%
Live woody moisture	119%	60%
20 ft. wind speed (mph)	19 mph	20 mph sustained wind speed; 50 mph (expected gust speed)
Wind adjustment factor	0.4	0.4
Slope steepness	12%	7 to 9%

Source: Dudek 2024.

4.7.2.4 BehavePlus Fire Behavior Modeling Effort

As mentioned, the BehavePlus fire behavior modeling software package was used in evaluating anticipated fire behavior within the vicinity of the project site. Three focused analyses were completed, each assuming worst-case fire weather conditions for a fire approaching the project site from the north/northwest, west, and south/southwest. The results of the modeling effort included anticipated values for surface fires (flame length (feet), rate of spread (mph), and fireline intensity (Btu/ft/s), as well as crown fires (critical surface intensity (Btu/ft/s), critical surface flame length (feet), transition ratio (ratio: surface fireline intensity divided by critical surface intensity), transition to crown fire (yes or no), crown fire rate of spread (mph), critical crown rate of spread (mph), active ratio (ratio: crown fire rate of spread divided by critical crown fire rate of spread), active crown fire (yes or no), and fire type (surface, torching, conditional crown, or crowning)) for a fire going through the riparian area. The aforementioned fire behavior variables are an important component in understanding fire risk and fire agency response capabilities. Flame length, the length of the flame of a spreading surface fire within the flaming front, is measured from midway in the active flaming combustion zone to the average tip of the flames (Andrews, Bevins, and Seli 2008). Fireline intensity is a measure of heat output from the flaming front, and also affects the potential for a surface fire to transition to a crown fire. Fire spread rate represents the speed at which the fire progresses through surface fuels and is another important variable in initial attack and fire suppression efforts (Rothermel and Rinehart 1983). Spotting distance is the distance a firebrand or ember can travel down wind and ignite receptive fuel beds.

4.7.2.5 BehavePlus Fire Behavior Modeling Results

The results presented in Tables 4 and 5 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.

Based on the BehavePlus analysis, worst-case fire behavior is expected in untreated, native and non-native coastal sage scrub and chaparral fuels northwest, west, and southeast of the project site under Peak weather conditions (represented by Fall Weather, Scenario 2). The fire is anticipated to be a wind-driven fire from the west/northwest during the fall. Under such conditions, expected surface flame lengths reach 41 feet with wind speeds of 50+ mph. Under this scenario, fireline intensities reach 18,346 BTU/feet/second with fast spread rates of 6.2 mph and could have a spotting distance up to 2.3 miles away.

Based on the BehavePlus analysis, post development fire behavior expected in the irrigated and replanted with plants that are acceptable with the SDFRD (BMZ Zone 1 – FM8), as well as in an area with thinning of the existing shrubs (BMZ Zone 2 – Sh1/Sh2) under peak weather conditions (represented by Fall Weather, Scenario 2) is presented in Table 5. Under such conditions, expected surface flame length is expected to be significantly lower, with flames lengths reaching approximately 10 feet with wind speeds of 50+ mph. Under this scenario, fireline intensities reach 760 BTU/feet/second with relatively slow spread rates of 1.3 mph and could have a spotting distance up to 0.8 miles away. Therefore, the modified BMZ's proposed for the project are approximately 2.5-times the flame length of the worst-case fire scenario under peak weather conditions and would provide adequate defensible space to augment a wildfire approaching the perimeter of the project site. Further, the substantial retaining walls along the south and west edges of the developed area provide flat, vertical non-combustible surfaces that separate the thinning areas from the developed areas. This condition is a direct benefit to fire protection and is a commonly used approach within the shelter in place community of Cielo, Rancho Santa Fe, for example.

Table 4. RAWS BehavePlus Fire Behavior Model Results – Existing Conditions

Fire Scenario	Flame Length[1] (feet)	Spread Rate[1] (mph[5])	Fireline Intensity[1] (Btu/ft/s)	Spot Fire[1] (miles)	Surface Fire to Tree Crown Fire	Tree Crown Fire Rate of Spread (mph)	Crown Fire Flame Length (feet)
Scenario 1: 7% slope; Fall Off-shore Extreme Wind (97th percentile) – Pre-BMZ (Northwest of Project site)							
Moderate Load, Dry Climate Shrub (Sh2)	8.5 (15.1)[6]	0.3 (0.9)	597 (2,073)	0.4 (1.1)	N/A	N/A	N/A
Coastal Sage scrub (Sh5)	25.1 (41.1)[6]	2.1 (6.2)	6,242 (18,324)	0.9 (2.3)	N/A	N/A	N/A
Scenario 2: 9% slope; Fall Off-shore, Extreme Winds (97th percentile) – Pre-BMZ (West of Project site)							
Riparian Habitat (FM9)	5.8 (11.7')[6]	0.4 (1.7)	256 (1,193)	0.3 (1.0)	Crowning [4]	1.1 (4.1)	142.9
Moderate Load, Dry Climate Shrub (Sh2)	8.5 (15.1)[6]	0.3 (0.9)	600 (2,075)	0.4 (1.1)	Crowning [4]	1.1 (4.1)	151.4
Riparian Habitat - Timber Shrub (Sh4)	13.0 (23.2)[6]	1.2 (4.1)	1,492 (5,261)	0.6 (1.5)	Crowning [4]	1.1 (4.1)	146.1
Coast Sage Scrub (Sh5)	25.1 (41.2)[6]	2.1 (6.2)	6,265 (18,346)	0.9 (2.3)	Crowning [4]	1.1 (4.1)	155.5
Scenario 3: 12% slope; Summer, Onshore Winds (50th percentile) – Pre-BMZ (Southwest of Project site)							
Moderate Load, Dry Climate Shrub (Sh2)	1.8	0.0	20	0.1	N/A	N/A	N/A
Coastal Sage scrub (Sh5)	14.6	0.9	1,923	0.6	N/A	N/A	N/A

Notes:

1. Wind-driven surface fire.
2. Riparian overstory torching increases fire intensity. Modeling included canopy fuel over Sh4, which represents surface fuels beneath the tree canopies.
3. A surface fire in the mixed sycamore riparian forest would transition into the tree canopies generating flame lengths higher than the average tree height (25 feet). Viable airborne embers could be carried downwind for approximately 1.0 mile and ignite receptive fuels.
4. Crowning= fire is spreading through the overstory crowns.
5. MPH=miles per hour
6. Spotting distance from a wind driven surface fire; it should be noted that the wind mph in parenthesis represent peak gusts of 50 mph.

Source: Dudek 2024.

A crown fire with the modeled flame lengths listed in Table 4 would not be expected based on the BMZs being proposed, the ongoing maintenance of the BMZs, and the high moisture levels within the riparian zone areas. An active crown fire flame length modeled using the BehavePlus software is calculated based on the active crown fire intensity, which assumes that the crown fire is fully active.

Table 5. RAWS BehavePlus Fire Behavior Model Results – Post BMZ Conditions

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[7]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles)[8]
Scenario 1: 7% slope; Fall Off-shore Extreme Wind (97th percentile) – Pre-BMZ (Northwest of Project site)				
BMZ Zone 1 (FM8)	1.8	0.1 (0.1)	19	0.1
BMZ Zone 2 (SH1)	5.8	0.4 (1.3)	257	0.3
Scenario 2: 3% slope; Fall Offshore, Extreme Winds (97th percentile) – Pre-BMZ (Holes 3 and 4)				
BMZ Zone 1 (Gr1)	3.1 (3.1)	0.5 (0.5)	67 (67)	0.2 (0.4)
BMZ Zone 2 (Gr2)	9.4 (14.1)	1.7 (4.2)	736 (1,791)	0.4 (1.1)
Scenario 3: 2% slope; Fall, Offshore, Extreme Winds (97th percentile) – Pre-BMZ (Hole 12)				
BMZ Zone 1 (Gr1)	3.1 (3.1)	0.5 (0.5)	67 (67)	0.2 (0.4)
BMZ Zone 2 (Gr2)	9.4 (14.1)	1.7 (4.2)	737 (1,791)	0.4 (1.1)

Source: Dudek 2024.

The following describes the fire behavior variables (Heisch and Andrews 2010) as presented in Tables 4 and 5:

Surface Fire:

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

Crown Fire:

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

Fire Type:

Fire type is one of the following four types: surface (understory fire), torching (passive crown fire; surface fire with occasional torching trees), conditional crown (active crown fire possible if the fire transitions to the overstory), and

7 mph = miles per hour
8 Spotting distance from a wind driven surface fire; it should be noted that the wind mph in parenthesis represent peak gusts of 50 mph.

crowning (active crown fire; fire spreading through the overstory crowns). Dependent on the variables: transition to crown fire and active crown fire.

The information in Table 6 presents an interpretation of the outputs for five fire behavior variables as related to fire suppression efforts. The results of fire behavior modeling efforts are presented in Tables 4 and 5. Identification of modeling run locations is presented graphically in Figure 6.

Table 6. 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: Dudek 2024.

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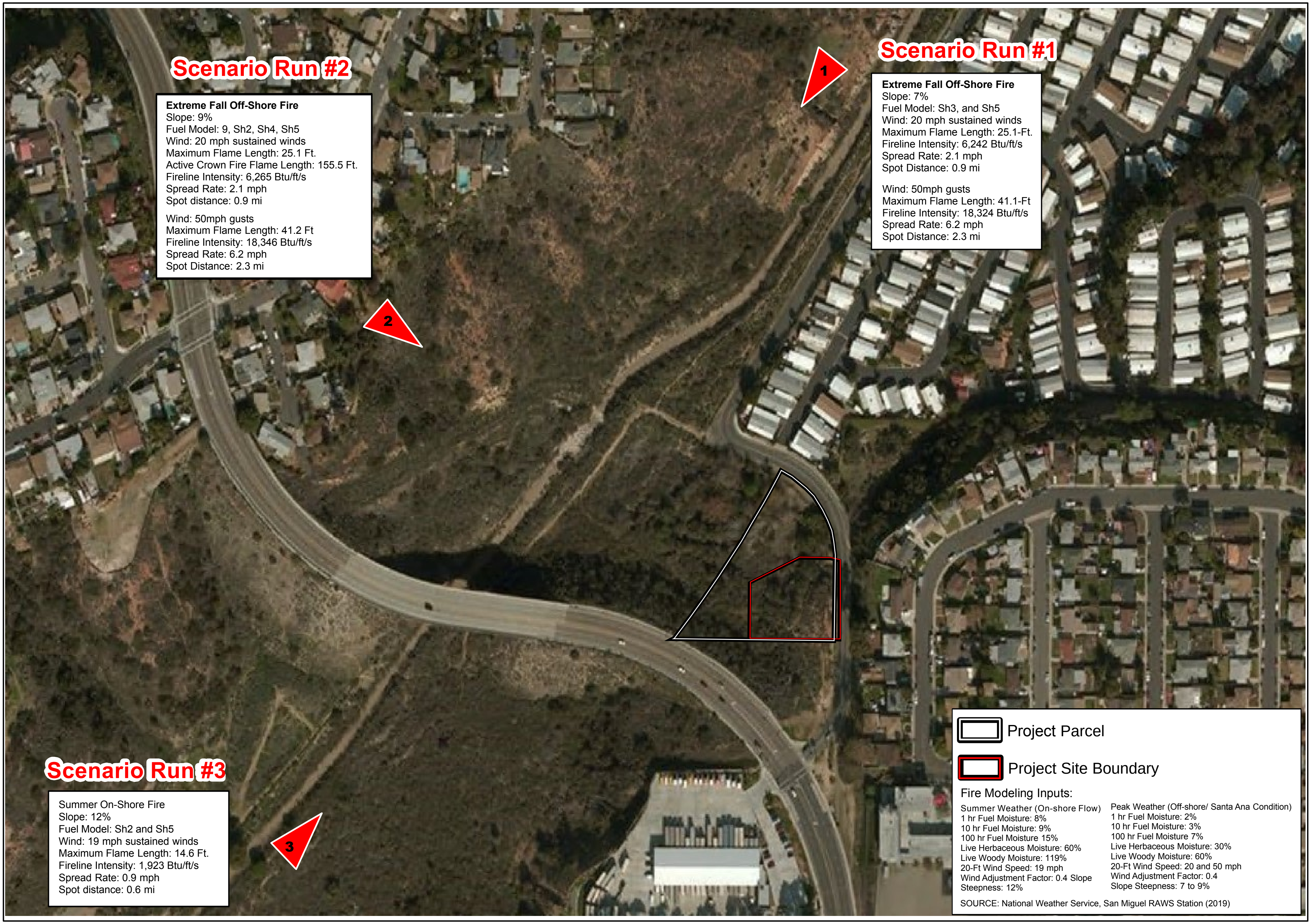

AERIAL SOURCE: BING Maps, 2020

DUDEK

0 500 1,000 Feet

FIGURE 6

Fire Behavior Modeling Runs Map

Fairmount Avenue Fire Station Project - Fire Fuel Load Modeling Report

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5 Brush Management Zones

As indicated in preceding sections of this report, an important component of a fire protection system is the Brush Management Zone (BMZ). BMZs are typically designed to gradually reduce fire intensity and flame lengths from advancing fire by strategically placing thinning zones and irrigated zones adjacent to each other on the perimeter of the WUI exposed structure(s). BMZs are arguably more important when situated adjacent to older structures that were built prior to the latest ignition resistant codes and interior sprinkler requirements.

Based on the modeled flame lengths for the project, the site's fire environment, and experienced judgement from similar projects, flame lengths under extreme fall weather conditions for sparse groupings of native shrubs on the western portion of the study area can reach approximately 41 feet or taller. Although the riparian forest fuels approximately 160 feet north/northwest of the project site resulted in modeled flame lengths of 100 feet or more, these flame lengths would not be expected to impact the project site based on location of the riparian forest, the high fuel moisture levels within the riparian forest areas, and the lack of continuous canopy toward the project site. An active crown fire flame length modeled using the BehavePlus software is calculated from based on the active crown fire intensity, which assumes that the crown fire is fully active.

As mentioned, the BMZs proposed for this project are not standard SDFRD widths as some areas include reduced Zone 1 and/or Zone 2 areas and are less than 100 feet. A typical landscape/brush management installation in the City consists of a 35-foot-wide, irrigated Zone 1 and a 65-foot-wide, non-irrigated Zone 2. The majority of the proposed, perimeter BMZs (e.g., north/northwest portion of the project site) comply with the City's standards. However, based on the project's site and grading plans, it is not feasible to achieve the City's standard BMZ widths along the project's western and southern boundaries. As such, Zone 1 would consist of a partially irrigated landscape area along with a concrete parking area and would extend 35 feet beyond the fire station building except on the west and south sides of the building, where it would extend between 10 and 15 feet beyond the building up to the proposed approximately six (6)-foot tall retaining fire wall (which would act as an alternative construction measure to compensate for the reduced Zone 1 Defensible Space). A Zone 2 Brush Management thinning area varying in width between approximately 53 feet is proposed in the northwest portion of the project site up to approximately 90 feet in the western portion of the project site, would extend beyond Zone 1 (see Appendix E, *Brush Management Zone Plan Maps*). According to Section 142.0412(f) of the San Diego Municipal Code, "the Zone 2 width may be decreased by 1 ½ feet for each 1 foot of increase in Zone 1 width," thus the reduced Zone 2 BMZ in the northwestern portion of the site. Additionally, the extended Zone 2 BMZ along the western portion of the project boundary would create additional defensible space where a full 35-foot Zone 1 cannot be achieved. According to Section 142.0412(c)(1), a brush management zone located off site will require a recorded easement granted by an adjacent property owner; however, an easement is not achievable for this site, therefore the BMZs are to be located within the property lines of the project site. A small portion of the onsite Zone 2 Brush Management area would extend beyond the project impact footprint and would have a small overlap with the MHPA boundary, however, Zone 2 Brush Management is considered "impact neutral" and not part of the development area by the San Diego Land Development Manual - Biology Guidelines (Biology Guidelines; City of San Diego 2018a).

The recommended Zone 2 thinning brush management area in addition to the proposed retaining fire walls surrounding the perimeter of the project boundary, ranging in height from approximately 6 to 25 vertical feet, along with the ignition resistance of the essential fire station facility is expected to provide a fire hardened site. The thinning zones and vertical retaining walls provide a level of fire protection that is considered at least as robust as a standard BMZ, providing the same practical effect and enabling deviation from the City's standard. The specific BMZ requirements for the project, listed below, outline the Brush Management requirements of the San Diego Municipal Code Section 142.0412, as well as the City of San Diego Brush Management Regulations of Bulletin #1 – Brush Management Guide.

Specific Brush Management Zone Requirements for the Fairmount Avenue Fire Station

1. Within the Zone 1 BMZ area, the vegetation that is not fire resistive shall be cleared and re-planted with fire-resistant plants. Zone 1 shall be permanently irrigated. In the Zone 2 area (where applicable), all dead and dying vegetation shall be removed. Native vegetation may remain in this area provided that the vegetation is modified so that combustible vegetation does not occupy more than 50% of the square footage of this area. Weeds and annual grasses shall be mowed to a height of 4–6 inches. Any chipping that is done on site shall be spread not to exceed 6 inches in depth.
2. Landscaping and BMZs shall adhere to the plant palette and brush management criteria and consist of low maintenance, fire-resistive plants, which are addressed in the Project's Conceptual Landscape Plan.
3. Zones 1 and 2 shall be maintained annually, or as required by the SDFRD, per the City's BMZ standards (San Diego Municipal Code, Section 142.0412 – Brush Management Requirements).
4. All trees shall be planted and maintained at a minimum of 10 feet from the tree's mature drip line to any combustible structure.

5.1 Fuel Modification Area Vegetation Maintenance

All fuel modification area vegetation management shall occur as-needed for fire safety, compliance with the BMZ requirements detailed in this report, and as determined by the SDFRD. The City of San Diego or similar, funded entity shall be responsible for all vegetation management throughout the project site, in compliance with the requirements detailed herein and SDFRD requirements. The City of San Diego or similar entity shall be responsible for ensuring long-term funding and ongoing compliance with all provisions of this report. The City of San Diego shall also be responsible for enforcing the landscape maintenance at least annually and prepare a report for submittal to the SDFRD.

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6 Justification for Reduced Brush Management Zones

As presented in this FFLMR, the BMZs provided for the proposed project are not standard BMZs. Rather, the BMZs provided include Zone 1 areas that vary from 10 to 43 feet in width and Zone 2 areas comprising the remaining distance to provide a 100-foot-wide BMZ for most areas. However, a small area within the northwestern portion of the project site would be just under the 100 feet required width, but is considered to meet the intent of the City's standard, since BMZs ranging between 53 and 90 feet in width are suitable for the type of fire anticipated from off-site fuel sources. Additionally, it may not be feasible to perform brush management on the southern side of the project site, as it potentially may encroach into sensitive coastal sage scrub habitat to the south or into the MHPA. This is a decision that would need to be made by the City. It is anticipated that the proposed fire station would be able to withstand a short duration, low to moderate intensity fire and ember shower that is projected from off-site, adjacent fuels based on several factors, as discussed below.

6.1 Structure Ignition

There are three primary concerns for structure ignition: (1) radiant and/or convective heat, (2) burning embers, and (3) direct flame contact (NFPA 1144 2008, IBHS 2008, and others). Burning embers have been a focus of building code updates for at least the last decade, and new structures in the Wildland Urban Interface (WUI) built to these codes have proven to be very ignition resistant. Likewise, radiant and convective heat impacts on structures have been minimized through incorporation of Chapter 7A of the California Building Code exterior fire ratings for walls, windows and doors. Additionally, provisions for modified fuel areas separating wildland fuels from structures have reduced the number of fuel-related structure losses. As such, most of the primary components of the layered fire protection system provided for the project are required by the City and state building codes but are worth listing because they have been proven effective for minimizing structural vulnerability to wildfire and, with the inclusion of required interior sprinklers (required in the 2013 Building/Fire Code update), of extinguishing interior fires, should embers succeed in entering a structure. The proposed fire station would include highly resistant building materials and construction methods that would meet the California Essential Services Buildings Standards, which are a least as ignition resistant as Chapter 7A of the San Diego Building Code. Even though these measures are now required by the latest Building and Fire Codes, at one time, they were used as mitigation measures for buildings in WUI areas, because they were known to reduce structure vulnerability to wildfire. These measures performed so well they were adopted into the code. The following project features are required for new development in WUI areas and form the basis of the system of protection necessary to minimize structural ignitions as well as providing adequate access by emergency responders:

1. Application of the CBC, Chapter 7A ignition resistant building requirements.
2. Minimum 1-hour rated exterior walls and doors.
3. Multi- pane glazing with a minimum of one tempered pane, fire-resistance rating of not less than 20 minutes when tested according to NFPA 257, or be tested to meet the performance requirements of State Fire Marshal Standard 12-7A-2.
4. Ember resistant vents (recommend BrandGuard or similar vents).

5. Automatic, interior fire sprinkler system to code for occupancy type.

6.2 Fuel Separation

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

These results support Cohen's (2000) findings that if a community's homes have a sufficiently low home ignitability, the community can survive exposure to wildfire without major fire destruction. This provides the option of mitigating the wildland fire threat to homes/structures at the residential location without extensive wildland fuel reduction. Cohen's (1995) studies suggest, as a rule-of-thumb, larger flame lengths and widths require wider fuel modification zones to reduce structure ignition. For example, valid Structure Ignition Assessment Model (SIAM) results indicate that a 20-foot-high flame has minimal radiant heat to ignite a structure (bare wood) beyond 33 feet (horizontal distance). Whereas a 70-foot-high flame requires about 130 feet of clearance to prevent structure ignitions from radiant heat (Cohen and Butler 1996). This study used bare wood, which is more combustible than the ignition resistant exterior walls for structures built today. Obstacles, including steep terrain and non-combustible walls can block or deflect all or part of the radiation and heat, thus making narrower fuel modification distances possible. Fires in ravines, chutes, coves, v-drainages, and steep-sided canyons can, under specific conditions, result in an upward draft, similar to a fireplace chimney. Chimneys on the landscape are created when air is drawn in from lower elevations, creating strong upslope drafts. The result can be acceleration of radiant and convective heat as well as actual fire spread, similar to opening the damper in a fireplace chimney. Areas where the terrain includes a restriction or narrowing can result in this type of acceleration. The terrain features adjacent the site include few mild examples of these "chimneys" that are not expected to significantly alter fire behavior.

6.3 Heat Deflecting Walls

The project's slopes require significant retaining walls at the edge of the developed area. This creates an elevated pad and vertical separation from fuels below. The retaining walls function as heat-deflecting surfaces and provide justification for the BMZ deviations.

When buildings are set back from slopes, and a wall is placed near the top of slope, flames spreading up those slopes are deflected and ground and low air-based embers are captured, reducing the effects of convective heat and ember encroachment on the structure. The duration of radiant heat impact on the downhill facing side of the building is also reduced.

Heat-deflecting retaining fire walls of masonry construction will be incorporated along the north, south, and west sides of the project's developed area. The retaining fire walls provide a vertical, non-combustible surface in the line of heat, fumes, flame and embers traveling up the slope. Once these fire byproducts intersect the wall, they are deflected or captured. In the case where lighter fuels are encountered, they are quickly consumed, heat and flame are absorbed or deflected by the wall, and the fuels burn peaks out within a short (30 second–2 minute) time frame (Quarles and Beall 2002). Walls like these have been observed to deflect heat and airborne embers on numerous wildfires in San Diego, Orange, Los Angeles, Ventura, and Santa Barbara counties. Rancho Santa Fe Fire Protection District, Laguna Beach Fire Protection District, Orange County Fire Authority, and others have used these walls as alternative methods based on observed performance during wildfires. This has led to these agencies approving use of non-combustible landscape walls as mitigation for reduced fuel modification zones and reduced setbacks at top of slope. These walls are consistent with the National Fire Protection Association (NFPA) 1144 Standard for Reducing Structure Ignition Hazards from Wildland Fire – 2008 Edition, Section 5.1.3.3 and A.5.1.3.3 and the International Urban Wildland Interface Code (ICC 2012). The NFPA 1144, A.5.1.3.3 states: "Noncombustible walls and barriers are effective for deflecting radiant heat and windblown embers from structures." These walls and barriers are usually constructed of noncombustible materials (concrete block, bricks, stone, stucco) or earth with emergency access openings built around a development where 30 feet (9 meters) of defensible space is not available.

As indicated in this report, the BMZs and additional fire protection measures proposed for this project provide equivalent wildfire buffers but are not standard SDFRD zones (see Appendix E, *BMZ Plan Maps,* Appendix E1, *Fairmount Avenue Fire Station Cross Section Exhibit, and Appendix E2, East-West Cross Section*). 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, fuels, neighboring communities relative to the proposed project area, 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.

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7 Conclusion

The goal of the BMZs along with the fire protection features provided for the Fairmount Avenue Fire Station Project is to provide the structure with the ability to survive a wildland fire with little intervention of firefighting forces. Preventing ignition to the proposed fire station would result in reduction of the exposure of firefighters/visitors to hazards that threaten personal safety and would reduce property damage and losses. Mitigating ignition hazards and fire spread potential reduce the threat to the structure and can help the SDFRD optimize the deployment of personnel and apparatus during a wildfire. The analysis in this report provides support and justifications for acceptance of the proposed BMZ for this project based on the site-specific fire environment. As presented in this report, the alternative measures proposed for the project's BMZ supplement the City's standard requirements and provide at least functional equivalency.

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8 Limitations

This report does not provide a guarantee that occupants and visitors would be safe at all times because of the proposed fire protection features. There are many variables that may influence overall safety. This report provides requirements and recommendations for implementation of the latest fire protection features that have proven to result in reduced wildfire-related risk and hazard.

For maximum benefit, the Fairmount Avenue Fire Station employees, visitors, contractors, engineers, and architects are responsible for proper implementation of the concepts and requirements set forth in this report. The City of San Diego (or similar entity) is responsible for maintaining the structure and the proposed BMZs as required by this report, the applicable Fire Code and the SDFRD, which helps protect against catastrophic loss as a result of a wildland fire.

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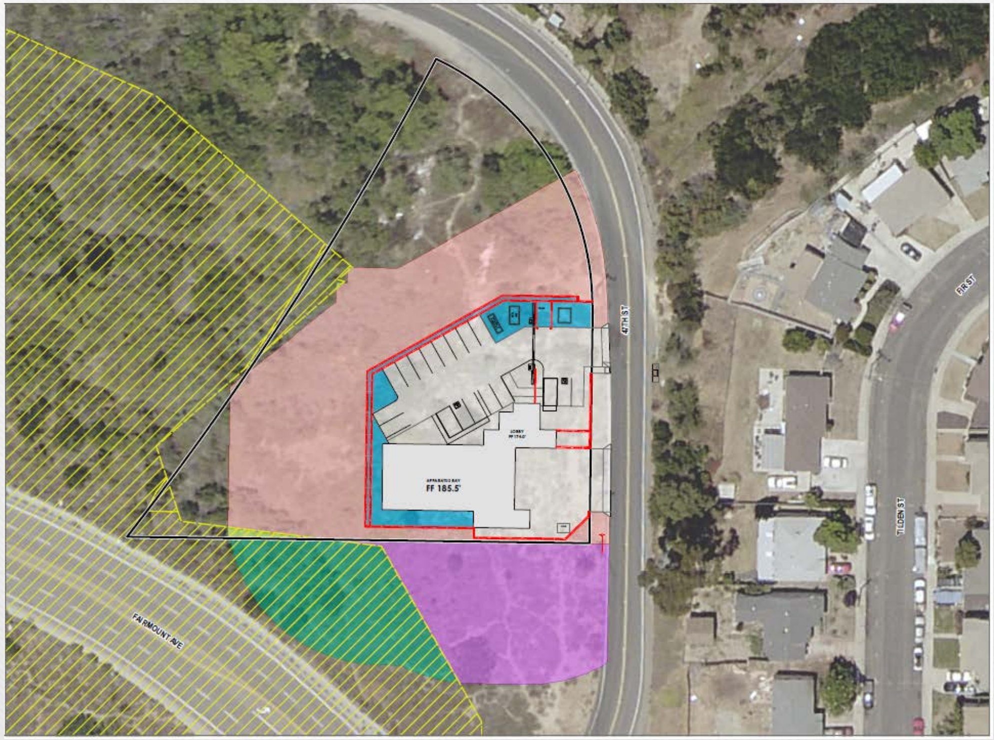
Appendix A
The Fairmount Avenue Fire Station Photograph Log

Fairmount Avenue Fire Station Photograph Log



Fairmount Avenue Fire Station
Photograph Log

Photograph 1. View looking west towards existing vegetation along the western property boundary. Note the existing riparian forest located approximately 160 feet northwest of the project site (red arrow).

Photograph 2. Photograph of the existing coastal sage scrub and chaparral located throughout the project area. Note the riparian area northwest of project site. Photograph taken facing northwest.

Photographs taken April 1, 2020

Fairmount Avenue Fire Station
Photograph Log

Photograph 3. Photograph of the existing coastal sage scrub and chaparral located throughout the project area. Photograph taken facing west along northern project boundary.

Photograph 4. Photograph of the existing coastal sage scrub and chaparral located throughout the project area. Photograph taken facing west towards center of project site.

Photographs taken April 1, 2020

Fairmount Avenue Fire Station
Photograph Log

Photograph 5. Photograph of the existing coastal sage scrub and chaparral located throughout the project area. Photograph taken facing southwest along southern project boundary.

Photograph 6. Photograph of the existing coastal sage scrub and chaparral located throughout the project area. Photograph taken facing south standing at the proposed apparatus bay driveway.

Photographs taken April 1, 2020

Fairmount Avenue Fire Station
Photograph Log

Photograph 7. Photograph of the existing coastal sage scrub and chaparral located throughout the project area. Photograph taken facing north standing along the northern project boundary looking at the riparian forest located approximately 160 feet northwest of the project site.

Photograph 8. Photograph of the existing coastal sage scrub and chaparral located throughout the project area. Photograph taken facing northeast standing along the western project boundary.

Photographs taken April 1, 2020

Fairmount Avenue Fire Station
Photograph Log

Photograph 9. Photograph of the existing coastal sage scrub and chaparral located throughout the project area. Photograph taken facing southeast standing along the western project boundary looking at location of proposed apparatus bay.

Photograph 10. Photograph of the existing coastal sage scrub and chaparral located throughout the project area. Photograph taken facing northeast standing above project site on Fairmount Avenue. Note the existing communities north and east of the project site.

Photographs taken April 1, 2020

Fairmount Avenue Fire Station
Photograph Log

Photograph 11. View looking northeast at the existing open space and walking trails west of the project site.

Photograph 12. Photograph of the existing open space and walking trails west of the project site. Photograph taken facing north.

Fairmount Avenue Fire Station
Photograph Log

Photograph 13. Photograph of the existing coastal sage scrub and chaparral located across Fairmount Ave, southwest of the project site. Photograph taken facing southwest.

Photograph 14. Photograph looking north up Fairmount Avenue.

Fairmount Avenue Fire Station
Photograph Log

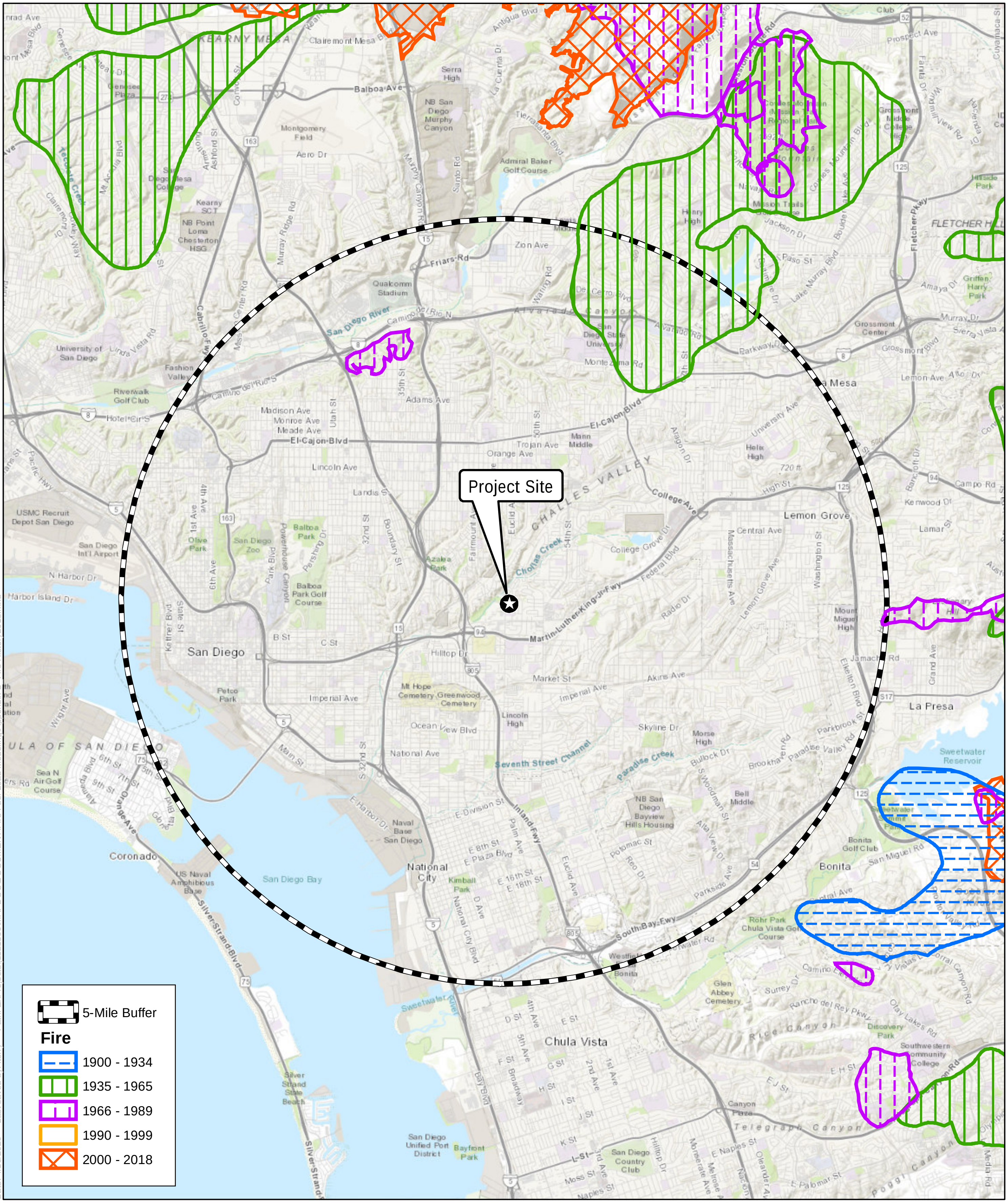
Photograph 15. Photograph of the intersection of Fairmount Avenue and 47th Street, just south of the project site.

Photograph 16. Photograph looking south up 47th Street at the approximate entrance of the Fairmount Avenue Fire Station..

Photographs taken April 1, 2020

Appendix B

Fire History Map



SOURCE: BASE- USGS; FIRE DATA-CALFIRE 2018

DUDEK

0 1 2 Miles

APPENDIX **B**

Fire History Map

Fairmount Avenue Fire Station - Fire Fuel Load Modeling Report

Appendix C

Fire Behavior Modeling Results – Pre BMZ Results

Inputs: SURFACE, SPOT

Description		Scenario 1: Extreme Fall Off-shore Wind (Pre Develop.)

Fuel/Vegetation, Surface/Understory

Fuel Model		sh2, sh5

Fuel/Vegetation, Overstory

Downwind Canopy Height	ft	4
Downwind Canopy Cover		Open

Fuel Moisture

1-h Fuel Moisture	%	2
10-h Fuel Moisture	%	3
100-h Fuel Moisture	%	7
Live Herbaceous Fuel Moisture	%	30
Live Woody Fuel Moisture	%	60

Weather

20-ft Wind Speed	mi/h	20, 50
Wind Adjustment Factor		0.4
Wind Direction (from north)	deg	220

Terrain

Slope Steepness	%	7
Site Aspect	deg	45
Ridge-to-Valley Elevation Difference	ft	130
Ridge-to-Valley Horizontal Distance	mi	0.13
Spotting Source Location		VB

Run Option Notes

Maximum effective wind speed limit IS imposed [SURFACE].

Fire spread is in the HEADING direction only [SURFACE].

Wind is in specified directions [SURFACE].

Wind and spread directions are degrees clockwise from north [SURFACE].

Wind direction is the direction from which the wind is blowing [SURFACE].

Output Variables

Surface Fire Rate of Spread (mi/h) [SURFACE]

Surface Fireline Intensity (Btu/ft/s) [SURFACE]

Surface Fire Flame Length (ft) [SURFACE]

(continued on next page)

Input Worksheet (continued)

Spot Dist from a Wind Driven Surface Fire (mi) [SPOT]

Notes

Scenario 1: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Surface Fire Rate of Spread (mi/h)

Fuel Model	20-ft Wind Speed mi/h 20	50
sh2	0.3	0.9
sh5	2.1	6.2

Scenario 1: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Surface Fireline Intensity (Btu/ft/s)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
sh2	597	2073
sh5	6242	18324

Scenario 1: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Surface Fire Flame Length (ft)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
sh2	8.5	15.1
sh5	25.1	41.1

Scenario 1: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Spot Dist from a Wind Driven Surface Fire (mi)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
sh2	0.4	1.1
sh5	0.9	2.3

Discrete Variable Codes Used
Scenario 1: Extreme Fall Off-shore Wind (Pre Develop.)

Fuel Model

142	sh2	Moderate load, dry climate shrub (S)
145	sh5	High load, dry climate shrub (S)

Downwind Canopy Cover

Open	Open

Spotting Source Location

VB	Valley Bottom

Inputs: SURFACE, CROWN, SPOT

Description		Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Fuel/Vegetation, Surface/Understory

Fuel Model		9, sh2, sh4, sh5

Fuel/Vegetation, Overstory

Canopy Height	ft	25
Downwind Canopy Height	ft	4
Downwind Canopy Cover		Open
Canopy Base Height	ft	3
Canopy Bulk Density	lb/ft3	0.062

Fuel Moisture

1-h Fuel Moisture	%	2
10-h Fuel Moisture	%	3
100-h Fuel Moisture	%	7
Live Herbaceous Fuel Moisture	%	30
Live Woody Fuel Moisture	%	60
Foliar Moisture	%	100

Weather

20-ft Wind Speed	mi/h	20, 50
Wind Adjustment Factor		0.4
Wind Direction (from north)	deg	180

Terrain

Slope Steepness	%	9
Site Aspect	deg	90
Ridge-to-Valley Elevation Difference	ft	60
Ridge-to-Valley Horizontal Distance	mi	.1
Spotting Source Location		VB

Run Option Notes

Maximum effective wind speed limit IS imposed [SURFACE].

Fire spread is in the HEADING direction only [SURFACE].

Wind is in specified directions [SURFACE].

Wind and spread directions are degrees clockwise from north [SURFACE].

Wind direction is the direction from which the wind is blowing [SURFACE].

Crown fire method uses Rothermel (1991) [CROWN].

(continued on next page)

Input Worksheet (continued)

Output Variables

Surface Fire Rate of Spread (mi/h) [SURFACE]
Surface Fireline Intensity (Btu/ft/s) [SURFACE]
Surface Fire Flame Length (ft) [SURFACE]
Transition Ratio [CROWN]
Transition to Crown Fire ? [CROWN]
Active Ratio [CROWN]
Active Crown Fire? [CROWN]
Crown Fire Type [CROWN]
Active Crown Fire Rate of Spread (ch/h) [CROWN]
Active Crown Fireline Intensity (Btu/ft/s) [CROWN]
Active Crown Fire Flame Length (ft) [CROWN]
Spot Dist from a Wind Driven Surface Fire (mi) [SPOT]

Notes

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Surface Fire Rate of Spread (mi/h)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	0.4	1.7
sh2	0.3	0.9
sh4	1.2	4.1
sh5	2.1	6.2

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Surface Fireline Intensity (Btu/ft/s)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	256	1193
sh2	600	2075
sh4	1492	5261
sh5	6265	18346

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Surface Fire Flame Length (ft)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	5.8	11.7
sh2	8.5	15.1
sh4	13.0	23.2
sh5	25.1	41.2

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Transition Ratio

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	6.0	28.1
sh2	14.1	48.8
sh4	35.1	123.8
sh5	147.4	431.5

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Transition to Crown Fire ?

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	Yes	Yes
sh2	Yes	Yes
sh4	Yes	Yes
sh5	Yes	Yes

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Active Ratio

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	10.1	36.3
sh2	10.1	36.3
sh4	10.1	36.3
sh5	10.1	36.3

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Active Crown Fire?

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	Yes	Yes
sh2	Yes	Yes
sh4	Yes	Yes
sh5	Yes	Yes

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Crown Fire Type

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	Crowning	Crowning
sh2	Crowning	Crowning
sh4	Crowning	Crowning
sh5	Crowning	Crowning

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Active Crown Fire Rate of Spread (ch/h)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	91.4	326.7
sh2	91.4	326.7
sh4	91.4	326.7
sh5	91.4	326.7

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Active Crown Fireline Intensity (Btu/ft/s)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	19100	68287
sh2	20827	74462
sh4	19752	70619
sh5	21672	77484

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Active Crown Fire Flame Length (ft)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	142.9	334.1
sh2	151.4	354.0
sh4	146.1	341.7
sh5	155.5	363.5

Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Head Fire

Spot Dist from a Wind Driven Surface Fire (mi)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
9	0.3	1.0
sh2	0.4	1.1
sh4	0.6	1.5
sh5	0.9	2.3

Discrete Variable Codes Used
Scenario 2: Extreme Fall Off-shore Wind (Pre Develop.)

Fuel Model

9	9	Long needle or hardwood litter
142	sh2	Moderate load, dry climate shrub (S)
144	sh4	Low load, humid climate timber-shrub (S)
145	sh5	High load, dry climate shrub (S)

Downwind Canopy Cover

Open	Open

Spotting Source Location

VB	Valley Bottom

Inputs: SURFACE, SPOT

Description		Scenario 3: Summer On-shore Wind (Pre Develop.)

Fuel/Vegetation, Surface/Understory

Fuel Model		sh2, sh5

Fuel/Vegetation, Overstory

Downwind Canopy Height	ft	4
Downwind Canopy Cover		Open

Fuel Moisture

1-h Fuel Moisture	%	8
10-h Fuel Moisture	%	9
100-h Fuel Moisture	%	15
Live Herbaceous Fuel Moisture	%	60
Live Woody Fuel Moisture	%	119

Weather

20-ft Wind Speed	mi/h	19
Wind Adjustment Factor		0.4
Wind Direction (from north)	deg	45

Terrain

Slope Steepness	%	12
Site Aspect	deg	225
Ridge-to-Valley Elevation Difference	ft	320
Ridge-to-Valley Horizontal Distance	mi	0.16
Spotting Source Location		VB

Run Option Notes

Maximum effective wind speed limit IS imposed [SURFACE].

Fire spread is in the HEADING direction only [SURFACE].

Wind is in specified directions [SURFACE].

Wind and spread directions are degrees clockwise from north [SURFACE].

Wind direction is the direction from which the wind is blowing [SURFACE].

Output Variables

Surface Fire Rate of Spread (mi/h) [SURFACE]

Surface Fireline Intensity (Btu/ft/s) [SURFACE]

Surface Fire Flame Length (ft) [SURFACE]

(continued on next page)

Input Worksheet (continued)

Spot Dist from a Wind Driven Surface Fire (mi) [SPOT]

Notes

Scenario 3: Summer On-shore Wind (Pre Develop.)

Head Fire

Fuel Model	Surface Fire Rate of Spread mi/h	Surface Fireline Intensity Btu/ft/s	Surface Flame Length ft	Surface Fire Spot Dist mi
sh2	0.0	20	1.8	0.1
sh5	0.9	1923	14.6	0.6

Discrete Variable Codes Used
Scenario 3: Summer On-shore Wind (Pre Develop.)

Fuel Model

142	sh2	Moderate load, dry climate shrub (S)
145	sh5	High load, dry climate shrub (S)

Downwind Canopy Cover

Open	Open

Spotting Source Location

VB	Valley Bottom

Appendix D

Fire Behavior Modeling Results – Post BMZ Results

Inputs: SURFACE, SPOT

Description		Scenario 1: Extreme Fall Off-shore Wind (Post BMZ)

Fuel/Vegetation, Surface/Understory

Fuel Model		8, sh1

Fuel/Vegetation, Overstory

Downwind Canopy Height	ft	4
Downwind Canopy Cover		Open

Fuel Moisture

1-h Fuel Moisture	%	2
10-h Fuel Moisture	%	3
100-h Fuel Moisture	%	7
Live Herbaceous Fuel Moisture	%	30
Live Woody Fuel Moisture	%	60

Weather

20-ft Wind Speed	mi/h	20, 50
Wind Adjustment Factor		0.4
Wind Direction (from north)	deg	220

Terrain

Slope Steepness	%	7
Site Aspect	deg	45
Ridge-to-Valley Elevation Difference	ft	130
Ridge-to-Valley Horizontal Distance	mi	0.13
Spotting Source Location		VB

Run Option Notes

Maximum effective wind speed limit IS imposed [SURFACE].

Fire spread is in the HEADING direction only [SURFACE].

Wind is in specified directions [SURFACE].

Wind and spread directions are degrees clockwise from north [SURFACE].

Wind direction is the direction from which the wind is blowing [SURFACE].

Output Variables

Surface Fire Rate of Spread (mi/h) [SURFACE]

Surface Fireline Intensity (Btu/ft/s) [SURFACE]

Surface Fire Flame Length (ft) [SURFACE]

(continued on next page)

Input Worksheet (continued)

Spot Dist from a Wind Driven Surface Fire (mi) [SPOT]

Notes

Scenario 1: Extreme Fall Off-shore Wind (Post BMZ)

Head Fire

Surface Fire Rate of Spread (mi/h)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
8	0.1	0.1
sh1	0.4	1.3

Scenario 1: Extreme Fall Off-shore Wind (Post BMZ)

Head Fire

Surface Fireline Intensity (Btu/ft/s)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
8	25	46
sh1	241	760

Scenario 1: Extreme Fall Off-shore Wind (Post BMZ)

Head Fire

Surface Fire Flame Length (ft)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
8	2.0	2.6
sh1	5.6	9.5

Scenario 1: Extreme Fall Off-shore Wind (Post BMZ)

Head Fire

Spot Dist from a Wind Driven Surface Fire (mi)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
8	0.2	0.3
sh1	0.3	0.8

Discrete Variable Codes Used
Scenario 1: Extreme Fall Off-shore Wind (Post BMZ)

Fuel Model

8	8	Short needle litter
141	sh1	Low load, dry climate shrub (D)

Downwind Canopy Cover

Open	Open

Spotting Source Location

VB	Valley Bottom

Inputs: SURFACE, SPOT

Description		Scenario 2: Extreme Fall Off-shore Wind (Post BMZ)

Fuel/Vegetation, Surface/Understory

Fuel Model		8, sh1

Fuel/Vegetation, Overstory

Downwind Canopy Height	ft	3
Downwind Canopy Cover		Open

Fuel Moisture

1-h Fuel Moisture	%	2
10-h Fuel Moisture	%	3
100-h Fuel Moisture	%	7
Live Herbaceous Fuel Moisture	%	30
Live Woody Fuel Moisture	%	60

Weather

20-ft Wind Speed	mi/h	20, 50
Wind Adjustment Factor		0.4
Wind Direction (from north)	deg	180

Terrain

Slope Steepness	%	9
Site Aspect	deg	90
Ridge-to-Valley Elevation Difference	ft	60
Ridge-to-Valley Horizontal Distance	mi	.1
Spotting Source Location		VB

Run Option Notes

Maximum effective wind speed limit IS imposed [SURFACE].

Fire spread is in the HEADING direction only [SURFACE].

Wind is in specified directions [SURFACE].

Wind and spread directions are degrees clockwise from north [SURFACE].

Wind direction is the direction from which the wind is blowing [SURFACE].

Output Variables

Surface Fire Rate of Spread (mi/h) [SURFACE]

Surface Fireline Intensity (Btu/ft/s) [SURFACE]

Surface Fire Flame Length (ft) [SURFACE]

(continued on next page)

Input Worksheet (continued)

Spot Dist from a Wind Driven Surface Fire (mi) [SPOT]

Notes

Scenario 2: Extreme Fall Off-shore Wind (Post BMZ)

Head Fire

Surface Fire Rate of Spread (mi/h)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
8	0.1	0.1
sh1	0.4	1.3

Scenario 2: Extreme Fall Off-shore Wind (Post BMZ)

Head Fire

Surface Fireline Intensity (Btu/ft/s)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
8	25	46
sh1	242	760

Scenario 2: Extreme Fall Off-shore Wind (Post BMZ)

Head Fire

Surface Fire Flame Length (ft)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
8	2.0	2.6
sh1	5.6	9.5

Scenario 2: Extreme Fall Off-shore Wind (Post BMZ)

Head Fire

Spot Dist from a Wind Driven Surface Fire (mi)

Fuel Model	20-ft Wind Speed mi/h	
	20	50
8	0.2	0.3
sh1	0.3	0.8

Discrete Variable Codes Used
Scenario 2: Extreme Fall Off-shore Wind (Post BMZ)

Fuel Model

8	8	Short needle litter
141	sh1	Low load, dry climate shrub (D)

Downwind Canopy Cover

Open	Open

Spotting Source Location

VB	Valley Bottom

Inputs: SURFACE, SPOT

Description		Scenario 3: Summer Onshore Wind (Post BMZ)

Fuel/Vegetation, Surface/Understory

Fuel Model		sh1, sh2

Fuel/Vegetation, Overstory

Downwind Canopy Height	ft	4
Downwind Canopy Cover		Open

Fuel Moisture

1-h Fuel Moisture	%	8
10-h Fuel Moisture	%	9
100-h Fuel Moisture	%	15
Live Herbaceous Fuel Moisture	%	60
Live Woody Fuel Moisture	%	119

Weather

20-ft Wind Speed	mi/h	19
Wind Adjustment Factor		0.4
Wind Direction (from north)	deg	45

Terrain

Slope Steepness	%	12
Site Aspect	deg	225
Ridge-to-Valley Elevation Difference	ft	320
Ridge-to-Valley Horizontal Distance	mi	0.16
Spotting Source Location		VB

Run Option Notes

Maximum effective wind speed limit IS imposed [SURFACE].

Fire spread is in the HEADING direction only [SURFACE].

Wind is in specified directions [SURFACE].

Wind and spread directions are degrees clockwise from north [SURFACE].

Wind direction is the direction from which the wind is blowing [SURFACE].

Output Variables

Surface Fire Rate of Spread (mi/h) [SURFACE]

Surface Fireline Intensity (Btu/ft/s) [SURFACE]

Surface Fire Flame Length (ft) [SURFACE]

(continued on next page)

Input Worksheet (continued)

Spot Dist from a Wind Driven Surface Fire (mi) [SPOT]

Notes

Scenario 3: Summer Onshore Wind (Post BMZ)

Head Fire

Fuel Model	Surface Fire Rate of Spread mi/h	Surface Fireline Intensity Btu/ft/s	Surface Flame Length ft	Surface Fire Spot Dist mi
sh1	0.0	2	0.6	0.1
sh2	0.0	20	1.8	0.1

Discrete Variable Codes Used
Scenario 3: Summer Onshore Wind (Post BMZ)

Fuel Model

141	sh1	Low load, dry climate shrub (D)
142	sh2	Moderate load, dry climate shrub (S)

Downwind Canopy Cover

Open	Open

Spotting Source Location

VB	Valley Bottom

Appendix E

Brush Management Plan Maps and Cross Sections

6' Fire Wall

BMZ Dimensions

Project Boundary

MHPA

Brush Management

Zone 1 - Brush Management

Zone 2 - Brush Management

MHPA (Zone 2 - Brush Management)

Project Component

Fire Station Structure

Impervious Surface

NOTE:

For Zone 2 Reduction where Zone 1 exceeds 35', please utilize §142.0412(f), which states: "The Zone Two width may be decreased by 1 ½ feet for each 1 foot of increase in Zone One width". The project proposes an expanded Zone 1 along the whole northern portion of the site.

Zone 2 should not expand further than 100' from the structure where Zone 1 is 35' or less.

For offsite brush management on adjacent properties, the offsite brush management shall be the responsibility of adjacent property owners. For fuel-load maintenance issues, contact the Fire-Rescue Department's Fire Hazard Advisor - Brush/Weed Complaint line at: (619) 533-4444

SOURCE: AERIAL-SANGIS 2017; DEVELOPMENT-RRM DESIGN GROUP 2020

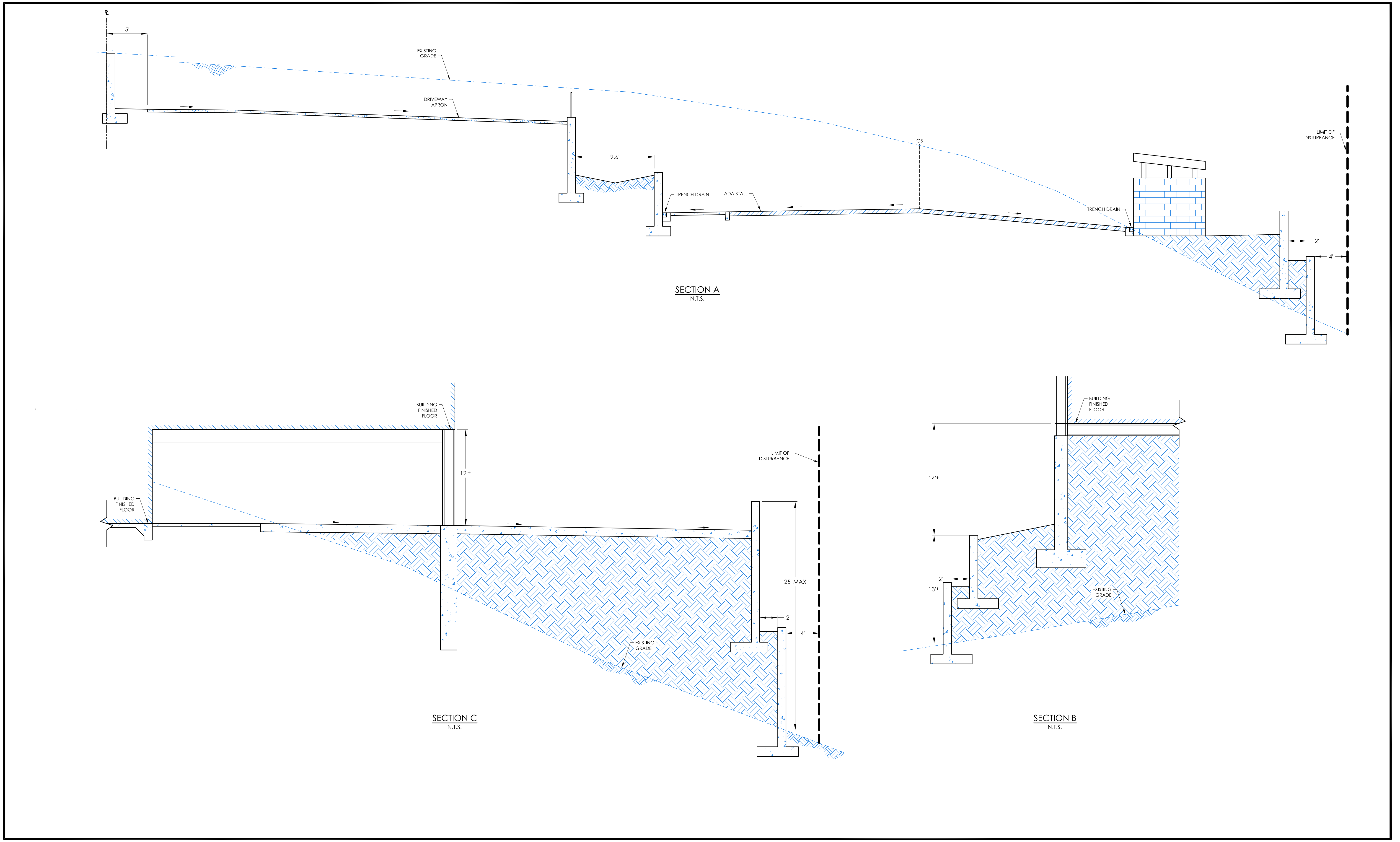
DUDEK

0 20 40 Feet

APPENDIX E

Brush Management Plan

Fairmount Avenue Fire Station - Fire Fuel Load Modeling Report



SOURCE: RRM Design Group, 2020

DUDEK

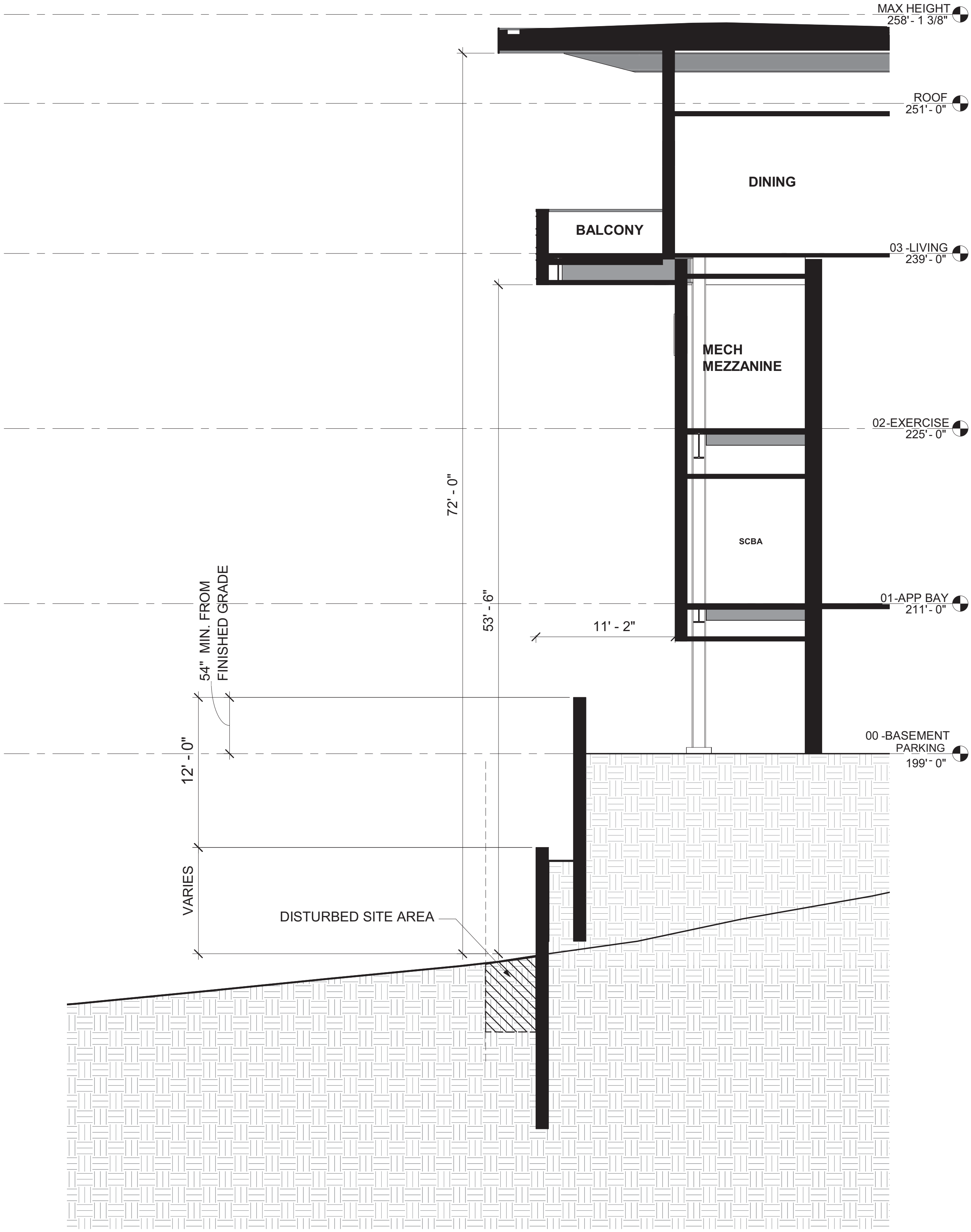
0 20 40 60 feet

1" = 20'

NORTH

APPENDIX **E1**

Fairmount Avenue Fire Station Project Cross-Sections A to C



SOURCE: RRM DESIGN GROUP 2020

APPENDIX E-2

East–West Cross Section