FINAL

Escondido Creek Preserve
Vegetation Management Plan

Prepared for:

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1.0 INTRODUCTION

The Escondido Creek Preserve (Preserve) is an approximately 347-acre open space preserve located southwest of Harmony Grove, west of the City of Escondido, south of the City of San Marcos, and east of the City of Encinitas, within the Elfin Forest community of unincorporated San Diego County, California. The Preserve is owned by the County of San Diego Department of Parks and Recreation (DPR) and is included in the proposed North County Multiple Species Conservation Program (MSCP) preserve system. The DPR proposes to manage the Preserve in accordance with a Resource Management Plan (RMP), including Area-Specific Management Directives (ASMDs), currently being developed for the Preserve pursuant to the requirements of the MSCP.

The majority of the Preserve supports high quality native vegetation communities; however, invasive non-native plants are present in portions of the Preserve and are outcompeting native species and reducing the biological functions and values of these communities. In discrete locations, human disturbance has resulted in unvegetated areas, which are subject to erosion. Over half of the Preserve was most recently burned during the 1996 Harmony Fire, while the vast majority of the remaining portions of the Preserve burned most recently in 1943 (FRAP 2011). Much of the vegetation on site has recovered during the 15 year fire-free period; although in some areas, effects of the fire remain more visible than others.

1.1 Purpose and Need

The purpose of this Vegetation Management Plan (VMP) is to describe the current site conditions within the Escondido Creek Preserve and provide recommendations for vegetation management within the Preserve including: 1) invasive species management; 2) habitat restoration; and 3) fire management. While this VMP is intended to be a standalone document, the information and recommendations presented will be used by DPR to develop ASMDs as part of the RMP currently being prepared for the Preserve. In addition, the VMP provides fire response personnel with critical site information for emergency fire response within and immediately adjacent to the Preserve boundaries and identifies targeted fuel management actions that can be implemented as preventative measures.

The Invasive Species Management section of this VMP lists the non-native invasive plant species observed on the Preserve, identifies and prioritizes target species for removal, and outlines standard removal methods. The Habitat Restoration section of this VMP identifies potential restoration opportunities within the Preserve and outlines standard restoration methods. The Fire Management section of this VMP outlines a framework to address wildfire risk and enables environmental documentation of strategic fuels management that may be needed. The

framework includes discussion of fire prevention, suppression, and post-suppression fire control activities within and adjacent to the Preserve.

The goals and objectives as well as the recommendations in this VMP are consistent with the County's MSCP and the County of San Diego Vegetation Management Report (County of San Diego 2009), which addresses vegetation management criteria for wildland and urban areas of unincorporated San Diego County. It is anticipated that this VMP will be revised once every five years, as needed, in conjunction with anticipated Preserve RMP updates.

1.2 Site Location and Description

The 346.6-acre Escondido Creek Preserve consists of 15 parcels and is located in the vicinity of Escondido Creek, southwest of Harmony Grove, west of the City of Escondido, south of the City of San Marcos, and east of the City of Encinitas in the Elfin Forest community of unincorporated San Diego County, California (Figure 1). The Preserve is within the Rancho Santa Fe, California U.S. Geological Survey (USGS) 7.5-minute quadrangle and is located in: Township 12 South, Range 3 West, Section 36; and Township 13 South, Range 3 West, Sections 3 and 4 (Figure 2).

The Preserve comprises of the following Assessor's Parcel Numbers (APNs):

264-031-40	264-041-13	264-042-87	679-130-12	679-140-12
264-031-39	264-041-30	679-140-01	679-140-06	679-140-14
264-031-33	264-032-10	679-130-05	679-140-13	679-140-15

The 15 parcels that comprise the Preserve are spread throughout the area surrounding Elfin Forest Road and Harmony Grove Road in the vicinity of San Elijo Canyon and the upper tributaries to Escondido Creek (Figure 2). Specifically, the Preserve parcels are located along Harmony Grove Road, Elfin Forest Road, Seaquest Trail, Canyon de Oro, Paint Mountain Road and Fortuna del Este. The Preserve parcels are bordered by low density, rural residential development, orchards, nurseries, and open space. The eastern parcels are adjacent to Elfin Forest Recreational Reserve to the south and Del Dios Highlands Preserve to the east. The western parcels are located adjacent to open space parcels to the west and south managed by Olivenhain Municipal Water District (OMWD) and the Center for Natural Lands Management. The central parcel is adjacent to rural residential development and commercial nurseries.

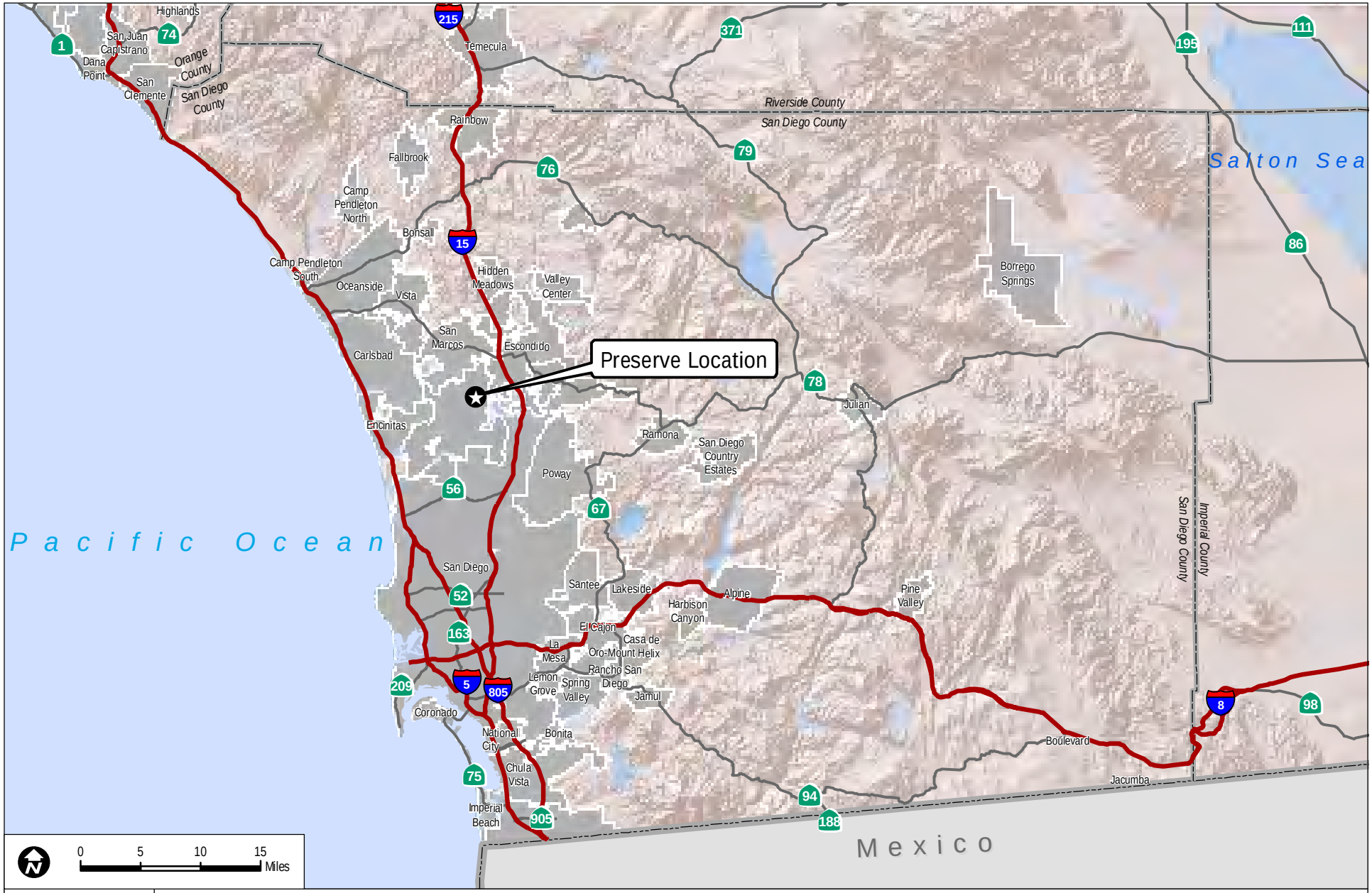

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FIGURE 1

Regional Map

Final Escondido Creek Preserve - Vegetation Management Plan

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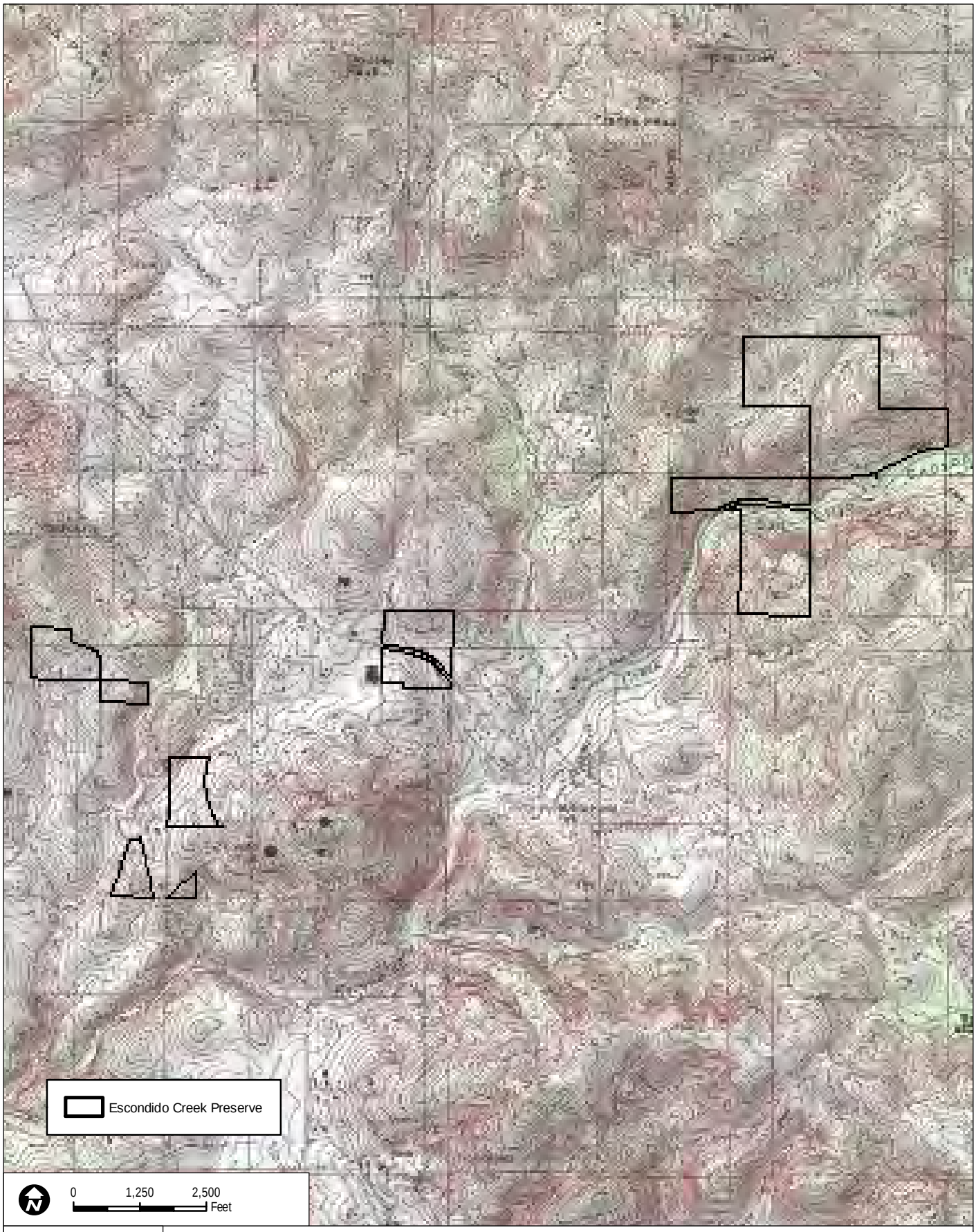

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SOURCE: USGS 7.5-Minute Series Quadrangle.

FIGURE 2

Vicinity Map

Final Escondido Creek Preserve - Vegetation Management Plan

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The Preserve is located in the North County MSCP Plan area and the Preserve parcels are spread across the designated Elfin Forest Core Area in the west and Harmony Grove Core Area in the east. The Preserve is located in the management district of one supervising park ranger, three park rangers, and three seasonal employees. Park rangers patrol the Preserve a minimum of three times a week and at times daily.

The Preserve is located in the coastal foothills of the Peninsular Ranges in northern San Diego County and is comprised of moderately to steeply sloping terrain ranging in elevation from 134 meters (440 feet) above mean sea level (AMSL) to approximately 316 meters (1,040 feet) AMSL. The Preserve consists primarily of southern mixed chaparral and is classified as a Very High Fire Hazard Severity Zone by the California Department of Forestry and Fire Protection (CAL FIRE) (FRAP 2011). The Preserve is designated a state responsibility area (SRA) and lies partially within the service area of the Elfin Forest/Harmony Grove Fire Department (EF/HGFD) and partially in an un-served area between the service areas of the EF/HGFD, the Rancho Santa Fe Fire Protection District, and the Encinitas Fire Department. Service in this un-served area is the responsibility of CAL FIRE, although adjacent fire agencies would likely respond during a wildfire event.

1.3 Vegetation Management Goals and Objectives

This VMP aims to develop management strategies consistent with those of the larger North County MSCP Plan. To that end, the vegetation management goals for the Preserve are focused on environmental resource preservation and enhancement of existing native habitat. The vegetation management goals for the Preserve include:

- Ensure the long-term viability and sustainability of native ecosystem function and natural processes.
- Protect the existing biological and cultural resources from disturbance-causing, incompatible activities within and adjacent to the Preserve.
- Manage invasive non-native species to ensure native vegetation community and resource preservation.
- Restore and/or enhance the quality of degraded vegetation communities in a manner consistent with overall species or habitat preservation goals.
- Develop fuel-load reduction methods that are consistent with overall Preserve management goals.

To achieve these long-term vegetation management goals for the Preserve, the following objectives have been formulated to achieve desired levels of resource protection, and public and firefighter safety:

- Maximize native vegetation community quality.
- Identify and prioritize removal/control of invasive non-native plant species on the Preserve.
- Provide methods for removal/control of invasive non-native plant species.
- Address current and long-term vegetation community restoration needs.
- Minimize adverse impacts to sensitive and high-value habitats.
- Utilize available fuel and invasive non-native plant reduction techniques, such as grazing, mowing, herbicide application, and prescribed fire, consistent with Preserve goals for habitat preservation, enhancement, and restoration, and asset and cultural resource protection.
- Provide site information on fire behavior to local fire agencies, including Elfin Forest/Harmony Grove Fire Department and CAL FIRE San Diego Unit, for inclusion in existing or future wildland pre-response plans.
- Establish vegetation management units (VMUs) based on topography or other clearly discernable landscape boundaries to facilitate fire management.
- Minimize likelihood of Preserve-wide, catastrophic wildfires.
- Identify wildland urban interface (WUI) areas and associated fuel management goals with a dual role of preventing wildfire from impacting urban areas, as well as protecting Preserve lands from fire originating in urban areas.
- Provide education for local firefighting personnel regarding sensitive resources and overall management considerations associated with the Preserve.
- Provide local fire agencies maps of sensitive biological and cultural resources to be avoided to the maximum extent possible.
- Prepare Preserve maps depicting relevant fire management data, including property boundaries, topography, vegetation and fuel types, access, and other major features, such as roads and structures.
- Prepare fire restoration management guidelines for each VMU including discussion of prevention, suppression, and post-suppression activities.
- Provide appropriate contact information to responding fire personnel in the event fire management activities may affect priority resources.

2.0 ENVIRONMENTAL RESOURCES

Baseline biological surveys of the Preserve were conducted between August 2010 and April 2011 (Dudek 2011). Field studies included vegetation mapping (including mapping invasive non-native plants), rare plant surveys, butterfly surveys, pitfall arrays, aquatic amphibian surveys, avian point counts, bat surveys, small mammal trapping, and tracking and camera stations. Brief descriptions of the existing vegetation communities, sensitive plant and wildlife species, and cultural resources documented within the Preserve during the baseline surveys are provided below.

2.1 Biological Resources

2.1.1 Vegetation Communities

The predominant vegetation community within the Preserve is southern mixed chaparral; however, twelve other vegetation communities and land cover types have been mapped within the Preserve including: Diegan coastal sage scrub, non-native grassland, southern coast live oak riparian forest, southern willow scrub, coast live oak woodland, eucalyptus woodland, southern riparian woodland, valley needlegrass grassland, non-native vegetation, disturbed habitat, developed land, and orchard (Table 1, Figures 3a-d).

Table 1
Vegetation Communities

Vegetation Community/Land Cover Type (Holland* Code)	Acres On Site[1]	Percentage
Disturbed Habitat (11300)	12.0	3.5%
Non-native Vegetation (11000)	0.8	0.2%
Orchard (18100)	0.01	<0.1%
Developed Land (12000)	6.9	2.0%
Eucalyptus Woodland (79100)	1.7	0.5%
Diegan Coastal Sage Scrub[2] (32500)	85.6	24.7%
Southern Mixed Chaparral (37120)	223.7	64.6%
Non-Native Grassland (42200)	3.3	1.0%
Valley Needlegrass Grassland (42110)	1.2	0.4%
Southern Coast Live Oak Riparian Forest (61310)	1.9	0.6%
Southern Riparian Woodland (62500)	0.9	0.3%
Southern Willow Scrub (63320)	1.9	0.6%
Coast Live Oak Woodland (71160)	6.5	1.9%
Total	**346.6**	**100.0%**

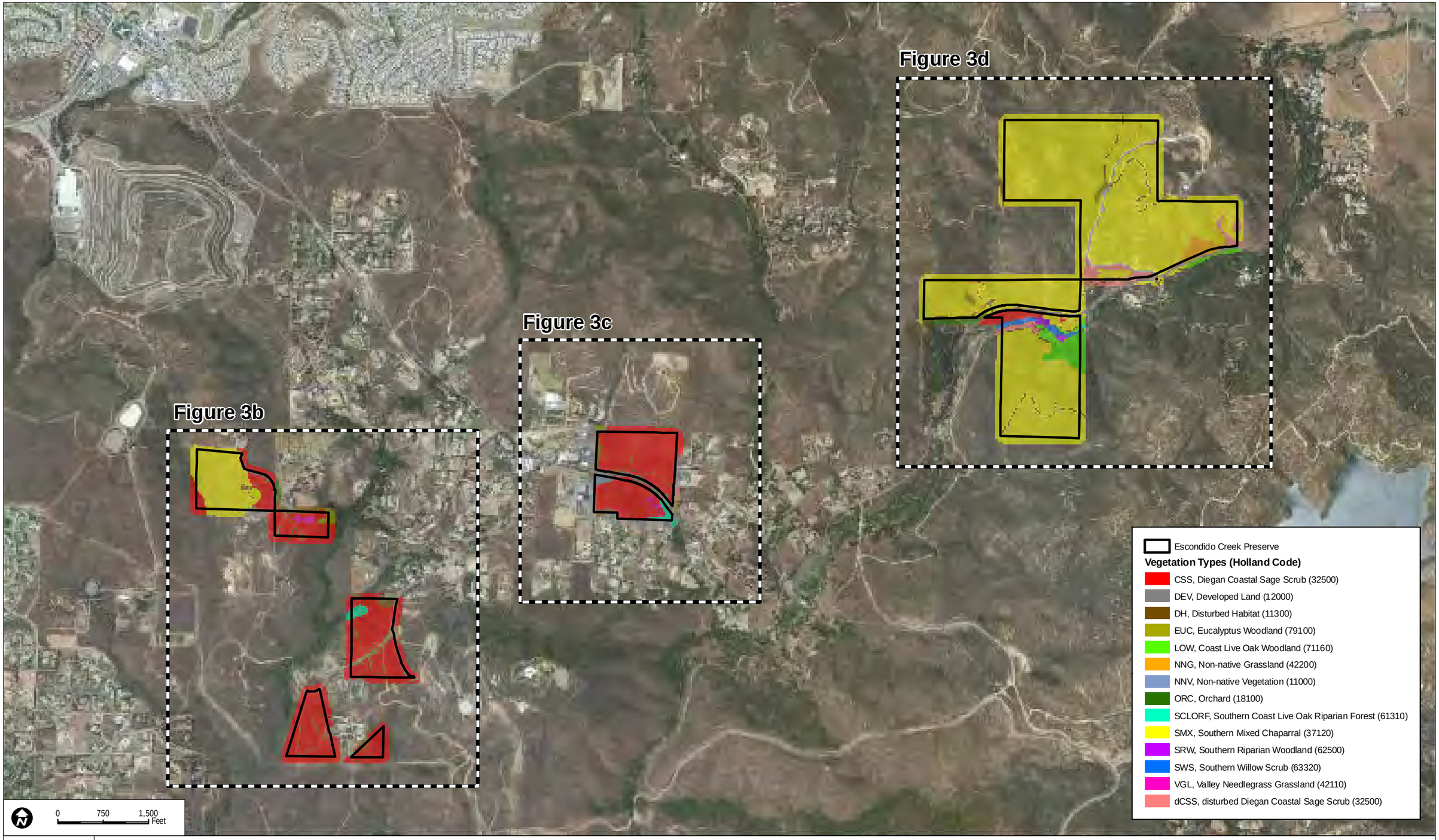
[1] Does not include 100-foot buffer acreage
[2] Includes 6.3 acres of disturbed Diegan Coastal Sage Scrub
*Updated by Oberbaur 1996.

2.1.2 Sensitive Plant Species

Six special-status plant species have been documented within the Preserve (Dudek 2011). Table 2 presents the special-status plant species identified in the Preserve. Sensitive plant species locations are presented on Figures 4a-d.

Table 2
Sensitive Plant Species Known to Occur in the Escondido Creek Preserve

Common Name	Scientific Name	Status
San Diego (Palmer's) Sagewort	*Artemisia palmeri*	CNPS List 4.2, County List D
Wart-Stemmed Ceanothus	*Ceanothus verrucosus*	CNPS List 2.2, County List B, MSCP Covered Species
San Diego Marsh-Elder	*Iva hayesiana*	CNPS List 2.2, County List B
Southwestern Spiny Rush	*Juncus acutus* var. *leopoldii*	CNPS List 4.2, County List D
San Diego Goldenstar	*Muilla clevelandii*	CNPS List 1B.1, County List A, MSCP Covered Species
Ashy Spike-moss	*Selaginella cinerascens*	CNPS List 4.1, County List D



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SOURCE: NAIP 2009

FIGURE 3a

Vegetation Communities/Habitats - Index Map

Final Escondido Creek Preserve - Vegetation Management Plan

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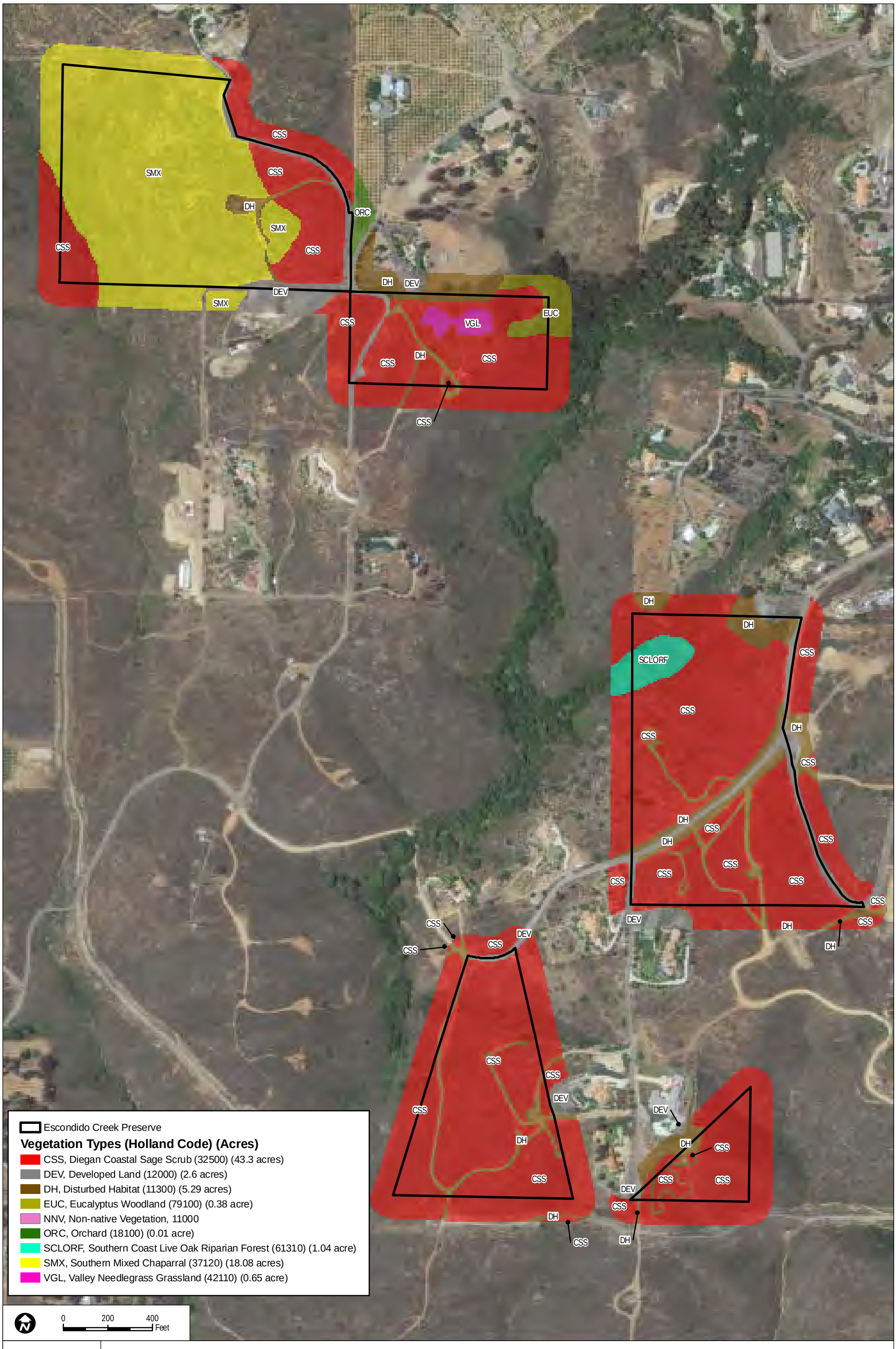

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FIGURE 3b

Vegetation Communities/Habitats

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Final Escondido Creek Preserve - Vegetation Management Plan

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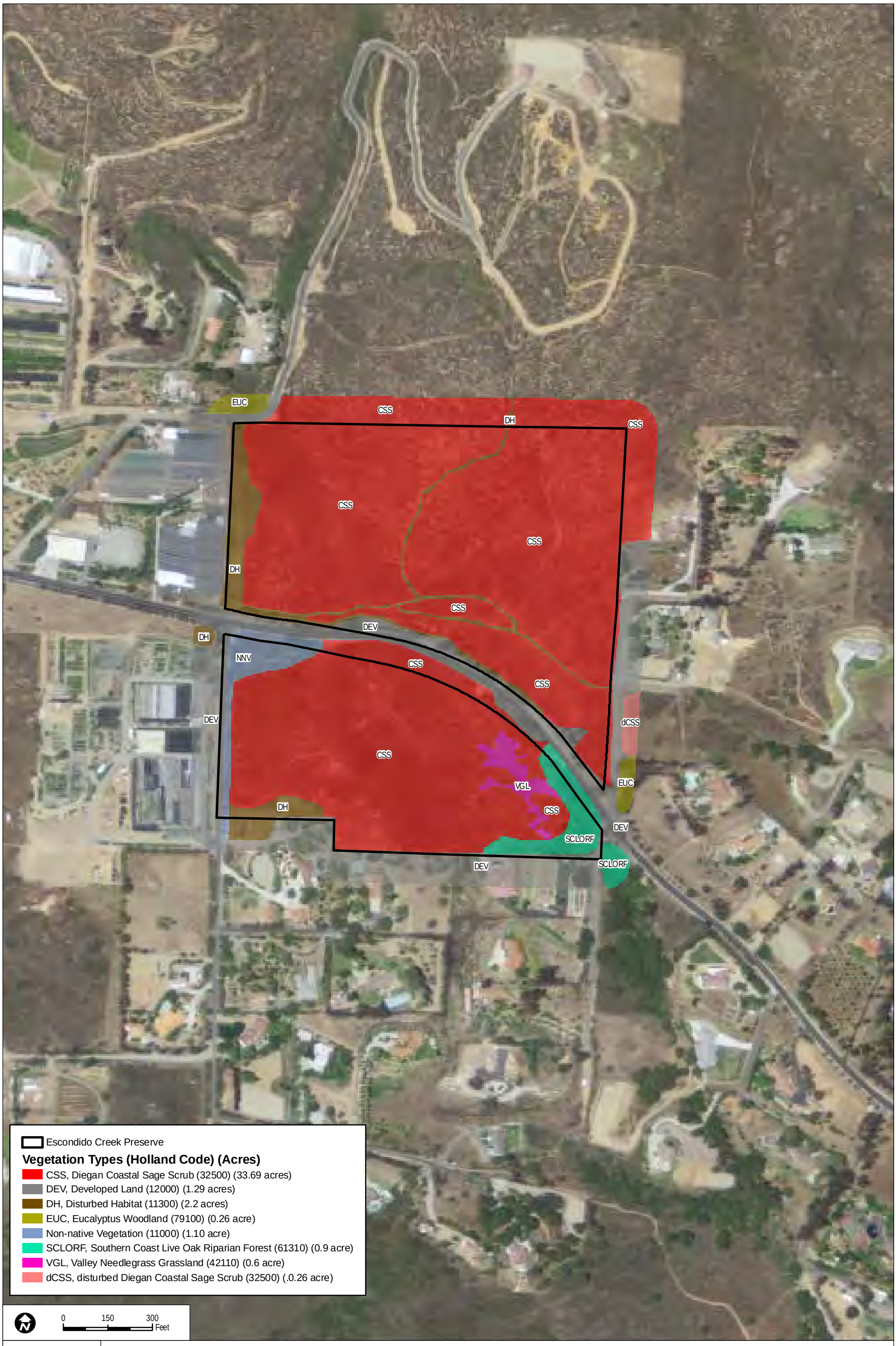

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SOURCE: NAIP 2009

FIGURE 3c

Vegetation Communities/Habitats

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Final Escondido Creek Preserve - Vegetation Management Plan

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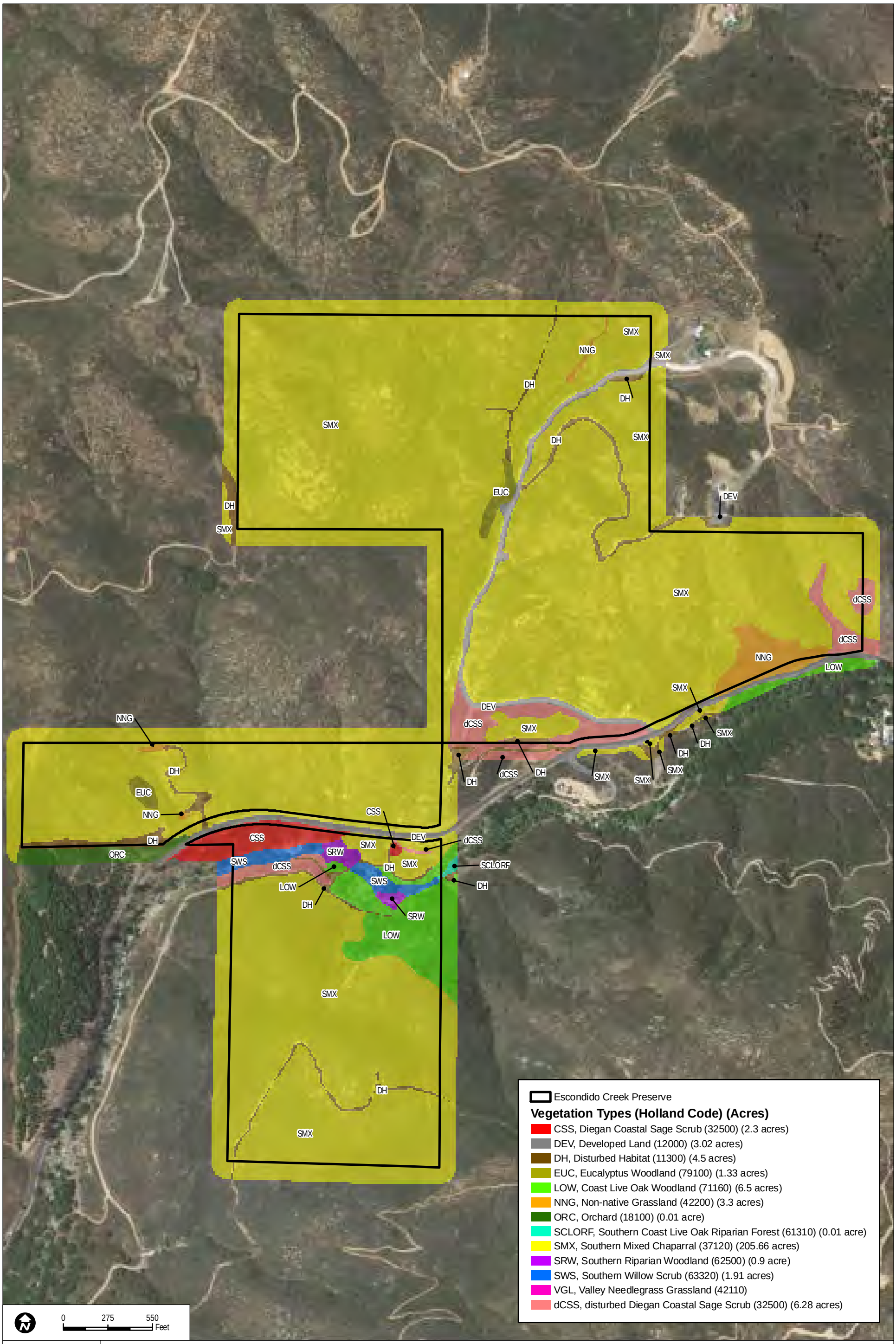

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SOURCE: NAIP 2009

FIGURE 3d

Vegetation Communities/Habitats

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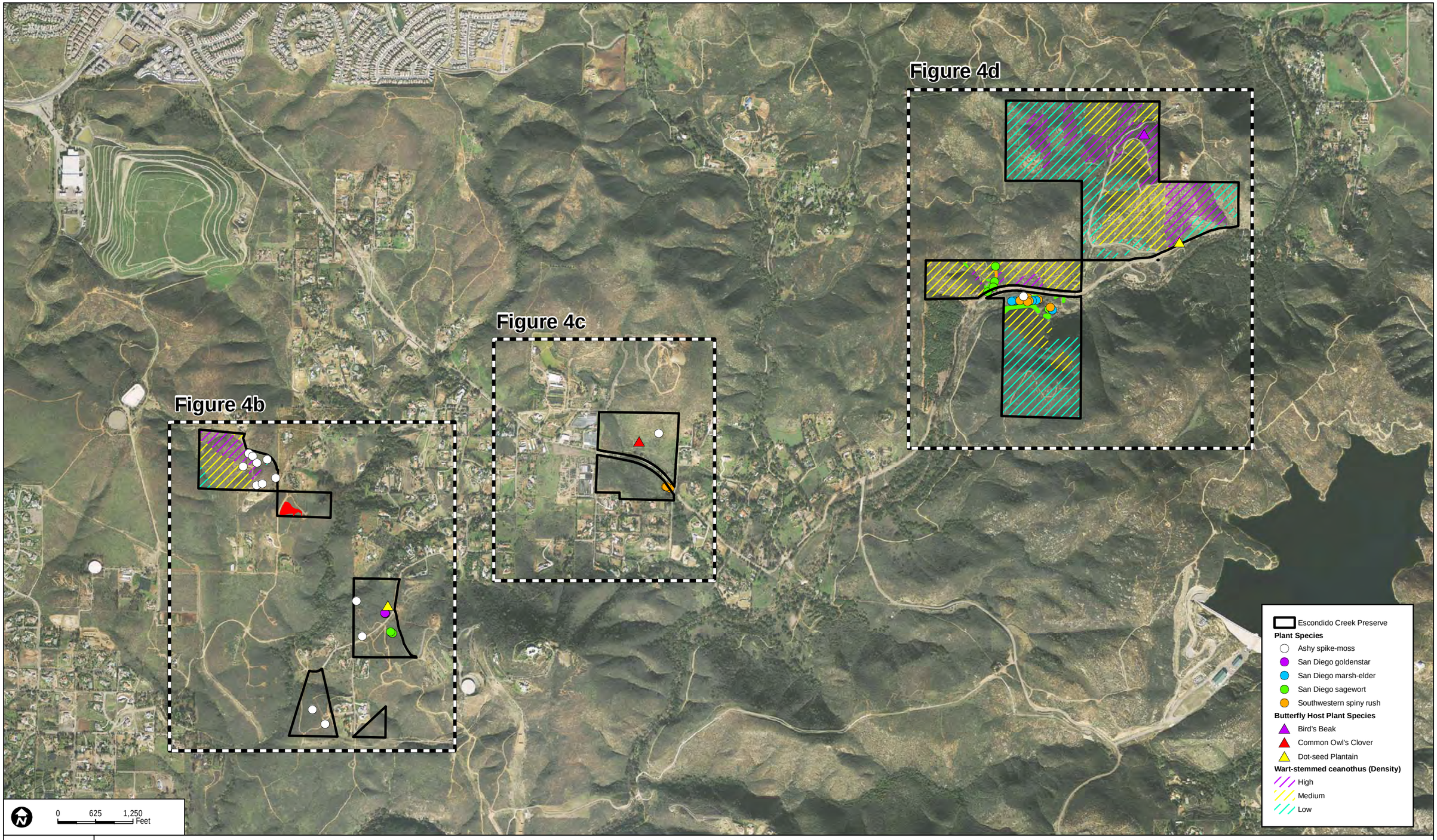

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SOURCE: Digital Globe 2008

FIGURE 4a

Special-Status and Butterfly Host Plant Species

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Escondido Creek Preserve

Plant Species (# = population count)

- Ashy spike-moss
- San Diego goldenstar
- San Diego sagewort

Butterfly Host Plant Species

- Dot-seed Plantain
- Common Owl's Clover

Wart-stemmed ceanothus (Density)

- High
- Medium
- Low

0 200 400 Feet

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SOURCE: NAIP 2009

FIGURE 4b

Special-Status and Butterfly Host Plant Species

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SOURCE: NAIP 2009

FIGURE 4c

Special-Status and Butterfly Host Plant Species

Final Escondido Creek Preserve - Vegetation Management Plan

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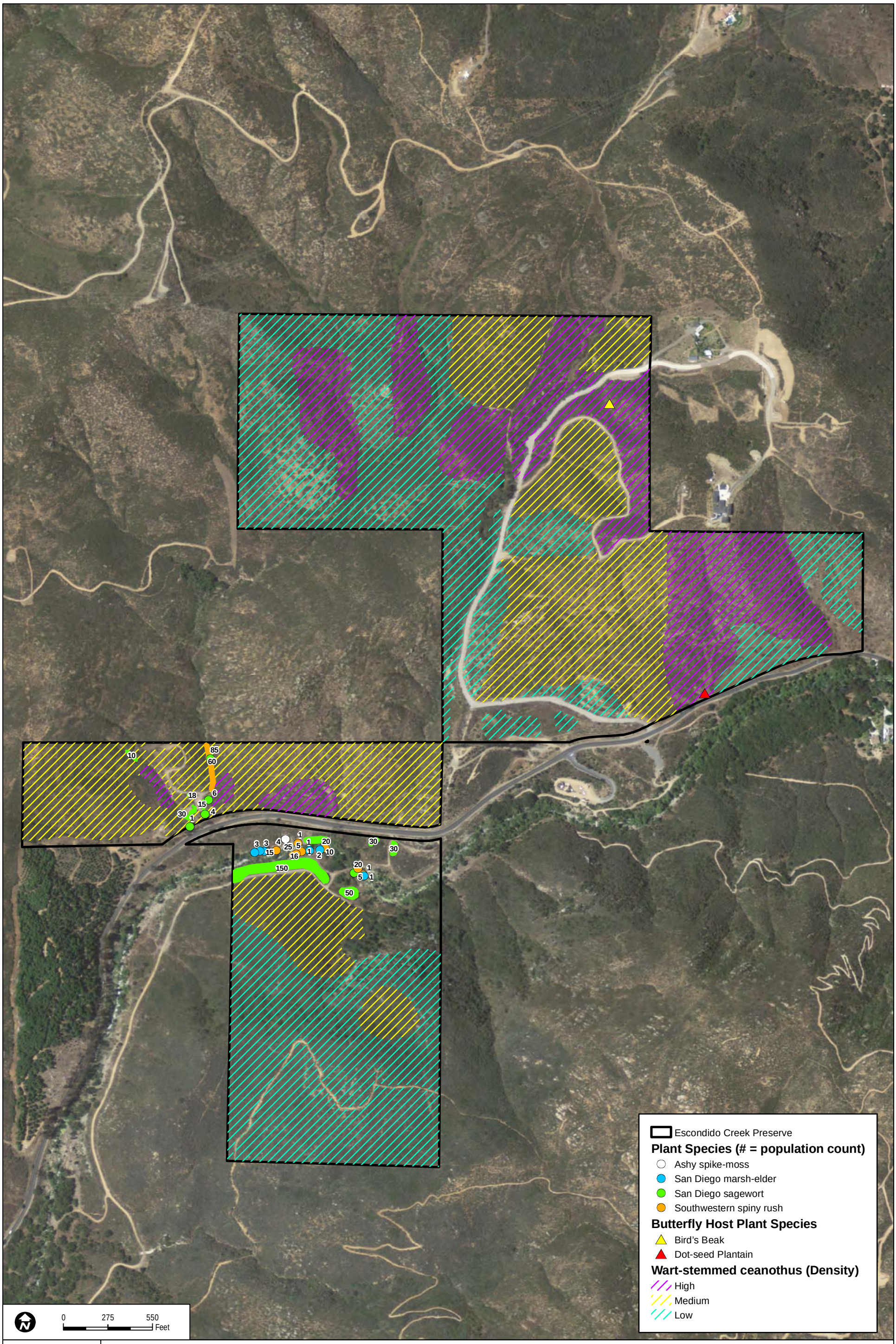

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SOURCE: NAIP 2009

FIGURE 4d

Special-Status and Butterfly Host Plant Species

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2.1.3 Sensitive Animal Species

Overall, 29 special-status wildlife species were observed or detected within the Preserve during the 2010-11 surveys. Table 3 presents the sensitive animal species observed in the Preserve. Sensitive animal species locations are presented on Figures 5a-d.

Table 3
Sensitive Animal Species Known to Occur in the Escondido Creek Preserve

Common Name	Scientific Name	Status (Federal/State/County/MSCP)[1]
Birds		
Cooper's Hawk	*Accipiter cooperii*	--/SWL/Group 1/--
Southern California Rufous-Crowned Sparrow	*Aimophila ruficeps canescens*	--/SWL/Group 1/MSCP
Red-Shouldered Hawk	*Buteo lineatus*	--/--/Group 1/--
Turkey Vulture	*Cathartes aura*	--/--/Group 1/--
White-Tailed Kite	*Elanus leucurus*	--/SFP/Group 1/--
Coastal California Gnatcatcher	*Polioptila californica californica*	FT/SSC/Group 1/MSCP
Barn Owl	*Tyto alba*	--/--/Group 2/--
Bell's Sage Sparrow	*Amphispiza belli belli*	--/SWL/Group 1/MSCP
Canada Goose	*Branta canadensis*	--/--/Group 2/--
Northern Harrier	*Circus cyaneus*	--/SSC/Group 1/MSCP
Yellow Warbler	*Dendroica petechia brewsteri*	--/SSC/Group 2/--
White-Faced Ibis	*Plegadis chihi*	--/SWL/Group 1/MSCP
Western Bluebird	*Sialia mexicana*	--/--/Group 2/--
California Gull	*Larus californicus*	--/SWL/Group 2/--
Gadwall	*Anas strepera*	--/--/Group 2/--
Great Blue Heron	*Ardea herodias*	--/--/Group 2/--
Mammals		
Northwestern San Diego Pocket Mouse	*Chaetodipus fallax fallax*	--/SSC/Group 2/--
San Diego Desert Woodrat	*Neotoma lepida intermedia*	--/SSC/Group 2/--
Western Red Bat	*Lasiurus blossevillii*	--/SSC/Group 2/--
Yuma Myotis	*Myotis yumanensis*	--/--/Group 2/--
Pocketed Free-Tailed Bat	*Nyctinomops femorosaccus*	--/SSC/Group 2/--
San Diego Black-tailed Jackrabbit	*Lepus californicus bennettii*	--/SSC/Group 2/MSCP
Southern Mule Deer	*Odocoileus hemionus*	--/--/Group 2/--
Herpetofauna		
Western Spadefoot	*Spea hammondii*	--/SSC/Group 2/MSCP
Coastal Western Whiptail	*Aspidoscelis tigris stejnegeri*	--/--/Group 2/--
Coronado Skink	*Eumeces skiltonianus interparietalis*	--/SSC/Group 2/--
Coast (Blainville's) Horned Lizard	*Phrynosoma blainvillei*	--/SSC/Group 2/MSCP
Two-Striped Garter Snake	*Thamnophis hammondii*	--/SSC/Group 1/MSCP
San Diego Ringneck Snake	*Diadophis punctatus similis*	--/--/Group 2/--

[1] Status - Federal Designations
FT: Federally Threatened
State Designations
SSC: Species of Special Concern
SFP: State Fully Protected
SWL: State Watch List

County Designations
Group 1: Animals of high sensitivity (listed or specific natural history requirements)
Group 2: Animals declining, but not in immediate threat of extinction or extirpation
MSCP: Covered under the North County MSCP

2.2 Cultural Resources

Three significant or potentially significant cultural resources have been identified within the Preserve including: a prehistoric lithic scatter, and historic building foundations, walls, and gates (ASM 2011). Table 4 presents the sensitive cultural sites identified in the Preserve. Cultural resources for the Preserve are discussed in greater detail in the *Archaeological Survey Report for the Escondido Creek Preserve* (ASM 2011). Locations of documented cultural resources in the Preserve are presented in the confidential appendices included in the aforementioned report.

Table 4
Escondido Creek Preserve Sensitive Cultural Sites

Primary or Trinomial Site#	Description	Significance Evaluation
CA-SDI-17670	Prehistoric lithic scatter	Not evaluated - Considered significant
P-37-031723	Historic site – foundation, wall, gate	Not evaluated - Considered significant
P-37-031724	Historic site – foundation	Not evaluated - Considered significant

3.0 INVASIVE SPECIES MANAGEMENT

Because invasive non-native plant species can have significant impacts on native plant associations, ecosystem processes and biodiversity, special management measures are needed for their removal and control. Non-native plants have few ecological controls on their population sizes, and they tend to thrive under conditions created by humans. They often exhibit aggressive growth, out-compete or otherwise harm sensitive species, and can alter natural fire regimes by increasing the frequency and intensity of wildfire (Bell 2009).

Twenty invasive non-native plant species have been identified in the Preserve, including both perennial and annual species (Dudek 2011). The perennial non-native species within the Preserve include: pampas grass (*Cortaderia selloana)*, tree tobacco (*Nicotiana glauca*), fountain grass (*Pennisetum setaceum*), Peruvian peppertree (*Schinus molle*), sweet fennel (*Foeniculum vulgare*), tamarisk (*Tamarix ramosissima*), Canary Island date palm (*Phoenix canariensis*), castor bean (*Ricinus communis*), pine trees (*Pinus* spp.), Italian thistle (*Carduus pycnocephalus*) and eucalyptus (*Eucalyptus* spp.). Table 5 lists the non-native perennial species and their associated California Invasive Plant Council (Cal-IPC) Inventory rating. Invasive plant species locations are shown on Figures 6a through 6d.

Table 5
Non-Native Perennial Plant Species at the Escondido Creek Preserve

Common Name	Scientific Name	U.S./California Weed List*	Cal-IPC Rating**
Canary Island Date Palm	*Phoenix canariensis*	NL	Limited
Castor Bean	*Ricinus communis*	NL	Limited
Eucalyptus	*Eucalyptus* spp.	NL	Limited/Moderate
Sweet Fennel	*Foeniculum vulgare*	NL	High
Fountain Grass	*Pennisetum setaceum*	NL	Moderate
Italian Thistle	*Carduus pycnocephalus*	CW	Moderate
Pampas Grass	*Cortaderia selloana*	NL	High
Peruvian Peppertree	*Schinus molle*	NL	Limited
Pine Trees (non-native varieties)	*Pinus* spp.	NL	None
Tamarisk (Salt Cedar)	*Tamarix ramosissima*	NL	High
Tree Tobacco	*Nicotiana glauca*	NL	Moderate

* USDA California State Listed Noxious Weeds
CW: California list C noxious weed. "C" rated weeds are generally widespread throughout the state.
NL: Not listed.

**Source: Cal-IPC California Invasive Plant Inventory Database, updated December 2010. Overall rating listed for southwest region, factoring impact, invasiveness, distribution and documentation level.
Inventory Categories
High: Species have severe ecological impacts, are conducive to moderate to high rates of dispersal/establishment and most are widely spread.
Moderate: Species have substantial and apparent, but generally not severe, ecological impacts, are conducive to moderate to high rates of dispersal, though establishment is generally dependent on ecological disturbance, and distribution may range from limited to widespread.
Limited: Species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score, have low to moderate rates of invasiveness, and are generally limited but may be locally persistent and problematic.

Ubiquitous non-native annuals are also present throughout the Preserve, and comprise the majority of species in the non-native grassland on site, which is dominated by foxtail chess (*Bromus madritensis*), wild oat (*Avena fatua*), tocalote (*Centaurea melitensis*), milk thistle (*Silybum marianum*) and shortpod mustard (*Hirschfeldia incana*). While non-native grassland consists primarily of non-native plant species, it is considered a natural vegetation community under the County's MSCP because it is a naturalized community that provides habitat for native and sensitive plants and animal species. Therefore, non-native grassland plant species are not included in this management plan for removal or control. Non-native annual plant species that are common to the Preserve are shown in Table 6.

Table 6
Non-Native Annual Plant Species at the Escondido Creek Preserve

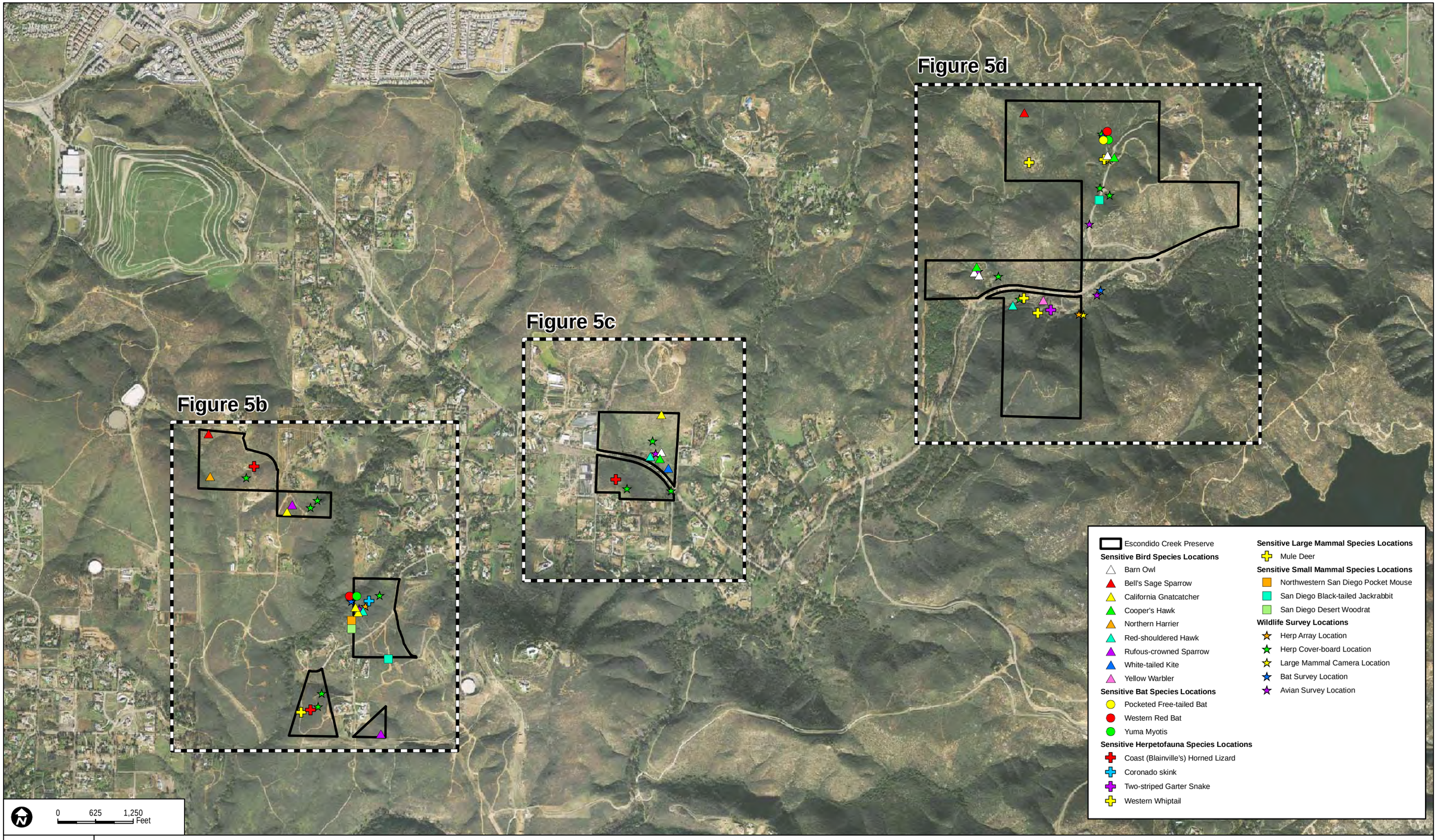
Common Name	Scientific Name
Black Mustard	*Brassica nigra*
Foxtail Chess	*Bromus madritensis* ssp. *rubens*
Milk Thistle	*Silybum marianum*
Redstem Filaree	*Erodium cicutarium*
Ripgut Brome	*Bromus diandrus*
Shortpod Mustard	*Hirschfeldia incana*
Soft Brome	*Bromus hordeaceus*
Tocalote	*Centaurea melitensis*
Wild Oat	*Avena barbata; A. fatua*

3.1 Target Invasive Species

Eleven of the 20 invasive non-native plant species observed within the Preserve have been identified as target species in need of removal and control. A removal priority ranking system was established for these target species to assist management efforts. The criteria used for assigning removal priority rankings for the invasive non-native species included an evaluation of the Cal-IPC rating, the current cover and distribution in the Preserve, the potential for invading sensitive habitat and the potential for increasing fire intensity. These species and associated management/control recommendations are presented below along with a removal priority ranking. Table 7 summarizes this information. Species ranked as high priority are recommended for control as soon as possible; species ranked as moderate priority are recommended for control as soon as high priority species are under control; and species ranked as low priority are recommended for control after high and moderate priority species are under control.

Table 7
Removal Priority of Target Invasive Non-Native Species

Common Name	Scientific Name	Removal Priority
Eucalyptus	*Eucalyptus* spp.	High
Castor Bean	*Ricinus communis*	High
Fountain Grass	*Pennisetum setaceum*	Moderate
Pampas Grass	*Cortaderia selloana*	Moderate
Tree Tobacco	*Nicotiana glauca*	Moderate
Tamarisk (Salt Cedar)	*Tamarix ramosissima*	Moderate
Peruvian Peppertree	*Schinus molle*	Moderate
Pine Trees (non-native varieties)	*Pinus* spp.	Low
Sweet Fennel	*Foeniculum vulgare*	Low
Canary Island Date Palm	*Phoenix canariensis*	Low
Italian Thistle	*Carduus pycnocephalus*	Low



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SOURCE: Digital Globe 2008

FIGURE 5a

Special Status Wildlife Species

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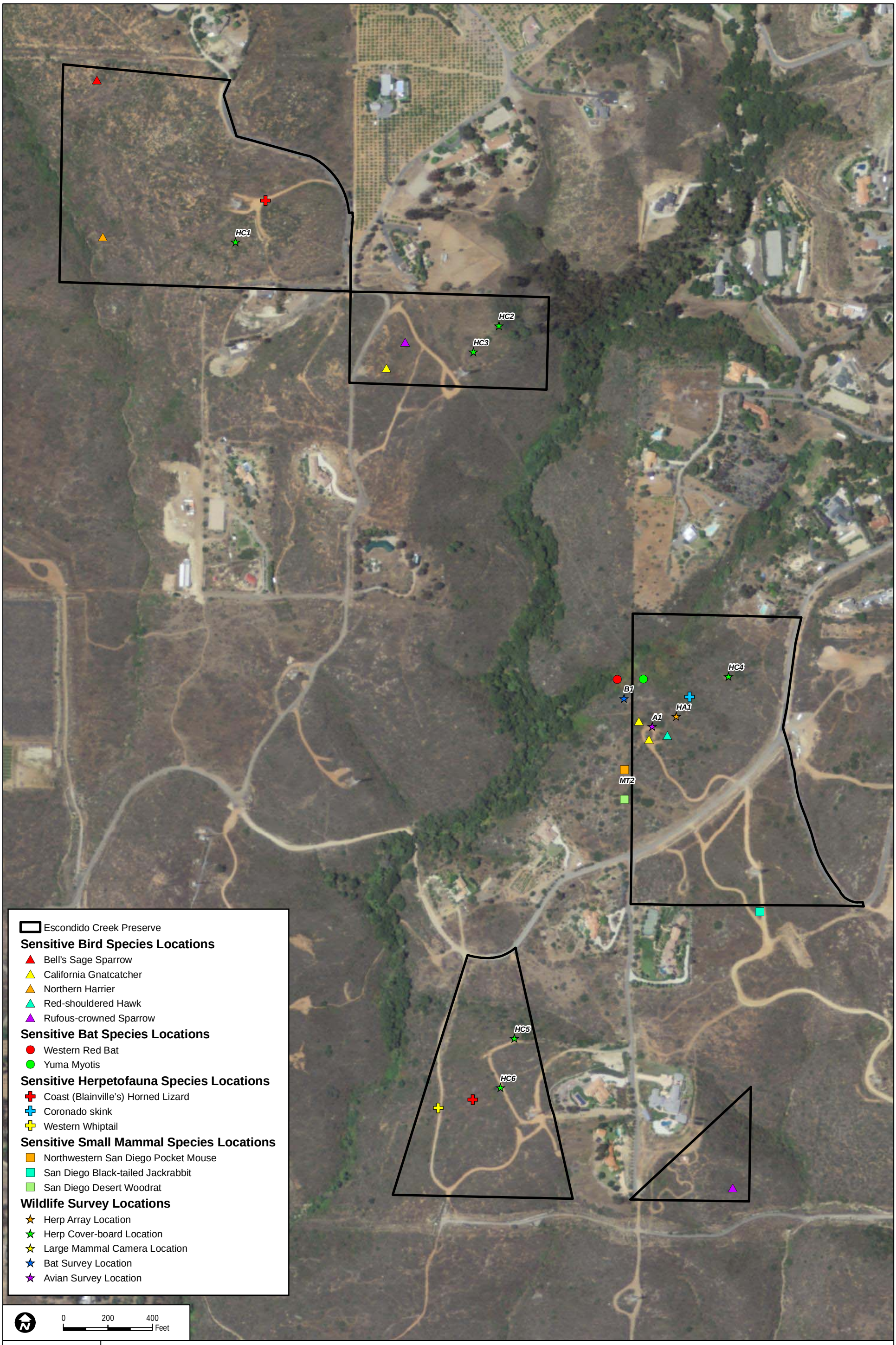

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SOURCE: NAIP 2009

FIGURE 5b

Special Status Wildlife Species

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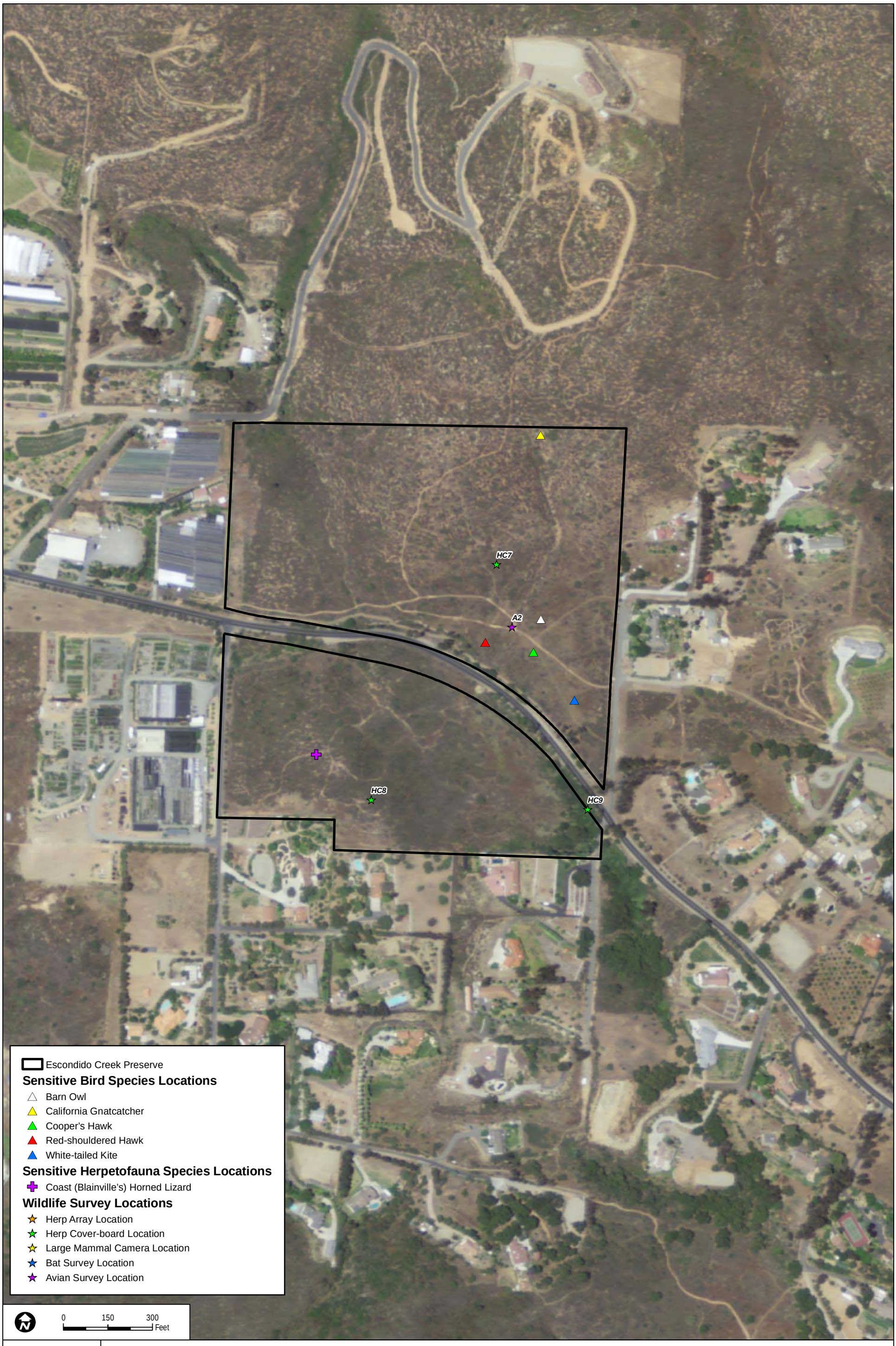

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SOURCE: NAIP 2009

FIGURE 5c

Special Status Wildlife Species

Final Escondido Creek Preserve - Vegetation Management Plan

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Escondido Creek Preserve
Del Dios Preserve Boundary

Sensitive Bird Species Locations
- Barn Owl
- Bell's Sage Sparrow
- Cooper's Hawk
- Red-shouldered Hawk
- Yellow Warbler
- Gadwall
- Great Blue Heron

Sensitive Bat Species Locations
- Pocketed Free-tailed Bat
- Western Red Bat
- Yuma Myotis

Sensitive Herpetofauna Species Locations
- Two-striped Garter Snake
- Western Whiptail
- San Diego Ringneck Snake
- Western Spadefoot Toad

Sensitive Large Mammal Species Locations
- Mule Deer

Wildlifepts

Sensitive Small Mammal Species Locations
- Northwestern San Diego Pocket Mouse
- San Diego Black-tailed Jackrabbit

Wildlife Survey Locations
- Herp Array Location
- Herp Cover-board Location
- Large Mammal Camera Location
- Bat Survey Location
- Avian Survey Location

HC10
B2
A3
M1
HC11
HC12
A4
A5
HC13
B3
A6
HC14
MT1
HA3
M2

0 275 550 Feet

DUDEK

6680-2D

SOURCE: NAIP 2009

FIGURE 5d
Special Status Wildlife Species

Final Escondido Creek Preserve - Vegetation Management Plan

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3.1.1 High Priority Species

Eucalyptus Trees (*Eucalyptus* spp.)

Eucalyptus are located in a small drainage in the northern most region of the Preserve, along sections of Harmony Grove Road, Elfin Forest Road, and a parcel south of Elfin Forest Road. Eucalyptus trees cover approximately 2.0 acres (Figures 6a through 6d). The majority of the eucalyptus trees within the Preserve are red gum (*Eucalyptus camaldulensis*) and blue gum (*Eucalyptus globulus*), with a few numbers of other eucalyptus species also present. While the Cal-IPC inventory categorizes Eucalyptus species as having overall ratings of "limited" or "moderate", they are ranked as a high priority for removal/control in the Preserve because of their tendency to displace native vegetation communities, the extent of their presence, and observed recruitment of new saplings. In addition this species is also of concern for fire hazard since its physical characteristics (resin content) can increase fire intensity, transition ground fire to crown fires, and propagate spot fires through the dislodging of canopy material during windy conditions. Therefore, the best treatment for eucalyptus removal is through mechanical removal and herbicidal treatments. Eucalyptus trees may be cut and sprayed with the appropriate herbicide, or trees may be removed with the use of girdling and herbicidal treatment. Herbicides should be applied within the first 1 to 2 minutes following cutting. Trees can be girdled past the xylem/phloem and treated with an appropriate herbicide. Follow-up herbicidal treatment may be necessary since sucker growth may occur.

Castor Bean (*Ricinus communis*)

Castor bean is a shrub-sized flowering plant which is used in commercial production for castor oil and the toxin ricin. It was also used as an ornamental plant in sub-tropical and Mediterranean climates, such Southern California. This perennial non-native can become aggressive when proper growing conditions are present, creating monotypic stands, and displacing native vegetation along wetland margins, or moderately dry upland areas. It produces a substantial tuberous root, in which it can store moisture and energy through times of drought, and/or if above ground plant parts are damaged, removed, or stressed. Castor bean was observed in one location, along the southern side of Harmony Grove Road, covering approximately 0.15 acre (Figures 6a and 6d). While its current footprint is discrete within the preserve, and it is rated as "limited" by Cal-IPC, it is ranked as a high priority for control due to its relatively close proximity to the Escondido Creek riparian corridor, as well as its difficulty to completely control. Given its substantial tuberous root system, it can take multiple, regular herbicide treatments to achieve control. Recommended control for this species includes cutting and removal of above ground plant parts prior to seed maturity for larger specimens that have developed a thick stem or trunk, and hand pulling for smaller seedlings and juveniles. Application of an appropriate

herbicide is recommended for remaining stumps and plant parts, as these can regenerate. Removed invasive plants should be properly disposed of at off-site facilities.

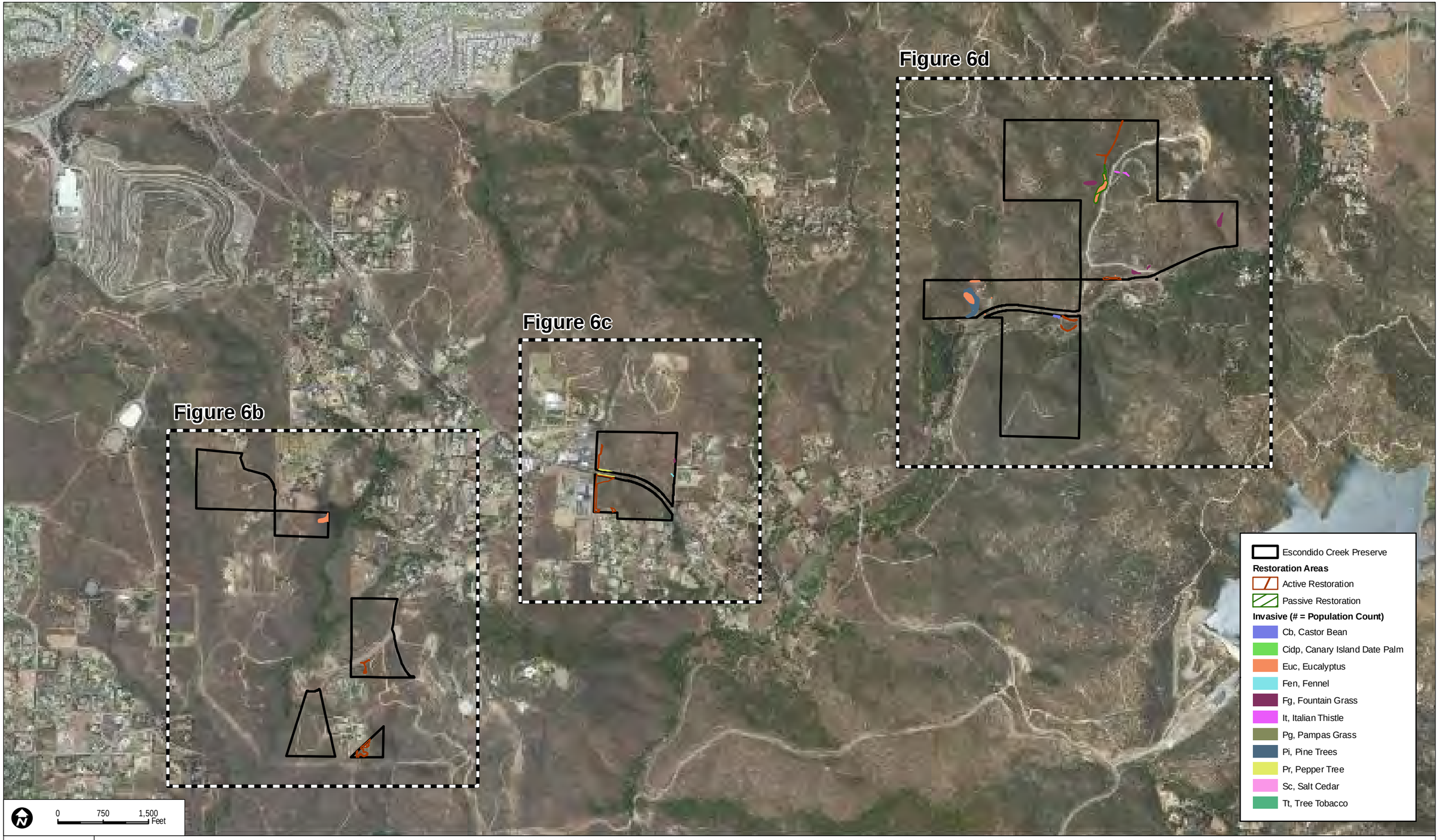
3.1.2 Moderate Priority Species

Fountain Grass (*Pennisetum setaceum*)

Fountain grass is a smaller clumping grass that has spread in large part due to its popularity as an ornamental plant. This species possesses a low ability to displace well-established native upland vegetation communities and will primarily colonize disturbed areas, or areas of naturally occurring sparse vegetation, such as sandy/rocky outcroppings on slopes. Fountain grass is well-adapted to fire, and can increase in density following a burn. A total of approximately 1.0 acre of fountain grass has been mapped primarily along or near Harmony Grove Road and Elfin Forest road within the Preserve (Figures 6a through 6d). The Cal-IPC inventory categorizes fountain grass as having an overall rating of "moderate", and it is ranked as a moderate priority for removal/control within the Preserve due to its high abundance within portions of the Preserve, but limited ability to displace established habitats. Recommended control for this species includes treatment with an appropriate herbicide prior to the development of mature seed heads. Should control not occur prior to maturation of seed, it is recommended that the seed heads be removed, bagged, and disposed of off site, with the remaining grass bunch receiving an herbicide treatment. Since the majority of the fountain grass stands occurring in the Preserve are located on steep, sparsely vegetated slopes, herbicide treatment would be preferable to hand-pulling due to soil disturbance.

Pampas Grass (*Cortaderia selloana*)

Pampas grass is a large clumping grass, about 6 to 8 feet (1.8 to 2.4 meters) tall. It is an aggressive spreading, ornamental species which produces significant amounts of biomass that is extremely flammable increasing the potential for fire ignition and/or spread. This species produces an abundance of seed, which is light, and can be wind-blown into the surrounding areas. The Cal-IPC inventory categorizes pampas grass as having an overall rating of "high"; however, it is ranked as a moderate priority for removal/control within the Preserve because of its limited distribution and location within upland habitat (as opposed to riparian habitat) where it is less likely to spread rapidly. This species was observed within southern mixed chaparral in the northern portion of the Preserve, totaling approximately 175 square feet (Figures 6a and 6d). Treatment and removal of pampas grass involves either hand digging or pulling/winching plants out of the ground. If complete removal of the plant is not feasible, they may be cut to near the ground surface, and treated with an appropriate herbicide. Treatment is recommended to occur prior to seed-set, and if viable seed is present at the time of treatment, plumes should be carefully cut and bagged to prevent seed spread.



DUDEK

6680-2D

SOURCE: NAIP 2009

FIGURE 6a

Target Invasive Non-Native Plant Species Locations and Potential Restoration Areas - Index Map

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6680-2D

SOURCE: NAIP 2009

FIGURE 6b

Target Invasive Non-Native Plant Species Locations and Potential Restoration Areas

Final Escondido Creek Preserve - Vegetation Management Plan

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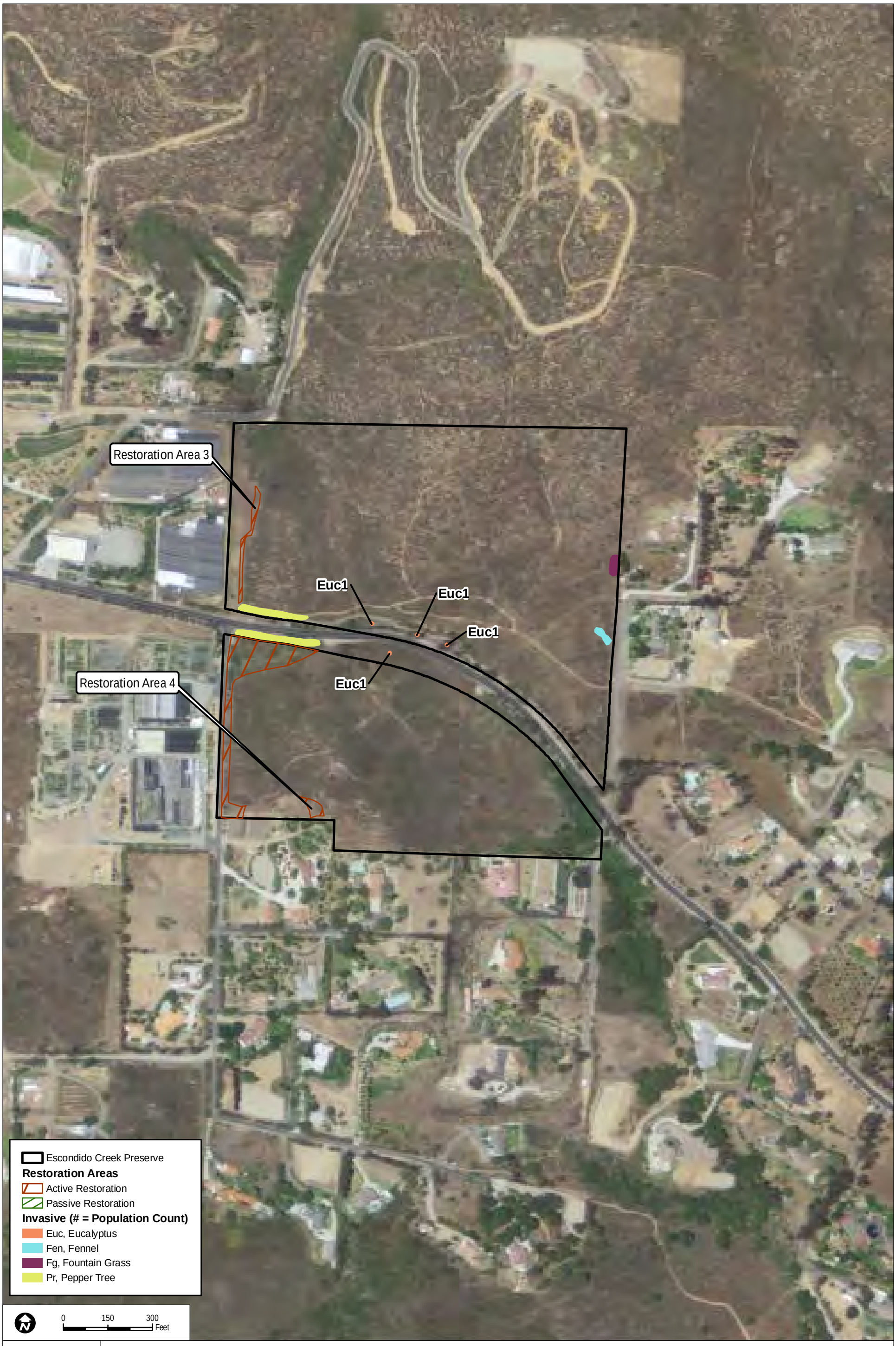

DUDEK

6680-2D

SOURCE: NAIP 2009

FIGURE 6c

Target Invasive Non-Native Plant Species Locations and Potential Restoration Areas

Final Escondido Creek Preserve - Vegetation Management Plan

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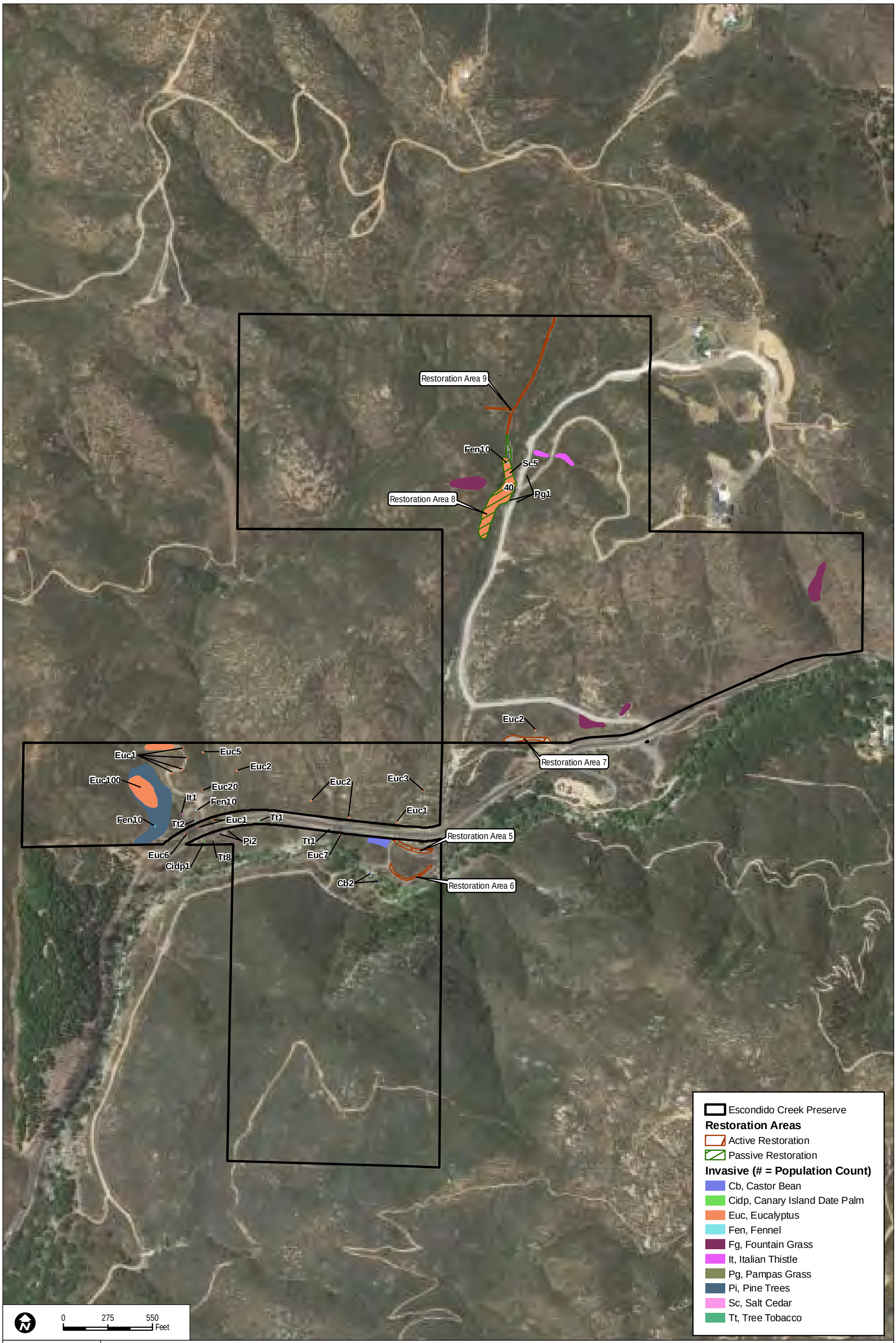

DUDEK

6680-2D

SOURCE: NAIP 2009

FIGURE 6d

Target Invasive Non-Native Plant Species Locations and Potential Restoration Areas

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Tree Tobacco (*Nicotiana glauca*)

Tree tobacco is an invasive tree/shrub that was first introduced in California as an ornamental but has escaped and frequently colonizes areas of soil disturbance in a variety of upland habitats. It is a prolific seed producer and has a high rate of spread. The Cal-IPC inventory categorizes tree tobacco as having an overall rating of "moderate", and it is ranked as a moderate priority for removal/control within the Preserve because of the species tendency to establish in disturbed areas and its limited presence in established habitat. Approximately 400 square feet of tree tobacco was observed in the Preserve, scattered along Harmony Grove Road, and in the southern most parcel within the preserve. (Figures 6a, 6b, 6d). Mechanical removal is recommended, with an appropriate herbicide applied to remaining stump and plant parts. Follow-up treatments may be necessary.

Tamarisk (*Tamarix ramosissima*)

Tamarisk (also known as salt cedar) is a shrub or tree typically found along waterways, drainages and riparian areas. It is associated with dramatic changes in geomorphology, groundwater availability, soil chemistry, fire frequency, plant community composition and native wildlife diversity. Tamarisk presents the greatest risk of reducing habitat quality within riparian areas, which are limited in presence within the Preserve. Tamarisk was observed within drainages in the northern most portion of the Preserve, with a footprint of approximately 80 square feet (Figures 6a and 6d). The Cal-IPC inventory categorizes tamarisk as having an overall rating of "high"; however, it is ranked as a moderate priority for control within the Preserve because of its limited extent within the Preserve, and because the drainage in which it occurs in contains well established riparian habitat. Because tamarisk is a sizable plant, it can be controlled by mechanical methods. Application of an appropriate herbicide is recommended for remaining stumps and plant parts since root fragments can regenerate. Removed invasive plants should be properly disposed of at off-site facilities. The area from which tamarisk would be removed is potentially appropriate for replanting with other native riparian plant species.

Peruvian Peppertree (*Schinus molle*)

Peruvian peppertree is an ornamental tree that can invade into natural areas with suitable soil moisture through shoot sprout or seed dispersal by birds or stream flows in drainages; however it is reported as only mildly invasive. Approximately 0.3 acre of peppertree is present along Elfin Forest Road within a Preserve parcel (Figures 6a and 6c), which forms a monotypic canopy. This area appears to be planted as ornamental vegetation. The Cal-IPC inventory categorizes Peruvian peppertree as having an overall rating of "limited" and it is ranked as a moderate priority for removal/control within the Preserve. While possessing the potential to colonize into surrounding

areas, the peppertrees may be removed, and the area restored to native vegetation. Given that peppertree can be difficult, or require repeated, regular follow-up treatments for control, it is ranked as a "moderate" priority for removal to provide ample time for complete control prior to initiating restoration of the area to a native vegetation community. Recommended control methods include mechanical removal, and application of an appropriate herbicide to remaining stump and plant parts. Follow-up herbicide control may be required.

3.1.3 Low Priority Species

Pine trees (*Pinus* spp.)

California is home to multiple native pine species, as well as many introduced pines. The majority of non-native pine trees found in California were introduced for ornamental purposes. In the preserve, a variety of non-native pines are located along Harmony Grove Road, totaling approximately 1.8 acres (Figures 6a and 6d). While this is second in acreage total to eucalyptus, pines are rated as a low priority for removal as no non-native pine species are rated on the Cal-IPC, and there is low potential for these trees to spread to adjacent areas at a fast rate. Recommended control methods include mechanical removal, and application of an appropriate herbicide to remaining stump and plant parts. Follow-up herbicide control may be required.

Sweet Fennel (*Foeniculum vulgare*)

Sweet fennel is a perennial herb common throughout the state. It can drastically alter the composition and structure of many plant communities, including grasslands, coastal scrub, riparian and wetland communities. In addition it can also alter fire regimes creating an intense, fast-moving fire. Sweet fennel was observed primarily adjacent to Harmony Grove Road, and in the northern most portion of the Preserve (Figures 6a through 6d). Approximately 0.05 acre of this species was observed in total. The Cal-IPC inventory categorizes fennel as having an overall rating of "high"; however, it is ranked as a low priority for removal/control on the Preserve due to its limited extent. Recommended control methods include cutting of the plants to near the ground, and treatment with an appropriate herbicide. Control should be performed prior to seed-set; however, if viable seed is present at the time of control, seed heads should be bagged, and disposed of appropriately off site. Follow up herbicide applications may be necessary for control.

Canary Island Date Palm (*Phoenix canariensis*)

Canary Island date palm is a species of palm tree commonly used for landscaping in Southern California which has the potential to establish in riparian areas and displace native trees. It is slow growing, and establishes exclusively from seed. The Cal-IPC inventory categorizes Canary Island date palm as having an overall rating of "limited". This species is ranked as a low priority

for removal/control within the Preserve due to its limited potential for additional colonization of the surrounding area, and its limited distribution. One occurrence of date palm was observed growing along the southern side of Harmony Grove Road (Figures 6a and 6d). Control for this tree may include mechanical removal, and treatment of the stump with an appropriate herbicide. Alternatively, the palm may be drilled, and injected with an appropriate herbicide, and left in place to die if removal is not desired. Complete mechanical removal would be preferable from a fire management perspective, as this would reduce the available deadwood fuel load present.

Italian Thistle (*Carduus pycnocephalus*)

Italian thistle is a winter annual thistle from the Mediterranean, which has become a noxious weed in multiple regions of the world, including California. This species has the ability to crowd out native forbs, grasses and other plants with its fast growing basal rosette which can serve as a fire ladder increasing fire frequency and movement into the overstory. Within the Preserve, approximately 0.16 acre was observed, located in the northern most area of the Preserve and along Harmony Grove Road (Figures 6a and 6d). Italian thistle is a California list C noxious weed and Cal-IPC rates this species as "moderate". For the preserve, it is given a low priority for removal given its limited range, and potential to invade its surrounding locations in comparison with other exotic species present in the Preserve listed for control.

3.2 Removal Methods

The selection of the appropriate removal methodology should be determined with consideration of many variables, including the time of year, severity of infestation, the presence of sensitive plants and wildlife, the degree of intermixing of invasive species with sensitive native habitats, access, and proximity to surface water. The U.S. Army Corps of Engineers and California Department of Fish and Game should be consulted regarding potential permitting requirements if invasive removal will occur in waterways or wetlands under their jurisdiction. General recommendations for the Preserve are provided below.

3.2.1 Manual Removal

Manual vegetation removal (e.g., hand pulling, grubbing and hoeing) is a low impact method of controlling non-native species within a focused area dominated by native vegetation. Due to the perennial nature of the target invasive plant species, their size, and difficulty of control, manual vegetation removal has limited application within the Preserve. Appropriate applications for manual removal are for small occurrences of annual weeds and seedlings of perennial species when complete removal of the root system is possible. More mature perennial plants will limit the ability for manual removal based on their size and root mass. Manual removal should be incorporated where herbicide

application alone is inadequate, or proximity of sensitive plant species prevents safe application (e.g., overspray or drifting of herbicides). Weeds or non-native plants in early stages of growth may be routinely pulled or removed when found along trails or in other areas of the Preserve. All removed non-native plant material that is feasible (portions of trees may be too large to remove without significant effort or impact) should be disposed of properly off site.

3.2.2 Mechanical Removal

Mechanical removal may be necessary for control of some larger target invasive species, such as eucalyptus, fan palms, pampas grass, and tamarisk, and is recommended to be combined with herbicide application. Cutting and removal of the aboveground plant material can be conducted with chainsaws and/or hand saws. The resulting material should be chipped and hauled off site. Subsequent application of herbicides should follow product guidelines for safe transport, storage, and application. Stumps remaining on site after cutting and herbicide application are not recommended for removal or grinding, but should be left to decompose in place.

3.2.3 Herbicides

The application of herbicides to control target invasive species may be used on its own, or as a secondary treatment following manual or mechanical removal for controlling sprout growth and regeneration. Herbicide application is recommended following removal of all target invasive tree species, and other perennial species with the ability to regenerate root fragments when removal of all plant material is not feasible. Herbicide use should be limited to localized applications rather than foliar applications to eliminate the possibility for drift and impacts to neighboring desirable species. A wide range of herbicides are available for such types of treatment. Herbicide labels and material safety data sheets (MSDS) list susceptible target plant species and provide proper direction in the use and handling of the products. Herbicides should be applied by state licensed applicators.

3.2.4 Cut and Daub

Cut and daub treatment is recommended for larger invasive plants to control re-growth and kill the portion of the plant remaining below ground. Cut and daub involves the cutting of invasive plant stalks and then the direct application of an appropriate herbicide directly to the freshly cut stump. Other related methods include drill and fill where holes are drilled into the trunk of a tree and herbicide is injected; or the glove method, where an herbicide soaked glove is used to apply directly to plant foliage or freshly cut stumps. It is critical that the herbicide treatment occur immediately after the plants are severed so that the herbicide is carried into the plant tissue. If enough time elapses to allow the cut surface of the severed plant to dry out, a fresh cut should be made prior to herbicide application.

4.0 HABITAT RESTORATION

The goal of habitat restoration is to reestablish or enhance the biological functions and values of vegetation communities that have been degraded by either human or natural causes. Restoration methods range from active revegetation (involving soil preparation and planting), to passive management (involving weed control and allowing time for natural recruitment to occur). Active restoration may assist the recovery of an area that has been disturbed and is showing difficulty in recovering. Any proposed restoration activity should utilize current, accepted techniques and avoid/minimize impacts to sensitive species or native vegetation communities. Any proposed revegetation activities should use only local native species.

The purpose of restoration within the Preserve is to reclaim native vegetation community acreage lost or compromised due to human or other induced disturbance involving the clearing or grading of native vegetation. Restoring disturbed areas will provide an overall increase of acreage of native vegetation, connectivity of existing native vegetation, and erosion control in areas of disturbance. Restoration of these areas is important to the integrity of the surrounding vegetation communities, as cleared areas can provide opportunity for non-native species to colonize (many non-native annuals are flashy fuels that can increase fire danger), provide opportunity for erosion by exposing the soil surface, reduce acreage of native vegetation communities, and sever connectivity among vegetation communities.

4.1 Proposed Restoration Areas

The Preserve is generally composed of high quality native vegetation communities and habitat restoration opportunities are limited within the Preserve. Within the Preserve, 2.9 acres of disturbed habitat are proposed for restoration, which primarily include old dirt road spurs, graded turnarounds and non-native plant removal areas. These areas are numbered 1 through 9, as shown in Figures 6b through 6d. Passive restoration is recommended for Restoration Area 8 as identified on Figure 6d. Active restoration is recommended for Restoration areas 1 through 7, and 9 as identified on Figures 6b through 6d.

4.2 Restoration Methods

Two methods of restoration are proposed for the disturbed areas within the Preserve: (1) passive restoration, and (2) active restoration. Of the 2.9 acres proposed for restoration, 0.9 acre is identified as passive restoration and 2.0 acres as active restoration (Figures 6a through 6d).

4.2.1 Passive Restoration

Passive restoration involves performing weed and erosion control, as needed, in disturbed areas where natural recruitment of native plant species is actively occurring. Passive restoration is recommended for Restoration Area 8 (Figure 6d). Since the process of recruitment and establishment of native plant species has already begun in this area, no soil disturbance (e.g., ripping, tilling, grading) or other soil preparation is recommended. Based on individual site conditions, erosion control measures and weed control should be conducted where necessary. Erosion control features will help to limit further erosion and soil loss and, if installed correctly, will capture sediments that can create areas for native plants to establish. Passive restoration areas should be maintained weed free to allow native recruitment to continue until the area is reincorporated back into the surrounding southern mixed chaparral. Should natural recruitment slow, or stop over time, seed application and/or container plants could be incorporated.

4.2.2 Active Restoration

Active restoration involves soil preparation and planting of disturbed or degraded areas where native vegetation recruitment is not actively occurring. Active restoration is recommended on cleared areas which are not showing significant natural recruitment of native plant species, and/or which are degraded from erosion. These areas are numbered 1 through 7 and 9 (Figures 6b through 6d). These areas should be prepared prior to planting by ripping the soil, incorporating organic matter, and re-contouring to natural contours. Appropriate erosion control measures should be installed after site preparation activities to limit potential erosion and soil loss. Upon completion of site preparation activities, native seed and container plants may be installed. Weed control should be performed regularly, to allow container plants to establish and transition the area to native vegetation.

Preparation of the soil should begin with ripping to loosen the soil surface layer and allow for seed to be incorporated into the soil. It is recommended that the sites are ripped, to a depth greater than 12 inches, and amended with organic matter to assist in creating soil structure to reduce settling. Ripping a soil without incorporation of organic matter provides only temporary and marginal initial increase in infiltration capacity and soil structure improvement, and soil settlement and surface sealing can occur and reduce or negate any positive gains to soil structure (Luce 1997). No fertilizer is recommended for addition to the amendments, as this can favor establishment of faster growing, annual non-natives. The final ripping/tilling pattern should avoid having the “rows” parallel to the fall line of the slope to reduce presence of microtopography which may assist formation of rill or gully erosion.

Following ripping and any necessary re-contouring, seed and/or container plants could be installed. Plant materials should be native species from San Diego County, originating within 25 miles from the site. Tables 8 through 11 provide seed mixes and plant palettes for areas of active restoration. These are native species which are common to southern mixed chaparral and coastal sage scrub found in the Preserve. Restoration areas 1, 2, 3, 4, and 7 are coastal sage scrub. Restoration areas 5, 6, and 9 are southern mixed chaparral. Plant quantities, rates, and composition should be determined on an individual basis, based on the existing plant composition around the restoration sites. Additional native species appropriate to the adjacent vegetation community may be added as appropriate.

Table 8
Chaparral Seed Mix

Scientific Name	Common Name	%Purity	%Germination	Lbs/Acre
Achnatherum coronatum	giant needlegrass	70	40	2
Adenostoma fasciculatum	chamise	90	20	4
Baccharis sarothroides	chaparral broom	5	40	0.5
Ceanothus tomentosus var. *olivaceus*	woolly leaf ceanothus	95	65	2
Eriogonum fasciculatum	California buckwheat	10	65	4
Eriophyllum confertiflorum	golden yarrow	30	50	0.1
Eschscholzia californica	California poppy	98	75	0.5
Hazardia squarrosa	sawtooth goldenbush	10	20	2
Helianthemum scoparium	rock rushrose	95	60	0.5
Lasthenia californica	California goldfields	50	60	0.5
Lessingia filaginifolia	sand aster	2	4	2
Lotus scoparius	deerweed	95	40	0.5
Lupinus bicolor	pygmy lupine	98	80	2
Malacothamnus fasciculata	chaparral mallow	15	60	4
Malosma laurina	laurel sumac	95	60	0.5
Mimulus aurantiacus puniceus	sticky monkeyflower	2	60	0.5
Nassella lepida	foothill needlegrass	90	60	2
Plantago erecta	dot seed plantain	98	75	1
Rhamnus crocea	spiny redberry	90	40	3
Rhus integrifolia	lemonade berry	90	60	4
Salvia mellifera	black sage	70	50	1
Vulpia microstachys	small fescue	90	80	1
Xylococcus bicolor	Mission manzanita	90	40	4
			Total	**41.6**

Table 9
Chaparral Container Plant Species

Scientific Name	Common Name	Average Spacing, Feet on Center
Adenostoma fasciculatum	chamise	4
Baccharis sarothroides	chaparral broom	4
Ceanothus tomentosus var. *olivaceus*	woolly leaf ceanothus	5
Ceanothus verrucosus	wart-stemmed ceanothus	5
Eriogonum fasciculatum	California buckwheat	4
Hazardia squarrosa	sawtooth goldenbush	4
Malacothamnus fasciculata	chaparral mallow	6
Malosma laurina	laurel sumac	8
Mimulus aurantiacus puniceus	sticky monkeyflower	5
Rhamnus crocea	spiny redberry	5
Rhus integrifolia	lemonade berry	8
Salvia mellifera	black sage	5
Xylococcus bicolor	Mission manzanita	5

Table 10
Coastal Sage Scrub Container Seed Mix

Scientific Name	Common Name	%Purity	%Germination	Lbs/Acre
Artemisia californica	California sagebrush	10	65	5
Encelia californica	California encelia	40	60	5
Eriogonum fasciculatum	California buckwheat	10	65	4
Eriophyllum confertifolium	golden yarrow	30	50	1
Eschscholzia californica	California poppy	98	75	1
Lasthenia californica	California goldfields	50	60	1
Lessingia filaginifolia	sand aster	2	4	2
Lotus scoparius	deerweed	95	40	3
Malosma laurina	laurel sumac	95	60	1
Mimulus aurantiacus puniceus	sticky monkeyflower	2	60	1
Nassella lepida	foothill needlegrass	90	60	1
Plantago erecta	dot seed plantain	98	75	1
Rhus integrifolia	lemonade berry	90	60	4
Salvia apiana	white sage	70	35	3
Salvia mellifera	black sage	70	50	4
Vulpia microstachys	small fescue	90	80	1
			Total	**38**

Table 11
Coastal Sage Scrub Container Plant Species

Scientific Name	Common Name	Average Spacing, Feet on Center
Eriogonum fasciculatum	California buckwheat	4
Heteromeles arbutifolia	toyon	12
Malosma laurina	laurel sumac	8
Mimulus aurantiacus puniceus	sticky monkeyflower	5
Rhus integrifolia	lemonade berry	8
Salvia mellifera	black sage	5

All of the proposed Restoration areas are adjacent, or reasonably near a primary or secondary road for access. This may provide opportunity for irrigation, either from a tanker truck sprayer, or from existing utilities within the road right-of-ways, should they exist at the given locations. Seed application should occur prior to the onset of the winter rainy season to take advantage of the full growing season. An effective seed application technique would be to hand broadcast seed, rake into the soil, and cover with a fine mulch seed topper at approximately ¼-inch depth. The fine mulch seed topper helps protect the seed from getting eaten by birds and rodents, and also helps keep the soil moist during the rainy season.

If container plants are installed, they should be installed in the fall at the onset of the rainy season. Without supplemental irrigation, installation of container plants would likely have limited success. Standard planting procedures should be employed for installing container plants. All container plants should be checked for viability and general health prior to installation. Holes approximately twice the size of the rootball of the plant should be dug using a shovel, post hole digger or power auger. Holes should be filled with water and allowed to drain immediately prior to planting. Backfill soil containing amendments (such as a fertilizer tab, or equivalent), as directed by the project's biologist, should be placed in every planting hole following soaking, and container plants should be installed so that the top of the root ball is at grade or slightly above grade. Plants should be monitored for signs of stress or mortality. In the months following planting, and especially if dryer than average conditions exist, periodic hand watering may be necessary to help establish the plants. Chaparral and coastal sage scrub species that can be planted from container stock are included in Tables 9 and 11.

5.0 FIRE MANAGEMENT

5.1 Current Fire Management Practices

Currently, fire management practices on the Preserve are limited to fuel modification zones and defensible space near some, but not all, adjacent residences, and include the following:

- 30 feet of fuel treatment along either side of Canyon de Oro and Paint Mountain Road, which serve as an evacuation route
- Defensible space associated with Preserve-adjacent structures on APNs 264-041-13 and 264-042-87 (VMUs 3 and 6, respectively).

The fragmented nature of the Preserve parcels allows for access via paved or maintained dirt roads. Some parcels contain power line access roads or other non-maintained dirt roads/trails which may be utilized in fire suppression efforts.

An analysis of the fire environment has been conducted as part of this VMP. This analysis, presented in the following sections, provides the basis for evaluation of existing fire management practices and their adequacy for meeting Preserve goals and providing for public safety.

5.2 Fire Environment

Several factors comprise the fire environment. Fires can occur in any environment where conditions are conducive to ignition and fire movement. The three major components of fire environment are climate, topography, and vegetation/fuels. The state of each of these components and their interaction with each other determine the potential characteristics and behavior of a fire at any given moment. Understanding these existing conditions is necessary to understanding the potential for fire within and around the Preserve.

Wildfires are a regular and natural occurrence in most of Southern California. However, increasing numbers of fires and acres burned annually has been experienced over the last decade. These wildfires are mostly human-caused, suggesting that the historic fire interval has been artificially affected across large areas. In addition, wildfire suppression efforts over the last several decades may have aided in the accumulation of fuels in some natural communities (Minnich 1983; Minnich and Chou 1997) resulting in larger and more intense wildfires. Large wildfires have had, and will continue to have a substantial and recurring role in native California landscapes (Keeley and Fotheringham 2003), in part because (1) native landscapes become highly flammable each fall, (2) the climate in the region has been characterized by fire climatologists as the worst fire climate in the United States (Keeley 2004) with Santa Ana winds

occurring during autumn after a 6-month drought period each year, and (3) ignitions via anthropogenic sources have increased or are increasing in many wildland or wildland-urban interface (WUI) areas.

Based on available information and an understanding of the fire environment of the region, it is expected that large wildfires will occur again and will burn within the Escondido Creek Preserve.

5.2.1 Climate

As with most of Southern California, the Preserve area is influenced to a certain extent by the Pacific Ocean and is frequently under the influence of a seasonal, migratory subtropical high pressure cell known as the Pacific High. Typical of a Mediterranean climate, wetter winters and dry summers, with mild seasonal changes, generally characterize the Southern California region. This climate pattern is occasionally interrupted by extreme periods of hot weather, winter storms, or dry, easterly Santa Ana winds.

Additionally, the local vegetation and the seasonal drying produce climatic conditions that result in fuel-driven wildfires and fire-associated climatic changes. This type of condition is referred to as a plume dominated wildfire. Plume dominated wildfires are fires where the energy produced by the fire in conjunction with atmospheric instability creates significant convective forces and increased winds. Such fires are extremely unpredictable, spread in various directions simultaneously, and exhibit extreme fire behavior. These fires are extremely dangerous and are often large in size.

The inland location of the Preserve affects the degree of influence of the Pacific Ocean, resulting in less regulated temperatures. The average high temperature for this area is approximately 77.7º Fahrenheit (F), with higher temperatures in summer and early fall (July through October) averaging between 87°F and 89°F. A record high temperature of 107°F at the nearby Summer Creek weather station was recorded on September 27, 2010, although this extreme temperature is rarely approached. The mean precipitation for the area is 15.1 inches per year, with the majority of rainfall concentrated in the months of December (1.78 inches), January (3.37 inches), February (3.16 inches), and March (3.30 inches).

The prevailing wind pattern is from the west, but the presence of the Pacific Ocean causes a diurnal wind pattern known as the land/sea breeze system. During the day, winds are typically from the west–southwest (sea), and, at night, winds are from the northeast (land). During the summer season, the diurnal winds can be slightly stronger 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. On the Preserve, the varied topography may affect wind velocity and patterns. The highest wind velocities are typically associated with downslope, canyon, and Santa Ana winds.

The fire season in Southern California typically starts in June as vegetation begins to dry out after winter and spring rains, and typically ends in October, although fire weather may be present year round (Schroeder and Buck 1970). The highest fire danger for this area coincides with the Santa Ana winds. 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. They are dry, 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.

General weather conditions for the region were derived from the Summer Creek weather station[1] and are presented in Table 12. Additional weather variables were analyzed to determine extreme fire weather conditions, specifically, 97th percentile wind and fuel moisture conditions to be used in the fire behavior modeling efforts conducted for the Preserve. The fire weather variables and an analysis of fire behavior for the Preserve are presented in Section 5.2.5 and Appendix C.

Table 12
General Weather Conditions for the Escondido Creek Preserve

Season	Wind Speed (mph)		Air Temp. (°F)			Humidity (%)			Avg. Monthly Precipitation (in.)
	Avg.	*Max.*	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*	
Summer (6/21–9/21)	8.7	15.0	73	106	55	59	88	8	0.06
Fall (9/22–12/20)	7.1	24.0	63	107*	38	56	95	6	0.66
Winter (12/21–3/19)	7.8	32.0	56	84	36	54	92	4	2.77
Spring (3/20–6/20)	9.6	17.0	64	96	44	60	88	8	1.54

* The high temperature of 107 degrees occurred on September 27, 2010

5.2.2 Topography

The topography of the Preserve includes moderate and steep slopes with elevation ranges from approximately 360 to 1,040 feet AMSL. The parcels in the northeastern-most portion of the Preserve are characterized primarily by the steep slopes associated with San Elijo Canyon. In this area, the Preserve includes steep north and south-facing slopes dropping toward Escondido Creek. Elevations in this area range from 440 feet to 1,040 feet AMSL while slopes measurements reach 120 percent (approximately 50 degrees).

The parcels in the central portion of the Preserve (adjacent to Elfin Forest Road) are characterized by north and south-facing slopes dropping toward Elfin Forest Road and a small drainage feeding

[1] The Summer Creek station is located in Escondido, approximately 2 miles northeast of the Preserve. The following summarizes the location and available data ranges for the Summer Creek weather station: Latitude: 33.096; Longitude: -117.116; Elevation: 820 feet; Data years: 2006 to 2011.

Escondido Creek to the south. Elevations in this area range from 480 feet to 760 feet AMSL while slope measurements reach nearly 85 percent (approximately 40 degrees). The parcels comprising the southwest portion of the Preserve are situated within three drainages that flow southward to Escondido Creek. The topography of this area is characterized by east and west-facing slopes. Elevations in this area range from 360 feet AMSL along drainage bottoms to over 760 feet AMSL. Slope measurements in this area reach 85 percent (approximately 40 degrees).

5.2.3 Watershed Description

The Preserve is located within the Carlsbad Watershed and all waters from Preserve lands drain to Escondido Creek. The northeast portion of the Preserve is located within San Elijo Canyon, through which flows Escondido Creek. A small tributary flows southward through the central portion of the Preserve toward Escondido Creek, located approximately 2,000 feet downstream. The parcels comprising the southwest portion of the Preserve are situated within three small drainages that flow southward to Escondido Creek, approximately 4,000 feet downstream from the southern-most Preserve parcel in this area. Escondido Creek flows westward and terminates at the Pacific Ocean approximately 7 miles from the western-most portion of the Preserve.

5.2.4 Fire History

Fire history is an important component in understanding fire frequency, fire type, significant ignition sources, and vulnerable areas. The topography, vegetation, and climatic conditions associated with the Preserve combine to create a unique situation capable of supporting large-scale, high-intensity wildfires, such as the Harmony Fire in 1996. The history of wildfires on the Preserve is graphically portrayed in Figure 7.

Based on historical fire perimeter data (FRAP 2011)[2], nearly all of the Preserve has burned at least once during the recorded data period, with fires occurring in 1943, 1986, 1989, and 1996. Approximately 43 percent of the Preserve has burned twice dating to 1943. Table 13 presents the quantity of times the Preserve has burned by land area (acreage).

[2] Based on polygon GIS data from CAL FIRE's Fire and Resource Assessment Program (FRAP), which includes data from CAL FIRE, USDA Forest Service Region 5, BLM, NPS, Contract Counties and other agencies. The data set is a comprehensive fire perimeter GIS layer for public and private lands throughout the state and covers fires 10 acres and greater between 1878 and 2008.

Table 13
Quantity of Escondido Creek Preserve Wildfires

Quantity of Times Burned*	Acreage	Percentage
0	0.68	0.2
1	196.61	56.7
2	149.33	43.1
Total	**346.62**	**100.0**

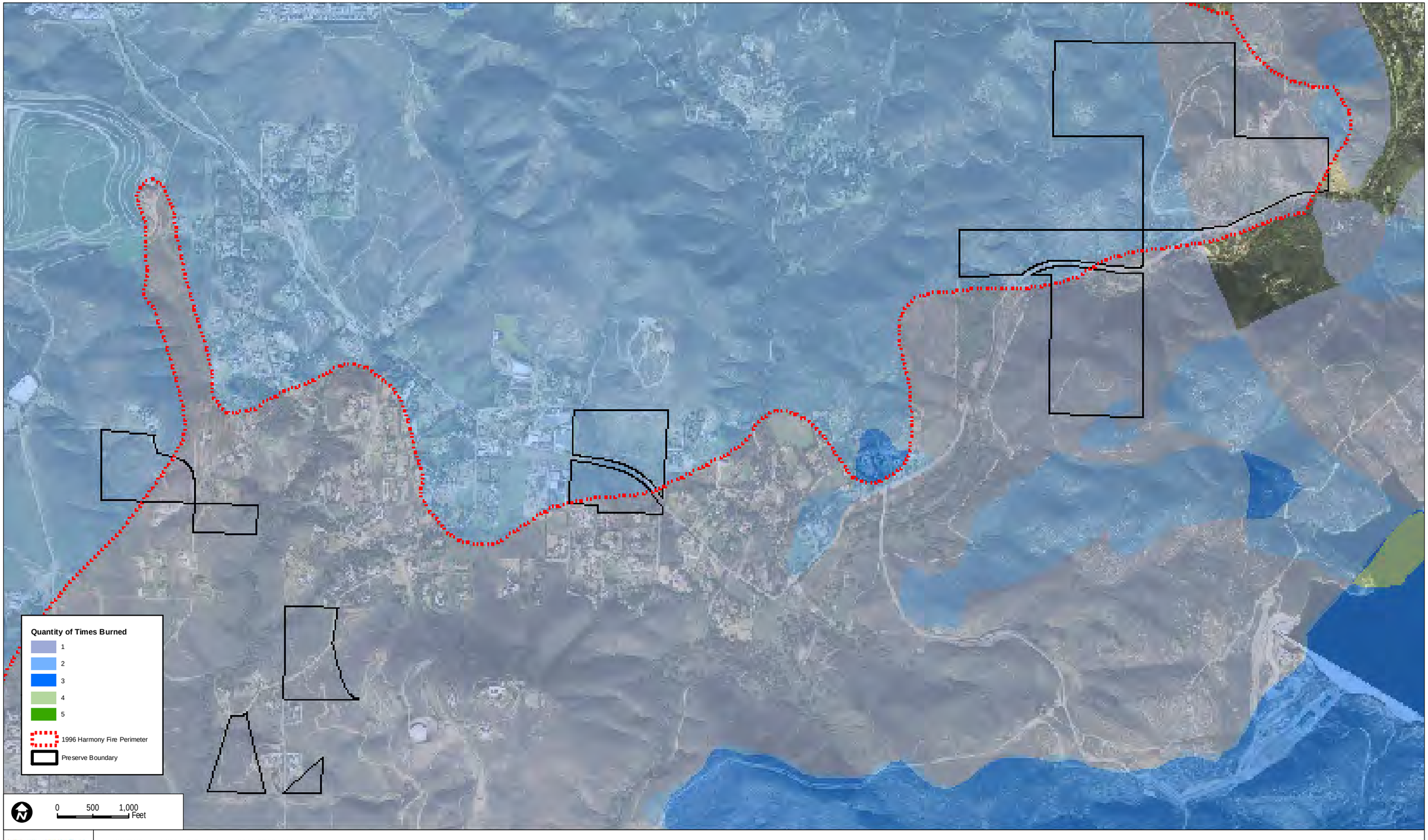
*FRAP 2011

Based on an analysis of this fire history data set, specifically the years in which the fires burned, the average interval between wildfires on the Preserve was calculated to be 18 years with intervals ranging between 3 and 43 years. Based on this analysis, it is expected that the Escondido Creek Preserve would be subject to wildfire occurrence every 18 years, with the realistic possibility of shorter interval occurrences. Table 14 presents the fire interval data for the Preserve.

Table 14
Fire Intervals for the Escondido Creek Preserve

Fire Year*	Fire Name	Interval (years)	Acreage Burned on Preserve	Percent of Preserve Burned**
1943	Un-named Fire	N/A	267.37	77.1
1986	Harmony Fire	43	0.06	0.0
1989	Harmony Fire	3	1.66	0.5
1996	Harmony Fire	7	226.17	65.3

*FRAP 2011
**Based on total Preserve acreage of 346.62



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SOURCE: SanGIS 2007; Digital Globe 2008; FRAP 2011

FIGURE 7

Fire History

Final Escondido Creek Preserve - Vegetation Management Plan

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Based on an analysis of the fire history, vegetation age classes on the Preserve vary depending on the extent and location of fire-free periods. Specifically, over 65% of the vegetation on the Preserve is 15 years old, burning most recently in the 1996 Harmony Fire. The remaining vegetation on site is a mixture of age classes, including: 22-year-old vegetation resulting from the 1989 Harmony Fire (0.5%); 68-year-old vegetation resulting from the un-named 1943 fire (34.1%); and vegetation older than 100 years (0.2%) which has not burned during the recorded fire history period. While younger vegetation is generally considered less susceptible to fire than the older vegetation, all vegetation is capable of igniting and carrying fire, especially during extreme weather (Red Flag Warning Conditions) and over time, the younger age vegetation will become more susceptible to fire ignition and spread.

5.2.5 Vegetation Dynamics and Fuel Loads

Utilizing site vegetation maps, field evaluations were conducted to evaluate fuel loading and classify vegetation types into fuel models (Anderson 1982, Scott and Burgan 2005, Weise and Regelbrugge 1997). Fuel model assignments are presented in Table 15 by vegetation type and are graphically presented in Figure 8. Certain vegetation types increase fire hazard based on plant physiology (resin content), biological function (flowering, retention of dead plant material), and/or physical structure (leaf size, branching patterns). Specifically, the following chaparral and sage scrub species found throughout the majority of the Preserve are considered to exhibit higher potential hazard based on such criteria: coastal sagebrush (*Artemisia californica*), chamise (*Adenostoma fasciculatum*), California buckwheat (*Eriogonum fasciculatum*), and black sage (*Salvia mellifera*).

In addition, non-native invasive plants can increase the frequency of fires by providing more continuous fuels that are more easily ignited (Brooks et al. 2004). Invasive plants also present hazards when located adjacent to neighboring structures or within fuel modification zones that are meant to provide defensible space. Non-native invasive species of the greatest concern within the Preserve include: tamarisk, pampas grass, sweet fennel, and eucalyptus (Figures 6a-d).

Table 15
Vegetation Communities and Associated Fuel Models for the Escondido Creek Preserve

Vegetation Community/Land Cover	Fuel Model	Acres	Percentage
Coast Live Oak Woodland	9	6.5	1.9
Diegan Coastal Sage Scrub	SCAL18	85.6	24.7
Disturbed Habitat	1	12.0	3.5
Eucalyptus Woodland	TU5	1.7	0.5
Non-native Grassland	1	3.3	0.9
Non-native Vegetation	GS2	0.8	0.2

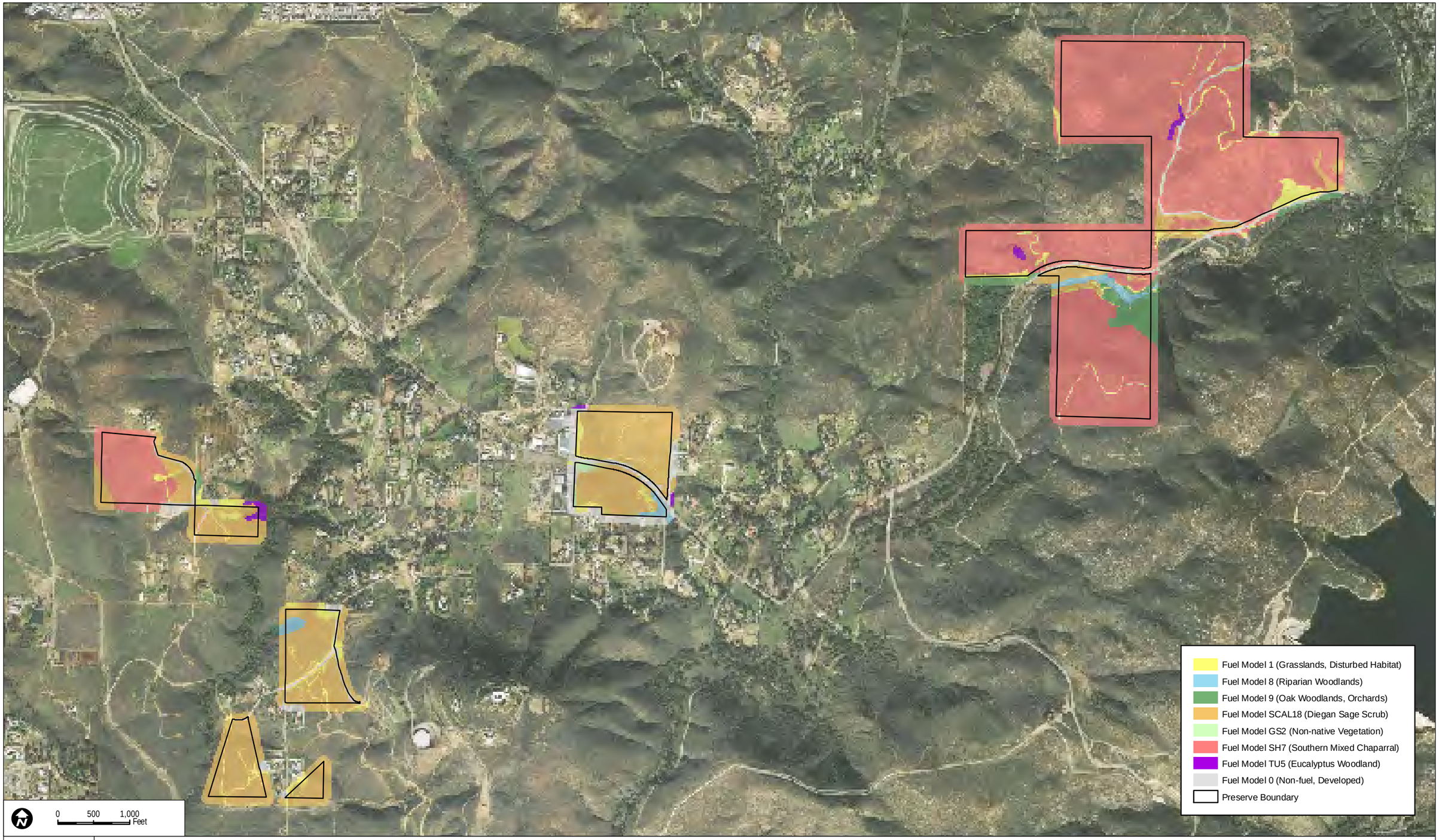
Table 15
Vegetation Communities and Associated Fuel Models for the Escondido Creek Preserve

Vegetation Community/Land Cover	Fuel Model	Acres	Percentage
Orchard	9	0.0	0.0
Southern Coast Live Oak Riparian Forest	8	1.9	0.5
Southern Mixed Chaparral	SH7	223.9	64.6
Southern Riparian Woodland	8	0.9	0.3
Southern Willow Scrub	8	1.9	0.5
Urban/Developed	98	6.9	2.0
Valley Needlegrass Grassland	1	1.2	0.4
	Total	**346.6**	**100.0**

Vegetation Dynamics

Vegetation plays a significant role in fire behavior and is an important component of the fire behavior models discussed in this report. A critical factor to consider is the dynamic nature of vegetation communities. Fire presence and absence at varying cycles or regimes affect plant community succession, or the natural sequential replacement of vegetation types over time. Succession of plant communities, most notably the gradual conversion of shrublands to grasslands in areas with high fire frequencies and short intervals between fires, and grasslands to shrublands in areas with fire exclusion or long fire-free periods, is highly dependent on fire characteristics, including intensity, duration, and return interval. Additionally, encroachment of non-native plant species from residential landscaping into wildland areas is already occurring and is expected to continue based on the proximity of ornamental landscaping to the open space. Consequently, routine maintenance of the fuel modification/defensible space zones, and establishment of defensible space zones in some areas, is needed to maintain reduced hazard conditions.

Biomass and associated fuel loading will increase over time, assuming that disturbance or fuel reduction efforts are not realized. Depending on factors such as fire exclusion activities, mechanical treatments, and prescribed burning, among others, the current vegetation composition and density will continue to change, either through increased volume and the establishment of non-native species or the continued degradation of scrublands and persistence of annual grasses.



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SOURCE: SanGIS 2007; Digital Globe 2008

FIGURE 8

Fuels Distribution

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Final Escondido Creek Preserve - Vegetation Management Plan

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The Preserve is dominated by southern mixed chaparral, with scattered patches of coastal sage scrub and grassland, as well as isolated oak woodland stands and riparian communities. It should be noted that chaparral and sage are generally not susceptible to annual burning, but grass cover can burn yearly (Minnich and Scott 2005). Lack of disturbance such as fire and grazing will, over time, allow shrub cover to establish in areas currently dominated by grass cover. Shrub cover, although less likely to burn in the first 20 years during typical weather conditions, will burn under extreme fire events (Moritz 2003). Once established, the shrub cover will increase in volume, and, following approximately 20 years, the hazard will increase corresponding with fuel age (Keeley 2005; Moritz et al. 2004). Additionally, as previously mentioned, encroachment of non-native plants into open space areas is likely based on the proximity of ornamental landscaping to undeveloped open space land, in many cases increasing the fuel load and likelihood for higher intensity fire.

As with the changes in vegetative cover in grassland habitats over time, changes in the chaparral, woodland, and forest types will also occur with the lack of disturbance. Chaparral stands will continue to accumulate biomass and volume, often retaining dead plant material within individual component shrubs. Oak woodland cover types tend to limit ground fuel accumulation with age. Canopy closure serves to „shade-out' understory plants, resulting in mature oak woodland characterized by a dense canopy layer and an understory consisting primarily of leaf and twig litter. Hardwood stands vary in species composition with disturbance, but maintain typically consistent shrub and tree cover with associated ladder fuels allowing the potential for canopy fire spread.

Southern Mixed Chaparral Fire Effects

Southern mixed chaparral communities cover the majority of the Preserve (223.9 acres). This vegetation type typically ranges from 1 to 3 meters (3 to 10 feet) in height with little herbaceous understory in mature stands. Chaparral vegetation communities have developed post-fire reproductive strategies intended to survive stand-replacing wildfires. Specifically, component plant species can be classified as obligate sprouters, obligate seeders, or facultative seeders. Obligate sprouters reproduce via root systems that survive after a fire (e.g., toyon), while obligate seeders rely solely on seedling establishment for survival (e.g., ceanothus, manzanita) (Conrad 1987). Facultative seeders are those chaparral species that stump sprout and regenerate via seed following fire (e.g., chamise) (Conrad 1987).

Current fire frequency in chaparral communities averages between 20 and 30 years (Keeley and Keeley 1988), although historic fire frequency is likely in the range of 50 to100+ years (Conard and Weise 1998). The shortening of fire-free periods in chaparral has been affected by increases in ignition sources due to the proximity of chaparral communities to developed/urban areas. Fires in

chaparral typically consume all above-ground vegetation. In the first year following fire, there is typically abundant herbaceous vegetative growth, although by the fifth post-fire year, shrub cover dominates the site (Keeley and Keeley 1988). In general, vegetation/fuel volume in chaparral will increase in the years following fire, with the rate of biomass increase leveling out between 20 and 40 years, depending on numerous site-specific variables (Conard and Weise 1998).

Diegan Coastal Sage Scrub Fire Effects

Diegan coastal sage scrub occupies 85.6 acres within the Preserve. Following fire, typical sage scrub succession includes a predominance of annual herbs during the first year. Non-native species may dominate a landscape after wildfire due to their success in establishing quickly and outcompeting many native species. Non-native species tend to decline in subsequent years without fire or other disturbances as shrubs establish and attain greater cover. Perennial herb understory species, which may grow from re-sprouts, show low recruitment from the soil seed bank. Unlike herbaceous annuals, the overall diversity of perennial understory herbs remains constant the first few years following fire. New species continue to become established in recovering sage scrub, reaching a peak at 5 to 10 years after a fire. After the peak in species diversity, there is a general decline in perennial understory herb species, possibly attributable to shading effects from dominant shrubs (Wills 2000; Keeley and Keeley 1984).

Lack of fire will allow shrub cover to return to burn areas over time. Recovering shrub cover is less likely to burn in the first 20 years during typical weather conditions, but will burn under extreme fire events (Moritz 2003). The Preserve's vegetation age is variable, with the majority of vegetation being 15 years old (65%) at the time of this report. Shrub cover will continue to increase in volume, and, within approximately 7 years, the fire hazard will increase corresponding with fuel age (Keeley 2005). Changes in land use will also affect the vegetation distribution pattern. For example, the encroachment of non-native plants is likely based on the proximity of residential development and ornamental landscaping to the Preserve.

Grassland Fire Effects

Annual grassland responses to fire are varied. A review and analysis of the response to burning and grazing of California grasslands indicates that prescribed burning temporarily reduces non-native annual grasses, but also results in increased non-native and native forbs (Rice 2005; Bainbridge and D'Antonio 2003; D'Antonio et al. 2003). These studies indicate that single prescribed burns often decrease non-native annual grasses, but they recover by the third year in the absence of additional disturbance. Grazing or follow-up burns hinder the recovery of non-native annual grasses and maintain forb cover.

One effect that appears to be fairly common among non-native grasses is that lower-intensity grassland fires rarely damage seeds on or near the soil surface (Daubenmire 1968). Since seeds on the soil surface are not generally exposed to high enough temperatures to cause mortality in a grassland environment, burn timing is most effective after desirable species have dispersed their seeds, but when target invasive species have their seed heads directly exposed to flames (DiTomaso et al. 2006). For management purposes, non-native grassland burning must be timed appropriately so that the target seeds are consumed, resulting in decreased re-establishment of non-natives and reduced competition for annual forbs.

Live Oak Woodland and Forest Effects

Oak woodland and forest communities (coast live oak woodland and southern coast live oak riparian forest) cover 8.4 acres of the Preserve. Coast live oak trees are very fire resistant, with fire adaptations including evergreen leaves, thick bark, and post-fire sprouting from surviving tissue. Fire intensity affects individual tree survival, with the amount and extent of trunk char and canopy consumption playing a critical role in survival and response (Plumb and Gomez 1983). Following burning, coast live oaks sprout from the main trunk and upper crown even after severe burning (Plumb and McDonald 1981). Post-fire recovery of coast live oak woodlands is dependent on fire intensity and fall fire damage is typically more severe than those occurring earlier in the year (Plumb and Gomez 1983). While the thick bark of mature coast live oak trees minimizes the effects of heat exposure from wildfire, seedlings and acorns are much more susceptible to mortality, even following low-intensity fires (Lawson et al. 1997). Recovery of coast live oaks may take up to 3 years, so post-fire cutting of affected trees should be postponed to verify whether re-sprouting will occur (Plumb and Gomez 1983).

As with coastal sage and chaparral, decreases in fire frequency in coast live oak woodlands and forests favors woodland/forest expansion into neighboring grassland (Callaway and Davis 1993). Fire behavior in oak woodlands and forests is typically much less intense than wildfires burning in chaparral and sage scrub communities. Low, compacted leaf litter understory, canopy shading of ground fuels, and wind velocity reduction resulting from tree canopies significantly reduce the intensity and spread rates of surface fires in oak woodland and forest vegetation types. Transition from ground to canopy fire increases fire intensity, spotting, and tree mortality potential.

Fire Behavior

Fire behavior modeling provides reasonably accurate representations of how wildfire would move through available fuels in high-fire hazard areas. Fire behavior calculations are based on site-specific fuel characteristics supported by fire science research that analyzes heat transfer related to specific fire behavior. Current and accepted fire research data from several programs

that specialize in the study of wildland fire were utilized for the completion of this analysis for the Preserve. To objectively predict flame lengths and intensities, the FlamMap fire behavior fuel modeling system was applied using predominant fuel characteristics from representative fuel models observed on the Preserve. In addition to fuels data, topographic and weather data were utilized in developing fire behavior models for two separate weather conditions: summer (on-shore flow) and fall (off-shore flow). Results of fire behavior modeling efforts for the Preserve are presented in Appendix C.

5.3 Fuel Management Methods

Successful fire management requires pre-planning and utilization of fire prevention techniques and strategies. As the majority of the preserve has been fire-free for over 15 years (65%), management of fuels is an important component of overall Preserve management. To that end, vegetation management units (VMUs), based primarily on parcel boundaries, have been delineated on the Preserve to assist with fuel management planning. Figure 9 illustrates the VMU boundaries. VMU specific fuel reduction recommendations are provided in Section 6.3. A list of general fuel management methods and their suitability for use in the Preserve are discussed below.

5.3.1 Grazing

Grazing is an effective fuel reduction method and can be compatible with Preserve management goals. Focused grazing is a feasible alternative on this Preserve, but would need to be highly managed to avoid introducing and spreading non-native species, overgrazing, or escape grazing. Currently there is no pressing need to introduce grazing. However, the method should remain in the management tool box for specific applications adjacent highly sensitive habitats, adjacent roadways and potentially in areas that are considered fuel modification zones.

5.3.2 Mowing

Mowing is one of the most common and successful methods for reducing fuel loads and is compatible with Preserve management goals; but is of limited use in rocky and rugged terrain. Mowing is a feasible option for the Preserve to meet roadside fuel modification guidelines. However, annual mowing may convert shrub dominated areas to grasslands over time. Therefore, mowing should be conducted in late spring after weedy annuals have stopped growing, but have not yet produced viable seed (Bell 2009).

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SOURCE: SanGIS 2007; Digital Globe 2008

FIGURE 9

Vegetation Management Units

Final Escondido Creek Preserve - Vegetation Management Plan

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5.3.3 Herbicides

Chemical means to control fuels/non-native plants are an effective method, but one that has a negative connotation, potential toxicity for humans and wildlife, and can affect water quality. Focused chemical selection and application minimizes the detrimental effects and makes the use of chemicals, such as glyphosate and other selective chemicals, a feasible alternative.

5.3.4 Prescribed Fire

Prescribed fire occurs in two forms: (1) natural fire, occurring primarily through lightning strikes that are then allowed to burn; and (2) intentional, managed fires. Natural fires are rare in San Diego County due to a general lack of lightning. However, natural fires may occur and if allowed to burn as part of a fire plan, would then be considered a prescribed fire. Although considered unlikely, if natural fire occurs on the Preserve and the fire is determined to pose no threat to life or high-value resources, the fire may be allowed to burn, if it meets fire authority objectives. If unsafe conditions exist (e.g., high winds, low humidity, high temperature) and, without suppression, it has a high likelihood of burning into areas of fire exclusion or is threatening valuable resources on or off site, then assertive suppression would be pursued.

Intentionally managed fires are planned ignitions for purposes of reducing fuels primarily for public safety or habitat improvement, are regulated by all applicable laws, and are managed by CAL FIRE's Vegetation Management Program. Where prescribed burning is feasible, it shall be conducted under permit from CAL FIRE, or under contract with CAL FIRE under the statewide Vegetation Management Program.

Prescribed fire on the Preserve is not considered a realistic management option. Prescribed fire can only be implemented by CAL FIRE, or a similar fire authority with experience and certifications to conduct burns. Prescribed fire can be the least expensive form of fuel reduction, but considering the fragmented nature of the Preserve and adjacent residential and commercial land uses, is not feasible for Escondido Creek Preserve.

5.3.5 Hand Tool or Mechanical Equipment Thinning

Thinning can reduce fuel continuity and loading by selective removal of dead and dying, overly dense horizontal and vertical bunches, and non-natives. This type of fuel reduction is most useful in the interface and intermix areas around high-value resources, such as residences. Adjacent residences would have to maintain their own defensible space off site, but on site extensions are provided by the Preserve. Thinning is recommended to occur on an annual basis prior to June for fuel modification areas associated with off-site residences or other habitable structures. Thinning

is appropriate anywhere in the Preserve where insect or disease outbreaks, frost or drought kill occurs resulting in dense, dead vegetation.

5.3.6 Fuel Breaks

Fuel breaks provide areas of removed fuels that play an important role in helping contain wildfires. The local fire departments and CAL FIRE attempt to minimize impacts to sensitive resources when fighting fires in wildlands, when possible; and where feasible, fires are allowed to run to natural breaks including trails and roads. These locations then serve as a defensive position for fighting the fire. The existing access road network through the Preserve and fuel modification zones generally meet the anticipated fuel break requirements for the Preserve.

5.4 Fire Response Plan

The EF/HGFD and CAL FIRE are the primary responders to the Preserve. It is expected that EF/HGFD and CAL FIRE would be the primary agencies involved in wildland fire suppression on the Preserve, with assistance from the Rancho Santa Fe Fire Protection District (RSFFPD) and the Encinitas Fire Department (EFD) under a mutual aid agreement, as needed. These fire agencies, as well as the other agencies that would respond via automatic or mutual aid, are extremely qualified and experienced for responding to wildfires in this area. The EF/HGFD is located on Elfin Forest Road, approximately 750 feet west of the central Preserve parcel along Elfin Forest Road.

CAL FIRE provides response to wildfires in the SRA, including the Preserve, and the EF/HGFD provides response to structure fires, wildfire, medical and associated emergencies. CAL FIRE has a vast arsenal of firefighting personnel and apparatus throughout San Diego County that can be called upon for responding to wildfires within or in the vicinity of the Preserve, including:

- Air tankers
- Helicopters
- Air-tactical aircraft (AA)
- Various engine types
- Crew transports
- Bulldozers
- Communications centers.

CAL FIRE utilizes three levels of dispatch and response based upon weather conditions and time of year. The three levels are:

- Low – includes two engines with three personnel each
- Medium – includes three engines (Type III) with three personnel each, one Battalion Chief, One mid-sized bulldozer, one type III Helicopter, and one 16 person hand crew
- High – includes five engines with three personnel each, one Battalion Chief, two medium bulldozers, one AA, two Air Tankers, and one Type III Helicopter.

Dispatch levels are based on weather conditions. Low dispatch occurs during the winter months from November through May. Medium and High dispatch occur during the normally declared fire season, June through October. There is some variation in the timing of the dispatch levels, based entirely on weather.

EF/HGFD currently employs the following firefighting apparatus with associated firefighting personnel:

- 27 volunteers and two paid staff provide year-round fulltime service
- Type I structure engines
- Type III wildland engines
- Ambulance
- Command vehicles
- Utility vehicle.

RSFFPD currently employs the following firefighting apparatus with associated firefighting personnel:

- Structure protection Type I pumpers
- Type III brush engines
- 1 water tender
- Command vehicles.

Fire Response

This VMP stresses the need for fire-fighting response to minimize impacts to natural resources, when possible, by using pre-planned fire suppression tactics and actions within the boundary of

the Preserve. Fire suppression is considered the top priority across the Preserve due to the shortened fire return interval realized over the last 20 to 25 years.

Fire Suppression Air Support with fire retardant drops may be a component of responses to the entire Preserve for achieving goals and objectives, especially under conditions that would accelerate wildfire spread. Under extreme conditions, or at night, air support may not be available, and in these situations, response categories may become secondary to public safety. Fires occurring within open space areas have demonstrated the potential to move through the Preserve into urban areas, consequently overwhelming available fire resources.

Response to a fire within the Preserve will likely include the use of existing access roads for firefighting personnel, type I engines (limited to paved roadways), type III engines, fire crews, air attack and fire retardant, helicopters, and air tankers. Fire suppression actions may include one or more of the following: direct attack with engines, fire crews, helicopters, and firing operations. Line construction activities within the Preserve would be best carried out by hand crews. Dozers/road graders may be activated but should not be put into operation on the Preserve itself unless necessary for improving existing roads for engine access or constructing line or secondary line for preservation of high-value resources, including plant and animal species, habitats, people, or property.

5.4.1 Fire Hazard and Current Fire Management Practices Evaluation

Based on site specific data analysis, discussions with fire agencies responsible for fire suppression, and fire behavior modeling results, the Preserve includes an ongoing fire hazard that can result in significant fire intensity and spread during extreme weather events. This section presents a discussion of fire hazard situations for the Preserve. This information was collected during initial site analysis and reviews of project data, fire behavior modeling results, and high-resolution aerial imagery and was integrated into the preparation of this document and associated recommendations.

1. Based on topography, vegetation, and fire history of the region, a large conflagration during Santa Ana wind conditions will likely enter the Preserve from the east, traveling down the San Elijo Canyon or through the open space to the east and north of the Preserve, as seen in the 1996 Harmony Fire. Fires during typical on-shore wind patterns are likely to enter the Preserve area from either the adjacent WUI, transportation corridors (e.g., Rancho Santa Fe Road, San Elijo Road, Elfin Forest Road, Harmony Grove Road), or from open space areas south or west of the Preserve.
2. The Preserve area can be primarily classified as wildland urban intermix area, with a less well-defined interface between residential development and open space. Intermix areas consist of low-density development with non-maintained fuels between structures

providing for easier fire spread and reduced containment ability. The Intermix threat exists primarily in the central and western portions of the Preserve, with more limited residential construction in the San Elijo Canyon portion of the Preserve.

3. Potential ignitions include a variety of residential related sources including structure fire, hot works, and yard machines, amongst others. Ignition sources not associated with residential development include vehicular associated ignitions (e.g., car fire, catalytic converter, tossed cigarette, etc.) along the adjacent roads. Additional non-residential ignition sources include electrical transmission lines near and on the Preserve, and arson.
4. Wildfires fueled by Santa Ana winds may move rapidly across the Preserve. Grassland, sage scrub, and chaparral fuels will be the predominant carriers of fire across the site with flame lengths in the chaparral fuels exceeding 20 feet. Steep slopes with even steeper walled drainages typify the topography of the Preserve, primarily in the San Elijo Canyon area. Fires in grassland fuels will be fast-moving ground fires with lower flame lengths (less than 20 feet) while those in chaparral or sage scrub fuels will move more slowly, but produce greater flame lengths (greater than 20 feet) and associated heat output (in excess of 5,000 British thermal units).
5. A fire originating in a structure within approximately a one-mile radius of the Preserve could result in burning embers landing within the Preserve before they decay to the point of being unable to ignite fuels, potentially resulting in vegetation ignition if there is a receptive fuel bed.

Based on current roadways, firefighting access is good for most of the Preserve. For the eastern portion of the Preserve (San Elijo Canyon area), firefighting may be difficult on the Preserve due to lack of roads, or presence of only dirt roads that are not designed to accommodate typical responding fire apparatus (with the exception of the paved private road through the northeastern-most Preserve parcel. For the San Elijo Canyon portion of the Preserve, access under wildfire conditions is precarious and potentially dangerous due to narrow, steep, and dead-end roads with varying levels of traction, and vegetation (primarily chaparral) and terrain that can result in significant fire intensity and irregular spread. Air attack will be an important component, but may not be available or usable depending on the extent of the fire event and/or the time of day and weather conditions. For the central and western portions of the Preserve, access is good and vegetation (sage scrub) and terrain likely to result in less-intense fire than expected in the San Elijo Canyon portion of the Preserve. Firefighting in the central and western portions of the Preserve is expected to be driven primarily by structure protection efforts, given the more significant wildland urban intermix condition. Air attack in this area may also be an important component depending on fire intensity and spread rate, but may not be available or usable,

depending on the extent of the fire event, the time of day, weather conditions, and proximity to overhead power lines.

The catastrophic wildfire threat for the Preserve is extreme when severe fire weather occurs, which will coincide with Red Flag Warning periods. Red Flag Warnings are declared by the National Weather Service. The Preserve is located in Fire Weather Zones 243 (San Diego County Coastal Areas) and 250 (San Diego County Inland Valleys). For both zones, Red Flag Warnings are issued when sustained winds are greater than 25 miles per hour (mph) (with gusts greater than or equal to 35 mph) and relative humidity is 15% or lower (for at least six hours) or dry lightning occurs with more than isolated coverage (National Weather Service, San Diego Office 2011).

Beyond these provisions, fire management practices are restricted to response and tactical suppression efforts associated with wildfires originating on or burning onto the Preserve. No active fire or fuels management plans are currently employed on site.

5.4.2 Primary Actions and Contacts for Wildfire Emergency

The following persons/agencies should be contacted in the event of a wildfire on the Preserve or for information regarding fire management activities.

CAL FIRE
San Diego Unit
Emergency: 911
Non-Emergency - Unit Chief, El Cajon: 619.590.3100
Website: http://www.fire.ca.gov/

Elfin Forest/Harmony Grove Fire Department
Emergency: 911
Non-Emergency - Fire Chief: 760.744.2186
Website: http://www.eff-fire.org/

5.4.3 Roads/Access

Road access in the Preserve is variable, depending on Preserve parcel location. In general, road access is good in the central and western portions of the Preserve as this area is characterized by smaller Preserve parcels situated in a wildland urban intermix location. A network of paved, dirt, and power line access roads exists throughout the central and western portions of the Preserve, providing direct access to all parcels, some even bisecting Preserve lands. Conversely, road access in the northeastern portions of the Preserve in the San Elijo Canyon area is very limited, primarily

due to terrain, hydrology, and larger contiguous Preserve areas. Primary access in this area is gained via the Mt. Israel Truck Trail (dirt), or via a paved private road providing access to a small number of residences north of Harmony Grove Road. The majority of the Preserve is accessible via non-gated public or private roads, although gates limit public access to some Preserve parcels. Detailed access descriptions to the different Preserve parcels and associated VMUs are presented in Table 16. Road and gate locations are graphically presented in Appendix B.

5.4.4 Fuel Breaks

The existing road network throughout the Preserve area, and the existing fuel modification zones along the Preserve boundary adjacent to residential residences currently serve as fuel breaks. The existing road network (paved and dirt) in the Preserve area already provides numerous breaks in fuel continuity, therefore, creation of additional fuel breaks at this time is not recommended. However, the need for fuel breaks is dependent on the specific conditions of a fire. If new fire breaks are required, the location should be coordinated with the Incident Command Team where possible. The Incident Command Team includes the District Park Manager and fire agency staff with access to location information on sensitive biological and cultural resources that should be avoided, if possible.

5.4.5 Emergency Staging Areas

Due to the fragmented nature of the Preserve parcels, it is anticipated that fire response staging locations will vary, depending on fire location and progression. Staging areas, important for incident command and to organize, plan, and implement firefighting strategies, typically cause higher ground disturbance from personnel, vehicles, and equipment in confined areas. Staging areas for fires that affect the Preserve will likely occur off site in well-defended, lower hazard areas.

5.4.6 Fire Hydrants

Fire hydrants are located within adjacent residential development areas and on the periphery of the Preserve along existing roadways. Fire hydrants may be utilized during a fire event to refill engines, as necessary.

5.4.7 Other Water Sources

Other water sources which may be available during a wildfire event within the Preserve include:

- Lake Hodges, approximately 2.3 miles from the northeastern-most Preserve area and no more than 4.6 miles from the furthest reaches of the Preserve (western-most area), provides helicopter dipping access.

- The Olivenhain Reservoir, immediately east of the Preserve and approximately 1.3 miles from the northeastern-most Preserve area and no more than 3.5 miles from the furthest reaches of the Preserve (western-most area), is a source for helicopter dipping.

6.0 MANAGEMENT DIRECTIVES

This section provides recommendations for vegetation management within the Preserve including management directives specifically related to: invasive species management; habitat restoration; and fire management.

6.1 Invasive Species Removal

The short-term management directives below address high priority invasive species removal while longer term management directives consider invasive species for their risk of reducing vegetation community quality over time.

Management Directive Invasive 1 – Remove and Control High Priority Invasive Non-native Species. Remove aggressive, invasive non-native plant species and those with a high fire hazard within the Preserve, such as eucalyptus, as soon as possible.

Management Directive Invasive 2 – Identify and Pursue Funding for Long-term Invasive Non-native Plant Control. Coordinate with other agencies, non-profit organizations, and/or volunteer groups in order to seek funding and implement invasive, non-native plant removal projects for moderate and low priority non-native species within the Preserve.

Management Directive Invasive 3 – Conduct Invasive Non-native Species Monitoring. Continue to monitor other identified non-native species within the Preserve to determine if removal efforts are warranted in order to maintain and/or improve the quality of the existing native vegetation communities on site.

Management Directive Invasive 4 – Educational Outreach. Prepare and implement an invasive non-native plant species educational outreach program/materials to reduce use of these plants by adjacent property owners.

6.2 Restoration

The primary management directives for native vegetation community restoration include:

Management Directive Restoration 1 – Restore Native Vegetation Community Quality and Function. Restore the identified degraded areas to reestablish and/or enhance the biological functions and values of native vegetation communities in these areas.

1A – Passive Restoration. Perform weed and erosion control as needed in disturbed areas where natural recruitment of native plant species is actively occurring (Figure 6d; Restoration Area 8), as described in Section 4.2.1.

1B – Active Restoration. Conduct soil preparation and native planting of disturbed or degraded areas where native vegetation recruitment is not actively occurring (Figures 6b through 6d; Restoration areas 1 through 7, and 9), as described in Section 4.2.2.

Management Directive Restoration 2 – Address Long-term Restoration Needs. Restoration activities should occur following landscape changing disturbances that remove, damage, degrade, or alter the existing native vegetation communities. Restoration methods will be customized to the Preserve, based on the type of disturbance, and will require preparation and implementation of a restoration plan. Restoration will incorporate active revegetation, including:

- Native vegetation community establishment/creation
- Native vegetation community enhancement
- Removal of invasive plants when they are young
- Application of herbicides, pesticides and fertilizers if needed
- Application of supplemental irrigation if needed.

Management Directive Restoration 3 – Monitor Invasive Non-native Plant Removal Sites. Continue to monitor invasive species removal sites to ensure that passive natural recruitment is successfully occurring in these areas.

Management Directive Restoration 4 – Monitor Native Vegetation Community Quality. Continue to monitor the quality of native vegetation communities throughout the Preserve using comparative vegetation mapping over time and evaluation of potential type conversions.

Management Directive Restoration 5 – Monitor Pests and Disease. Monitor the presence of disease or pest levels to determine outbreaks and prescribe an active treatment, as appropriate.

6.3 Fire Management

The long-term strategic fire management plan considers strategic fire prevention activities, fire suppression with regard to fire effects on habitat, and post-fire monitoring and rehabilitation. The long-term strategic fire plan for the Preserve must prioritize public safety while meeting habitat management goals. Management directives are as follows.

Management Directive Fire 1 – Fire Suppression: Fire suppression, in combination with other management methods in targeted Preserve habitat management areas, is the priority for the northern portion of the Preserve (15-year-old vegetation) comprised of southern mixed chaparral. Lengthening the fire return cycle to an optimal frequency will require fuel reduction experiments, research, monitoring, and analysis as part of the overall management approach. The optimal fire frequency in southern mixed chaparral may be from 50 to 100 years or more (Conard and Weise 1998). It may be difficult to achieve the longer fire return intervals given the current and projected ignition sources that may affect the Preserve.

For the portions of the Preserve characterized by older vegetation (68 years), fire suppression efforts should focus on asset protection (residences, cultural sites, and sensitive species) and, when feasible, fire should be allowed to burn through the Preserve areas. However, results of site data analysis will more firmly establish the optimal return intervals to meet habitat goals, or if additional steps need to be implemented, to lengthen the return of fire.

Management Directive Fire 2 – Maintain Fuel Modification Zones. Annually maintain the existing fuel modification zones within the Preserve (Figure 9; VMUs 3, 4, 3-WUI, 6-WUI, and 7-WUI), as identified in Table 16.

Management Directive Fire 3 – Delineate Fuel Modification Areas. Install and maintain inconspicuous fuel modification extent markers for all fuel modification zones (Figure 9; VMUs 3, 3-WUI, 4, 6-WUI, and 7-WUI) to minimize additional thinning outside intended area.

Management Directive Fire 4 – Access Data Sharing. Maintain local fire agency gate locks and report any notice of removed or missing locks to the appropriate fire agency. Signs should be installed indicating access limitations and extents (map form) and provide road quality to local fire responders. This information will be included in their wildland pre-response plans, resulting in more efficient responses. Information readily

accessible by responders not familiar with the area, such as out-of-County or out-of-state responders, will improve fire fighter safety.

Management Directive Fire 5 – Control Illegal Access. Continue to restrict off-highway vehicles and shooting access. These are potential ignition sources that must be managed through restricting access (e.g., use of fence, gates, signage) and by establishing a high profile presence of park ranger staff.

Management Directive Fire 6 – Educational Outreach. Private property owners in the interface or intermix (located adjacent to the Preserve) should be encouraged to play an active role in reducing the potential fire hazard. It will also be beneficial if the public understands the management actions occurring on the Preserve, such as grazing, mowing, and herbicides, as applicable. As such, this VMP recommends a concerted effort to reach property owners who are situated in locations that may be affected by wildfire on the Preserve or whose properties and actions may serve as Preserve ignition sources. Educational material can be customized for these homeowners to include discussion of the importance of the Preserve. Standard measures for implementing a 100-foot fuel modification/defensible space zone can be provided from materials available from CAL FIRE and from the County of San Diego Department of Planning and Land Use[3]. As part of the public education program, private property owners should be encouraged to participate as "eyes on the Preserve" to help curb illegal access and report potential problems.

Management Directive Fire 7 – Reduce Ignition Sources: Ignition sources are present on and adjacent the Preserve. The high voltage electrical transmission lines that cross the Preserve present potential ignition sources. Adjacent sources include roadways with vehicular travel, especially Harmony Grove Road and Elfin Forest Road, adjacent residences, and recreational users, among many others. As such, it is not possible to remove all sources of ignition. Rather, reducing the potential spread of wildfire onto or throughout the Preserve is recommended. Fuel modification buffers on the Preserve edges near existing homes is provided in some instances, but will need to be provided for all adjacent ignition sources such that the source has 30-100 feet of fuel modification with half the fuel as an unmodified vegetation stand. Likewise, fuel reduction (especially non-native trees) beneath the transmission lines, as appropriate, and along utility line access roadways/trails will reduce the likelihood of ignitions and fire spread from the line or from vehicles on the access roads.

[3] On-line at: http://www.fire.ca.gov/cdfbofdb/pdfs/4291finalguidelines2_23_06.pdf
and http://www.sdcounty.ca.gov/dplu/fire_resistant.html

Management Directive Fire 8 – Conduct Recommended Fuels Management. Conduct fuels management using the identified VMUs, as feasible and as presented in Table 16. Table 16 provides a summary of the high-value resource areas acknowledged for the Preserve and the associated fire prevention strategy recommended for achieving long-term management goals.

Management Directive Fire 9 – Post-fire Management and Erosion Control. Provide controls following fire events to stabilize soils in the burn area and minimize potential for erosion. Erosion control best management practices (BMPs), such as mechanical rehabilitation treatments including straw mulch, hay bales, and jute rolls, should be in place as soon as possible after a fire and prior to the onset of the winter rainy season. Care should be taken to select and inspect these materials so they are not a source of invasive non-native plants. The use of certified weed-free hay is good policy (Bell 2009).

Table 16
Fuel Management Activities by VMU

VMU	Sensitive Resources	Fuel Reduction Practice
1 Area: 24.1 acres APNs: 264-031-40, 264-031-39 Access: Via Seaquest Trail	Sensitive Plant Species: Ashy spike-moss Wart-stemmed ceanothus Sensitive Animal Species: Bell's sage sparrow Coast (Blainville's) horned lizard Northern harrier	VMU 1 consists primarily of southern mixed chaparral, with smaller areas of coastal sage scrub in the eastern and southwestern portions of the VMU. Chaparral is predominantly 15 years in age in the western 2/3 of the VMU, while the remaining eastern portion is 68 + years old. Fuel treatment in VMU 1 should be limited to invasive species removal and strategic removal of dead fuels adjacent to existing roadways. Establishment of non-native plants, disease or pest-caused mortality of adjacent plants, or other means that result in increased ignition potential may require strategic thinning. If vegetation removal is necessary near sensitive species, sensitive species locations should be flagged and avoided to the maximum extent possible. Vegetation should be removed via manual methods in these areas.
2 Area: 8.4 acres APN: 264-031-33 Access: Via Seaquest Trail and power line access road within VMU.	Sensitive Animal Species: Coastal California gnatcatcher Southern California rufous-crowned sparrow	VMU 2 consists primarily of coastal sage scrub, with smaller sections of grassland and eucalyptus woodland. All vegetation is 68 + years old. Fuel treatment in VMU 2 should be limited to invasive species removal and strategic removal of dead fuels adjacent to existing roadways. Strategic understory shrub thinning/crown raising may be implemented along the sage scrub-eucalyptus interface to minimize the potential for crown fire occurrence, which is adjacent to an oak woodland system immediately east of the VMU. Establishment of non-native plants, disease or pest-caused mortality of adjacent plants, or other means that result in

Table 16
Fuel Management Activities by VMU

VMU	Sensitive Resources	Fuel Reduction Practice
		increased ignition potential may require strategic thinning. If vegetation removal is necessary near sensitive species, sensitive species locations should be flagged and avoided to the maximum extent possible. Vegetation should be removed via manual methods in these areas.
3 Area: 22.3 acres APN: 264-041-13 Access: Via Canyon de Oro (which bisects VMU), Fortuna del Este, Suerte del Este, or Paint Mountain Road.	Sensitive Plant Species: Ashy spike-moss San Diego goldenstar San Diego (Palmer's) sagewort Sensitive Animal Species: Coastal California gnatcatcher Coronado skink Northwestern San Diego pocket mouse Red-shouldered hawk San Diego desert woodrat Yuma myotis	VMU 3 consists primarily of coastal sage scrub, with a small stand of coast live oak riparian forest in the northwest corner of the VMU. All vegetation is 68 + years old. Existing paved roads, power line access roads, and dirt trails bisect the VMU. DPR maintains a 30-foot-wide fuel modification zone along Canyon de Oro and Paint Mountain Road, which serve as a designated evacuation route. Fuel treatment in VMU 3 should be limited to invasive species removal and strategic removal of dead fuels adjacent to existing roadways. Strategic understory shrub thinning/crown raising may be implemented along the sage scrub-oak woodland interface to minimize the potential for crown fire occurrence, which could negatively impact the continuation of the oak woodland system immediately west of the VMU. Establishment of non-native plants, disease or pest-caused mortality of adjacent plants, or other means that result in increased ignition potential may require strategic thinning. In addition, the existing dirt trails are recommended for active restoration. If vegetation removal is necessary near sensitive species, sensitive species locations should be flagged and avoided to the maximum extent possible. Vegetation should be removed via manual methods in these areas.
3-WUI Area: 0.6 acres APN: 264-041-13 Access: Via west side of Canyon de Oro at north edge of VMU. Via east side of Paint Mountain Road at south edge of VMU.	Residences	VMU 3-WUI is characterized by the adjacent residential properties to the north and south of the Preserve and contains coastal sage scrub and grass fuels. DPR maintains these areas as fuel modification zones to protect the adjacent existing residential structures within 100 feet of the Preserve property boundary. This VMU should continue to be routinely maintained by manual thinning, mowing, and non-native plant removal to minimize fire spread and ignition potential from residential development.
4 Area: 12.8 acres APN: 264-032-10	Sensitive Plant Species: Ashy spike-moss Sensitive Animal Species:	VMU 4 consists almost entirely of 68+ year old coastal sage scrub. Existing power line access roads bisect the VMU. DPR maintains a 30-foot-wide fuel modification zone along Canyon de Oro, which serves as a designated evacuation route.

Table 16
Fuel Management Activities by VMU

VMU	Sensitive Resources	Fuel Reduction Practice
Access: Via Canyon de Oro or gated dirt Preserve access road at north end of VMU. Also via power line access road immediately north of 1420 Paint Mountain Road.	Coast (Blainville's) horned lizard Coastal western whiptail	Fuel treatment in VMU 4 should be limited to invasive species removal and strategic removal of dead fuels adjacent to existing roadways. Establishment of non-native plants, disease or pest-caused mortality of adjacent plants, or other means that result in increased ignition potential may require strategic thinning. If vegetation removal is necessary near sensitive species, sensitive species locations should be flagged and avoided to the maximum extent possible. Vegetation should be removed via manual methods in these areas.
5 Area: 3.1 acres APN: 264-041-30 Access: At south end of Paint Mountain Road.	Sensitive Animal Species: Southern California rufous-crowned sparrow	VMU 5 consists almost entirely of 68+ year old coastal sage scrub. Existing dirt trails bisect the VMU. Fuel treatment in VMU 5 should be limited to invasive species removal and strategic removal of dead fuels adjacent to existing roadways. Establishment of non-native plants, disease or pest-caused mortality of adjacent plants, or other means that result in increased ignition potential may require strategic thinning. In addition, the existing dirt trails are recommended for active restoration.
6 Area: 14.1 acres APN: 264-042-87 Access: Via Elfin Forest Road, Elfin Forest Lane, or Colina Encantada Way.	Sensitive Plant Species: Southwestern spiny rush Sensitive Animal Species: Coast (Blainville's) horned lizard Cultural Sites: CA-SDI-17,670	VMU 6 consists primarily of coastal sage scrub, with smaller areas of grassland and coast live oak riparian forest in the eastern portion of the VMU, and non-native vegetation in the western portion. Vegetation is predominantly 15 years in age in the northern 2/3 of the VMU, while the remaining eastern portion is 68 + years old. Fuel treatment in VMU 6 should be limited to invasive species removal and strategic removal of dead fuels adjacent to existing roadways. Strategic understory shrub thinning/crown raising may be implemented along the sage scrub-oak woodland interface to minimize the potential for crown fire occurrence. Establishment of non-native plants, disease or pest-caused mortality of adjacent plants, or other means that result in increased ignition potential may require strategic thinning. In addition, the non-native vegetation area is recommended for active restoration. If vegetation removal is necessary near sensitive species, sensitive species locations should be flagged and avoided to the maximum extent possible. Vegetation should be removed via manual methods in these areas. The prehistoric lithic scatter within VMU 1 is non-flammable and therefore not vulnerable to wildfires. This cultural site should be avoided and protected with an appropriate buffer during

Table 16
Fuel Management Activities by VMU

VMU	Sensitive Resources	Fuel Reduction Practice
		thinning/fuel reduction efforts. If access to the cultural site is necessary to control non-native species or to remove dead/dying vegetation, vegetation should be removed via manual methods. Any ground disturbance should be monitored by a County-approved archaeological and Native American monitor.
6-WUI Area: 1.1 acres APN: 264-042-87 Access: Along east side of Elfin Forest Lane, immediately north of 20089 Elfin Forest Lane.	Residences Cultural Sites: CA-SDI-17,670	VMU 6-WUI is characterized by the adjacent residential properties to the south of the Preserve and contains coastal sage scrub, grass, and oak woodland type fuels. DPR maintains these areas as fuel modification zones to protect the adjacent existing residential structures within 100 feet of the Preserve property boundary. This VMU should continue to be routinely maintained by manual thinning, mowing, and non-native plant removal to minimize fire spread and ignition potential from residential development. The prehistoric lithic scatter within VMU 1 is non-flammable and therefore not vulnerable to wildfires. This cultural site should be avoided and protected with an appropriate buffer during thinning/fuel reduction efforts. If access to the cultural site is necessary to control non-native species or to remove dead/dying vegetation, vegetation should be removed via manual methods. Any ground disturbance should be monitored by a County-approved archaeological and Native American monitor.
7 Area: 23.5 acres APN: 264-042-87 Access: Via Elfin Forest Road, Colina Encantada Way, or Aguilera Lane.	Sensitive Plant Species: Ashy spike-moss Sensitive Animal Species: Barn owl Coastal California gnatcatcher Cooper's hawk Red-shouldered hawk White-tailed kite	VMU 7 consists almost entirely of coastal sage scrub which is 15 years old. There is an existing disturbed area along the western portion of the VMU. Fuel treatment in VMU 7 should be limited to invasive species removal and strategic removal of dead fuels adjacent to existing roadways. Establishment of non-native plants, disease or pest-caused mortality of adjacent plants, or other means that result in increased ignition potential may require strategic thinning. In addition, the existing disturbed area is recommended for active restoration. If vegetation removal is necessary near sensitive species, sensitive species locations should be flagged and avoided to the maximum extent possible. Vegetation should be removed via manual methods in these areas.
7-WUI Area: 0.8 acres APN: 264-042-87	Residences	VMU 7-WUI is characterized by the adjacent residential and commercial property to the west of the Preserve and contains disturbed coastal sage scrub and grass type fuels. This entire VMU is considered a fuel modification zone to protect the adjacent residential and commercial structures.

Table 16
Fuel Management Activities by VMU

VMU	Sensitive Resources	Fuel Reduction Practice
Access: Along south side of Aguilera Lane, immediately east of 20303 Aguilera Lane.		This VMU should be routinely maintained by manual thinning, mowing, and non-native plant removal to minimize fire spread and ignition potential from the adjacent development.
8 Area: 61.4 acres APNs: 679-140-01, 679-140-12, 679-140-13, 679-140-14, 649-140-15 Access: Via gated City of Escondido sewer easement access road along south side of Harmony Grove Road, approximately 1,250 feet west of the Elfin Forest Interpretive Center Parking Area. Also via Mt. Israel Truck Trail accessed on the east side of Via Ambiente.	Sensitive Plant Species: Ashy spike-moss San Diego marsh-elder San Diego (Palmer's) sagewort Southwestern spiny rush Wart-stemmed ceanothus Sensitive Animal Species: Southern mule deer Red-shouldered hawk Two-striped garter snake Coastal western whiptail Yellow warbler	VMU 8 consists primarily of southern mixed chaparral, with a smaller area of live oak woodland, riparian habitat, and coastal sage scrub adjacent to Escondido Creek in the northern portion of the VMU, just south of Harmony Grove Road. Vegetation is predominantly 68+ years old. An existing easement access road and several dirt trails bisect the VMU. Fuel treatment in VMU 6 should be limited to invasive species removal and strategic removal of dead fuels adjacent to existing roadways. Strategic understory shrub thinning/crown raising may be implemented along the chaparral-oak woodland and chaparral-riparian vegetation interface to minimize the potential for crown fire occurrence. Further, dead fuel removal and invasive species removal should be conducted along the northern edge of VMU 8 where it abuts Harmony Grove Road to minimize the likelihood of ignitions. Establishment of non-native plants, disease or pest-caused mortality of adjacent plants, or other means that result in increased ignition potential may require strategic thinning. In addition, the dirt trails are recommended for active restoration. If vegetation removal is necessary near sensitive species, sensitive species locations should be flagged and avoided to the maximum extent possible. Vegetation should be removed via manual methods in these areas.
9 Area: 31.5 acres APNs: 679-140-01, 649-140-06 Access: Via gated access to old structure location, along north side of Harmony Grove Road, approximately 2,400 feet west of the Elfin Forest Interpretive Center entrance.	Sensitive Plant Species: San Diego (Palmer's) sagewort Southwestern spiny rush Wart-stemmed ceanothus Sensitive Animal Species: Barn owl Cooper's hawk Cultural Sites: P-37-031723 P-37-031724	VMU 9 consists primarily of southern mixed chaparral which is 68+ years old. Fuel treatment in VMU 6 should be limited to invasive species removal and strategic removal of dead fuels adjacent to existing roadways. Dead fuel removal and invasive species removal should be conducted along the southern edge of VMU 9 where it abuts Harmony Grove Road to minimize the likelihood of ignitions. Establishment of non-native plants, disease or pest-caused mortality of adjacent plants, or other means that result in increased ignition potential may require strategic thinning. If vegetation removal is necessary near sensitive species, sensitive species locations should be flagged and avoided to the maximum extent possible. Vegetation should be removed via manual methods in these areas.

Table 16
Fuel Management Activities by VMU

VMU	Sensitive Resources	Fuel Reduction Practice
		The cultural sites should be avoided and protected with an appropriate buffer during thinning/fuel reduction efforts. If access to the cultural sites is necessary to control non-native species or to remove dead/dying vegetation, vegetation should be removed via manual methods. Any ground disturbance should be monitored by a County-approved archaeological and Native American monitor.
10 Area: 142.8 acres APNs: 679-130-05, 679-130-12 Access: Via private road (Wild Willow Hollow) along north side of Harmony Grove Road, approximately 500 feet east of the Elfin Forest Interpretive Center entrance. This road provides access to adjacent residences.	Sensitive Plant Species: Wart-stemmed ceanothus Sensitive Animal Species: Barn owl Bell's sage sparrow Cooper's hawk Southern mule deer Pocketed free-tailed bat San Diego black-tailed jackrabbit Western red bat Coastal western whiptail Yuma myotis	VMU 10 consists primarily of southern mixed chaparral, with a small area of non-native grassland in the southeast portion of the VMU. A paved road and dirt spur road bisect the VMU. Vegetation is 15 years old. Fuel treatment in VMU 10 should be limited to invasive species removal and strategic removal of dead fuels adjacent to existing roadways. Dead fuel removal and invasive species removal should be conducted along the northern edge of VMU 10 where it abuts Harmony Grove Road to minimize the likelihood of ignitions. Establishment of non-native plants, disease or pest-caused mortality of adjacent plants, or other means that result in increased ignition potential may require strategic thinning. In addition, there are several areas recommended for passive and active restoration. If vegetation removal is necessary near sensitive species, sensitive species locations should be flagged and avoided to the maximum extent possible. Vegetation should be removed via manual methods in these areas.

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APPENDIX A

Glossary of Terms and Acronyms

Appendix A
Glossary of Terms and Acronyms

Glossary of Terms -and Acronyms and Abbreviations

Acronyms and Abbreviations

AMSL – Above Mean Sea Level

ASMD – Area-Specific Management Directives

BMP – Best Management Practices

BTU – British Thermal Unit

CAL FIRE – California Department of Forestry and Fire Protection

Cal-IPC – California Invasive Plant Council

CEQA – California Environmental Quality Act

CNPS – California Native Plant Society

DPR – County of San Diego Department of Parks and Recreation

EF/HGFD – Elfin Forest/Harmony Grove Fire Department

MSCP – Multiple Species Conservation Program

MSDS – Material Safety Data Sheets

NOAA – National Oceanic and Atmospheric Administration

NFFL – National Forest Fire Laboratory

RAWS – Remote Automated Weather Station

RSFFPD - Rancho Santa Fe Fire Protection District

SRA – State Responsibility Area

USGS – United States Geological Survey

VMP – Vegetation Management Plan

VMU – Vegetation Management Unit

WUI – Wildland-Urban Interface

Terms

BehavePlus: Fire behavior prediction and fuel modeling computer program designed to model fire behavior characteristics based on fuel, weather, and topographic inputs. Model outputs include flame length values, fire spotting potential, and rate of fire spread.

Brush: A collective term that refers to stands of vegetation dominated by shrubby, woody plants, or low-growing trees; usually of a vegetation type undesirable for livestock or timber management.

Canopy: The stratum containing the crowns of the tallest vegetation present (living or dead), usually above 20 feet.

Combustible: Any material that, in the form in which it is used and under the conditions anticipated, will ignite and burn.

Conflagration: A raging, destructive fire. Often used to describe a fire burning under extreme fire weather. The term is also used when a wildland fire burns into a wildland/urban interface, destroying structures.

Crown Fire: A fire that advances from top-to-top of trees or shrubs more or less independent of a surface fire.

Defensible Space: An area either natural or man-made, where material capable of allowing a fire to spread unchecked has been treated, cleared or modified to slow the rate and intensity of advancing wildfire. This will create an area for increased for emergency fire equipment and evacuating or sheltering civilians in place and a point for fire suppression to occur.

Duff**:** The layer of decomposing organic materials lying below the litter layer of freshly fallen twigs, needles and leaves and immediately above the mineral soil.

Extreme Fire: A level of fire behavior characteristics that ordinarily precludes methods of direct control. One or more of the following is usually involved: high rates of spread, prolific crowning and/or spotting, presence of fire whirls, a strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environments and behave erratically, sometimes dangerously.

Fire Behavior: The manner in which a fire reacts to the influences of fuel, weather, and topography.

Fire Department: Any regularly organized fire department, fire protection district or fire company regularly charged with the responsibility of providing fire protection to the jurisdiction.

Fire Hazard: A fuel complex, defined by volume, type condition, arrangement, and location, that deter-mines the degree of ease of ignition and of resistance to control.

Fire Hydrant: A valved connection on a piped water supply system having one or more outlets that is used to supply hose and fire department pumpers with water.

Fire Prevention: Activities, including education, engineering, enforcement and administration that are directed at reducing the number of wildfires, the costs of suppression, and fire-caused damage to resources and property.

Fire Protection: The actions taken to limit the adverse environmental, social, political and economic effects of fire. Protection is relative, not absolute.

Fire Regime: Periodicity and pattern of naturally occurring fires in a particular area or vegetative type, described in terms of frequency, biological severity, and area of extent.

Fire Retardant: Any substance, except plain water, that by chemical or physical action reduces flammability of fuels or slows their rate of combustion.

Fire Season: (1) Period(s) of the year during which wildland fires are likely to occur, spread, and affect resource values sufficient to warrant organized fire management activities; (2) A legally enacted time during which burning activities are regulated by state or local authority.

Fire Weather: Weather conditions which influence fire starts, fire behavior or fire suppression.

Fire Whirl: Spinning vortex column of ascending hot air and gases rising from a fire and carrying aloft smoke, debris, and flame. Fire whirls range in size from less than 1 foot to over 500 feet in diameter. Large fire whirls have the intensity of a small tornado.

Firebrand: Any source of heat, natural or human made, capable of igniting wildland fuels. Flaming or glowing fuel particles that can be carried naturally by wind, convection currents, or gravity into unburned fuels. Examples include leaves, pine cones, glowing charcoal, and sparks.

Firefighter: A person who is trained and proficient in the components of structural or wildland fire.

Flame: A mass of gas undergoing rapid combustion, generally accompanied by evolution of sensible heat and incandescence.

Flammability: The relative ease with which fuels ignite and burn regardless of the quantity of the fuels.

Fuel Break: An area, strategically located for fighting anticipated fires, where the native vegetation has been permanently modified or replaced so that fires burning into it can be more easily controlled. Fuel breaks divide fire-prone areas into smaller areas for easier fire control and to provide access for firefighting.

Fuel Loading: The volume of fuel in a given area generally expressed in tons per acre.

Fuel Model: Simulated fuel complex for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.

Fuel Modification: Any manipulation or removal of fuels to reduce the likelihood of ignition or the resistance to fire control.

Fuel Modification Zone: A strip of land, typically 100-feet-wide or more, between an improved property and wildlands, where combustible vegetation has been removed, thinned, or modified and may be partially or totally replaced with approved drought-tolerant, fire-resistant and/or irrigated plants to provide an acceptable level of risk from vegetation fires. Fuel modification reduces radiant and convective heat, thereby reducing the amount of heat exposure on the roadway or structure and providing fire suppression forces a safer area in which to take action.

Fuels: All combustible material within the wildland/urban interface or intermix, including vegetation and structures.

Hazard: The degree of flammability of the fuels once a fire starts. This includes the fuel (type, arrangement, volume and condition), topography and weather.

High Value Resource: High Value Resources are natural or manmade resources, including plant and animal species, cultural resources, and residences that form the basis for fire management planning on the Preserve.

Ignition Time: Time between application of an ignition source and self-sustained combustion of fuel.

Invasive Plant Species: A plant species which is not native to the region, and has demonstrated the ability to aggressively out-compete native plant species that would normally colonize a given area.

Ladder Fuels: Fuels that provide vertical continuity allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease.

Overstory: That portion of the trees in a forest which forms the upper or uppermost layer.

Peak Fire Season: That period of the year during which fires are expected to ignite most readily, to burn with greater than average intensity, and to create damages at an unacceptable level.

Prescribed Burning: Controlled application of fire to wildland fuels in either their natural or modified state, under specified environmental conditions, which allows the fire to be confined to a predetermined area, and to produce the fire behavior and fire characteristics required to attain planned fire treatment and resource management objectives.

Prescribed Fire: A fire burning within prescription. This fire may result from either planned or unplanned ignitions.

Red Flag Warning Conditions: A **Red Flag Warning** is a forecast warning issued by the United States National Weather Service to inform area firefighting and land management agencies that conditions are ideal for wildland fire ignition and propagation. After drought conditions, and when humidity is very low, and especially when high or erratic winds which may include lightning are a factor, the Red Flag Warning becomes a critical statement for firefighting agencies, which often alter their staffing and equipment resources dramatically to accommodate the forecast risk.

Responsibility Area: That area for which a particular fire protection organization has the primary responsibility for attacking an uncontrolled fire and for directing the suppression action. Such responsibility may develop through law, contract, or personal interest of the fire protection agent. Several agencies or entities may have some basic responsibilities without being known as the fire organization having direct protection responsibility.

Restoration (**of native vegetation communities*****):*** The act of restoring ecological functions and values of vegetation communities which have been adversely effected by human or nature induced impacts, causing decrease in ecological functions and values.

Sensitive Species: A plant or animal species with a special status listing from federal, state or local regulatory agencies.

Slope: The variation of terrain from the horizontal; the number of feet rise or fall per 100 feet measured horizontally, expressed as a percentage.

Smoke: (1) The visible products of combustion rising above a fire; (2) Term used when reporting a fire or probable fire in its initial stages.

Spotting: The ignition of unburned fuels ahead of the fire front as a result of ignition by firebrands. Spotting enhances the spread of wildfires.

Structure Fire: Fire originating in and burning any part of all of any building, shelter, or other structure.

Suppression: The most aggressive fire protection strategy, it leads to the total extinguishment of a fire.

Surface Fuel: Fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low stature living plants.

Tree Crown: The primary and secondary branches growing out from the main stem, together with twigs and foliage.

Uncontrolled Fire: Any fire which threatens to destroy life, property, or natural resources, and (a) is not burning within the confines of firebreaks, or (b) is burning with such intensity that it could not be readily extinguished with ordinary, commonly available tools.

Understory: Low-growing vegetation (herbaceous, brush or reproduction) growing under a stand of trees. Also, that portion of trees in a forest stand below the overstory.

Urban Interface: Any area where wildland fuels threaten to ignite combustible homes and structures.

Vegetation Management Unit: Delineated Preserve unit based on topography, vegetation or other features used for internal invasive species, restoration, and fire management planning.

Weed: A plant species which interferes with a desired management objective. This term does not denote the native or non-native status of a plant species. Both native and non-native plants have the ability to interfere, depending on the objective (i.e. Native cattails can be considered a weed for flood control management objectives).

Wildfire: An unplanned and uncontrolled fire spreading through vegetative fuels, at times involving structures.

Wildland: An area in which development is essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered.

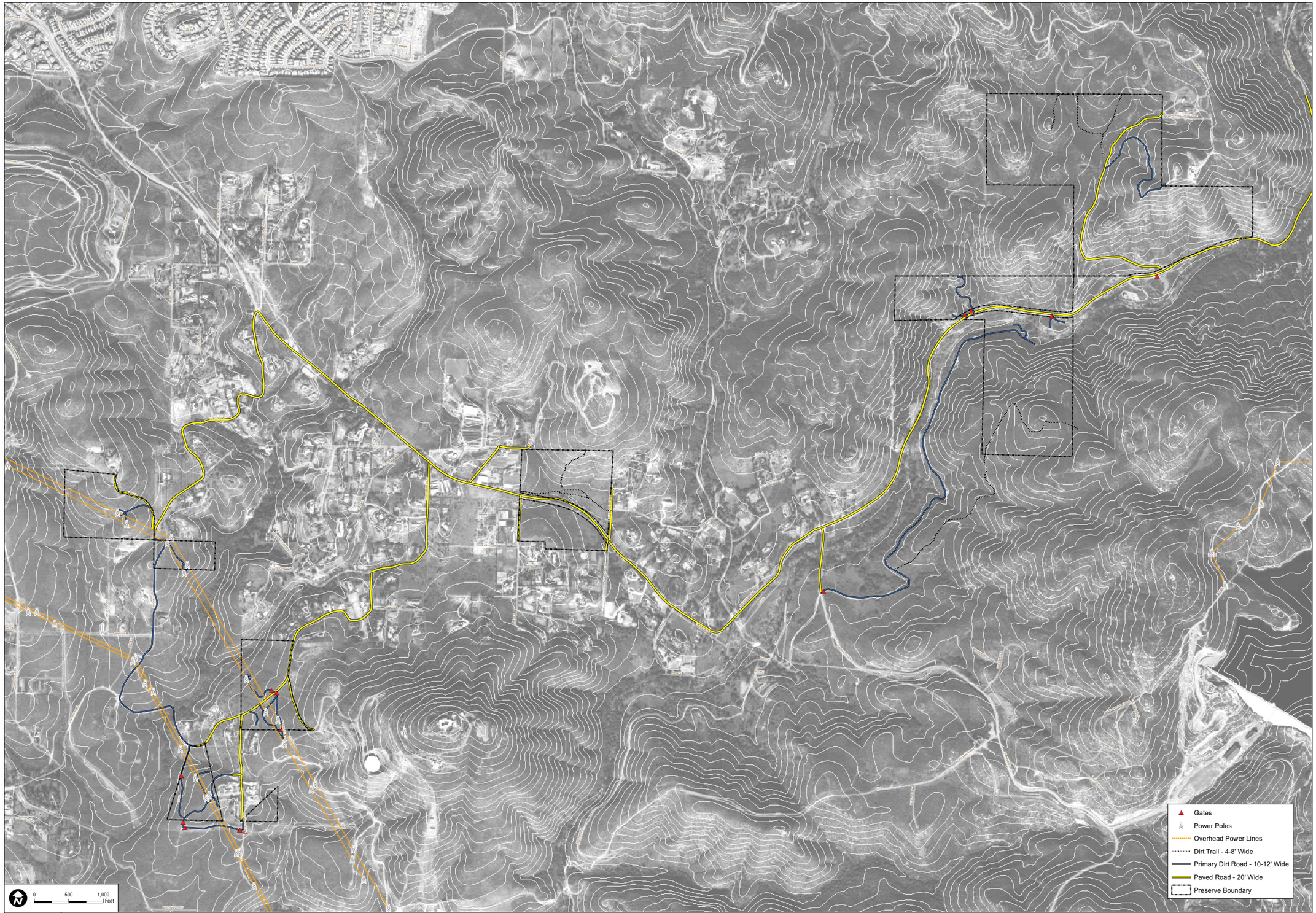
Wildland Fire: Any fire occurring on the wildlands, regardless of ignition source, damages or benefits.

Wildland-Urban Interface (WUI): The area where structures and other human developments meet or intermingle with undeveloped wildland (as defined in the County Fire Code, County Consolidated Fire Code and County Building Code).

Sources: www.firewise.org, and County of San Diego Guidelines for Determining Significance and Report Format and Content Requirements, Wildland Fire and Fire Protection (2010).

APPENDIX B

Preserve Map with Access Gates and Transmission Line Locations



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SOURCE: Digital Globe 2008

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APPENDIX B

Preserve Map

APPENDIX C

Fire Behavior Modeling Results

APPENDIX C
Fire Behavior Modeling Results

FUELS CLASSIFICATION

Reliable estimates of fire behavior must consider the relationship of fuels to the fire environment and 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.

All vegetation is considered fuel. All vegetation will burn; however, some species require more heat in order to ignite and propagate flame. The moisture content of vegetation is an important component; dry vegetation will ignite more rapidly, whereas green vegetation must lose its moisture before it will ignite. Consequently, shrubland vegetation with high oil content (above 6%) will burn more quickly and hotter than vegetation with high leaf moisture levels and low oil content levels. More than 90% of the flaming front of a wildfire is composed of fuel less than 0.5 inch in diameter and is consumed in minutes. Fuels larger than 1 inch in diameter are termed "residual" fuel and may require several hours to burn out. This larger fuel does not contribute to the forward rate of spread of the fire. The following factors describe the relationship between vegetation characteristics that affect fire behavior:

Fuel loading is defined as the oven dry weight of fuels in a given area, usually expressed in tons per acre. Natural fuel loading varies greatly by vegetative or fuel types in addition to the different size classes of fuel particles. Vegetation types can be rated as light, moderate, or heavy. Each rating is an estimate of the dead or live surface fuels that are less than 3 inches in diameter. Although specific measurements were not taken, based on the vegetation types identified in the cursory survey of the Escondido Creek Preserve (Preserve), the different vegetation types can generally be assigned a moderate to high rating.

> Measuring the intensity, force, and destructive potential of wildfire is accomplished by observing flame lengths produced by burning vegetation. A direct relationship exists between the amount of energy released during burning (per second) and the length of flame generated. The standard for measuring energy release in the United States is the British Thermal Unit (BTU). One BTU is defined as the amount of energy required to increase the temperature of 1 pound of water 1°F (a standard kitchen match or candle flame is approximately one BTU).

Size and shape affect the surface area to volume ratio of fuels. Small fuels have a greater surface area to volume ratio than larger fuels. Dead fuels are separated into four size classes: (1) grasses, litter, or duff less than 0.25-inch diameter; (2) twigs and small stems 0.25– to 1-inch diameter; (3) branches 1- to 3-inch diameter; and (4) large stems and branches greater than 3-inch diameter. The fine fuels less than 0.25 inch in diameter are most important for fire behavior analysis because their ignition time is less, and their fuel moisture content changes rapidly. This characteristic is typical for the grasses that were identified within and adjacent to the Preserve.

> The arrangement, size, and surface area of vegetative fuels play an important role in fire behavior and spread potential. Dense, concentrated biomass may burn evenly; however, when overall size decreases and surface area increases (as seen in native shrub stands), burning patterns change, resulting in faster ignition and spread. Live shrubland and grassland vegetation generally exhibit high surface to volume ratios. Standing grass, coastal sage scrub, and chaparral have high surface area to volume ratios, whereas forest litter and chipped or cut biomass exhibit very low surface to volume ratios.

Compactness, or spacing between fuel particles, affects the rate of combustion. For example, fuel particles that are closely compacted have less surface area exposed and less air circulation between particles and thus are slower to combust. The thick duff layer found underneath a mixed forest is an example of a tightly compacted fuel, whereas the open, dead branches on sagebrush or chaparral are considered a loosely compacted fuel. With the exception of the on-site oak woodlands, the fuels on the Preserve are loosely spaced with adequate air circulation required to carry a fire.

Horizontal continuity is the extent of horizontal distribution of fuels at various levels or planes. The vegetative types within various portions of the Preserve were analyzed for horizontal continuity and vertical arrangement. Fuels are either rated as uniform or patchy. Uniform fuels are evenly distributed and occur in a continuous, non-interrupted cover across the landscape. Patchy fuels are not continuous.

Vertical arrangement is defined as the relative heights of fuels above the ground, as well as their vertical continuity. Both of these vegetation characteristics influence the ability of fire to reach various fuel levels or strata. Vegetation of various heights that can transport fire from the low-level brush to tree canopies is called a fuel ladder and may create what is called a “crown fire.” When tall grasses and shrubs grow around trees with low hanging branches, the result is a fuel ladder. When a ground fire climbs the fuel ladder into the crowns of trees, it can spread canopy to canopy, creating higher fire intensity and firebrands.

Fuel moisture content is defined as the amount of water in fuels. The moisture content of plant materials plays a major role in the ignition, development, and spread of fires. Fuel moisture controls the current flammability of fuels both living and dead. During the most active growing periods of spring, the moisture content of plant foliage may be quite high. As the season progresses, a plant's moisture content declines until late summer or early fall when the plant becomes dormant or completely dies. Fine fuels, less than 0.25 inch thick, are most responsible for the spread of fire and have highly variable fuel moisture contents depending on the relative humidity of the air. Live fuel moisture content during the peak fire season (October through December) is estimated to be 60% to 80% in the drier open areas. This can potentially drop to less than 60% under extreme, dry wildfire conditions.

> There are two types of fuel moisture values to consider: (1) dead fuel moisture, with measurements of 1-, 10-, 100-, and 1,000-hour time-lag; and (2) live fuel moisture.

Dead fuel moisture percentages are determined by temperature, aspect, time of day, relative humidity, and time of year. One-hour time-lag fuel is less than 0.5 inch thick, 10-hour time-lag fuel is between 0.5 inch and 1 inch thick, 100-hour time-lag fuel is between 1 and 3 inches thick, and 1,000-hour time-lag fuel is greater than 3 inches thick. One-hour time-lag fuel can reach equilibrium with the surrounding atmosphere in 1 hour, or within minutes when air temperature exceeds 80°F and relative humidity is below 25%. One-hour time-lag fuel moisture may be calculated using a set of tables that reference time of day, month, aspect, slope, temperature, and relative humidity. Ten-hour, 100-hour, and 1,000-hour time-lag fuel can take up to 10 hours, 100 hours, or 1,000 hours to reach equilibrium with the surrounding atmosphere, respectively. In Southern California, 1-hour, 10-hour, and 100-hour time-lag fuels are usually given equal value. One thousand hour time-lag fuel, which occurs in more heavily wooded environments (i.e., timber), is generally used in measuring drought effects. Forests are considered "critical" when 1,000-hour fuel measurements are less than 15% (as a frame of references, kiln-dried wood moisture averages 22%).

> Despite variations in the topography and disturbance history of the Preserve, vegetative cover is classified into four main types: grass, chaparral, coastal sage scrub, and woodland. Frequent fires have created low-volume fuel beds throughout much of the Preserve. Although most fuels occur in the 1-hour size class, pockets of 10- and 100-hour fuels can be found, primarily in the woodland vegetation types on site.

Live fuel moisture is described as the moisture in leaves and woody portions of a plant. Field measurements of live fuel moistures are calculated by cutting small branches (less than 3 inches in diameter), weighing the branch, placing it in a low- temperature oven for 12 hours, removing

the branch, and weighing it again. The difference in weight is the loss of moisture in the leaves and woody portion of the branch. Consequently, live fuel moisture may exceed 100% of the dry weight of the plant. Live fuel moisture is the highest in the spring and early summer, and the lowest in late summer, fall, and early winter. This measurement is a valuable tool in predicting wildfire potential for a general area.

> Chaparral and coastal sage scrub are common Southern California vegetation types found in many upland locations and generally have reduced fuel moisture levels. Conversely, riparian vegetation, including willow (*Salix* spp.), coast live oak (*Quercus agrifolia*), and mulefat (*Baccharis salicifolia*), has higher leaf moisture values than vegetation growing in drier, more xeric sites. The importance of fuel moisture in examining fire hazard is that higher moisture levels ultimately require higher BTU output to ignite or sustain ignition. Consequently, fuel arrangement, along with fuel chemical/moisture content, plays an important role in wildfire combustion, spread, and heat output. Fuel moisture is a significant component, as vegetation requires external heat and energy to reduce moisture levels before it will ignite. High winds, low relative humidity, and/or high temperatures begin the process of removing fuel moisture, thus allowing vegetation to ignite and burn more rapidly. Consequently, lower fuel moisture values, including both dead and live fuel moistures, result in increased fire intensity. Moisture-laden fuels inhibit complete combustion while simultaneously producing excessive smoke output.

Fuel chemical properties include the presence of volatile substances such as oils, resins, wax, and pitch. These also affect the rate of combustion. Chaparral and sage scrub vegetation have high amounts of these volatile substances that contribute to rapid rates of spread and high fire intensities.

> Oil and moisture contents vary between fuels and fluctuate depending on the time of year. For example, black sage may have an oil content approaching 20% of its weight in dry summer or autumn months, but, in the spring, when sufficient groundwater is available, moisture content values can exceed 300%. When stressed during extreme dry weather conditions, numerous chaparral and coastal sage scrub species may react explosively when moisture falls below 60%, whereas larger shrubs may require higher energy to sustain ignition.

FUEL MODELS

All nine fuels characteristics are descriptors that help define the 13 standard fuel models (Anderson 1982), the more recently developed 40 fuel models (Scott and Burgan 2005), and five

custom fuel models developed for Southern California (Weise and Regelbrugge 1997). Seven fuel models (models 1, 8, 9, SCAL 18, GS2, SH7, and TU5) were used in the FlamMap analysis for the Preserve and are required inputs for the mathematical fire spread computations. Additionally, one non-burnable model (model 98) was utilized to represent non-fuel areas (e.g. roads)). Table 1 provides details of the six fuel models used in the analysis conducted for Preserve.

Table 1
Fuel Model Characteristics

Fuel Model	Description	Tons/acre; Btu/lb	Fuel Bed Depth (Feet)
1	Short grass	0.7 tons/acre; 8,000 Btu/lb	1.0
8	Closed timber litter	5.0 tons/acre; 8,000 Btu/lb	0.2
9	Hardwood litter	3.5 tons/acre; 8,000 Btu/lb	0.2
SCAL18	Sage/buckwheat	9.7 tons/acre; 9,200 Btu/lb	3.0
GS2	Moderate load, dry climate grass-shrub	2.6 tons/acre; 8,000 Btu/lb	1.5
SH7	Very high load dry scrub	14.4 tons/acre; 8,000 Btu/lb	6.0
TU5	Very high load, dry climate timber-shrub	14.0 tons/acre; 8,000 Btu/lb	1.0

WILDLAND FIRE BEHAVIOR MODELING

Fire behavior was analyzed for the Preserve site using FlamMap fire behavior modeling software and local topographic, fuels, and weather data. The FlamMap output data provide an indication of how vegetative fuels will burn under specific fuel, weather, and topographical conditions. The FlamMap (version 3.0) fire behavior software package (Finney 2004) is a geographic information system (GIS)-driven computer program that incorporates fuels, weather, and topography data in generating static fire behavior outputs, including values associated with flame length, rate of spread, and fireline intensity. It is a flexible system that can be adapted to a variety of specific wildland fire planning and management needs.

The calculations that result from FlamMap are based on the BehavePlus Fire Modeling System algorithms but result in a geographically distinct data set based on GIS inputs. FlamMap model outputs allow wildland resource managers to predict rate of spread, fireline intensity, and flame length, which provide important insights about the characteristics of wildfire spread within and adjacent to high-value areas, whether residential structures or preserved sensitive habitats. Each of the input variables used in FlamMap remain constant at each location, meaning that the input variables are applied consistently to each grid cell and the fire behavior at one grid cell does not impact that at a neighboring grid cell. Essentially, the model presents a “snapshot” in time and does not account for temporal changes in fire behavior or the movement of fire across the

landscape. As such, the results of the models contained herein should be utilized as valuable information sources and tools to prioritize fuel treatment options rather than an exact representation of how a fire would behave on the Preserve.

The basic assumptions and limitations of FlamMap are:

- The fire model output describes fire behavior only in the flaming front. The primary driving forces in the predictive calculations are the dead fuels less than 0.25 inch in diameter. These are the fine fuels that carry fire. Fuels greater than 1 inch in diameter have little effect to carry fire, and fuels greater than 3 inches in diameter have no effect.

- The model bases calculations and descriptions on a wildfire spreading through surface fuels that are within 6 feet of the ground and contiguous to the ground. Surface fuels are often classified as grass, brush, litter, or slash.

- The software assumes that weather is uniform. However, because wildfires almost always burn under non-uniform conditions, length of projection period and choice of fuel must be carefully considered to obtain useful predictions.

- The FlamMap fire behavior computer modeling system provides the average length of the flames, which is a key element for determining defensible space distances for minimizing structure ignition.

Fuel models used in the FlamMap analysis are classified into four groups based upon fuel loading (tons/acre), fuel height, and surface to volume ratio. Fuel model classifications were made during field analysis and in conjunction with available vegetation maps of the Reserve. The following list of fuel types describes the classification of fuel models based on vegetation type:

- Grasses Fuel, Models 1 through 3. These models represent the fast moving, light, flashy fuels found in grassland landscapes.

- Brush Fuel, Models 4 through 7, SCAL 14 through 18. These models are designed to represent the higher-intensity chaparral and sage scrub dominated landscapes.

- Timber Fuel, Models 8 through 10. Timber models are selected to represent the riparian woodland or ornamental forested landscapes.

- Logging Slash, Fuel Models 11 through 13. These models are used to represent slash; none were utilized for the Preserve.

FLAMMAP FUEL MODEL INPUTS

FlamMap software requires a minimum of 5 input files that represent field conditions in the study area, including elevation, slope, aspect, fuel model, and canopy cover. Each of these files was created as a raster geographic information system (GIS) file in Arc View 9.3.1 software, exported as an ASCII grid file, then utilized in creating a FARSITE Landscape file that served as the base for the FlamMap runs. The resolution of each grid file and associated ASCII file that was used in the models described herein is 3 meters, based on available digital elevation models (DEMs). In addition to the Landscape file, wind and weather data are incorporated into the model inputs. The output files chosen for each of the modeling runs included flame length (feet) and fireline intensity (BTU/ft/sec). Figures C-1 through C-4 depict the results of each of the four modeling runs and exhibit each of these output variables.

The following provides a description of the input and output variables used in processing the FlamMap models. In addition, data sources are cited and any assumptions made during the modeling process are described.

1. ***Elevation.*** Elevation data were derived from a 3 meter resolution Interferometric Synthetic Aperture Radar (IfSAR) measurement for coastal Southern California, acquired from the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center. This data were utilized to create an elevation grid file, using units of feet above mean sea level. The elevation data are a necessary input file for FlamMap runs and are necessary for adiabatic (i.e., a process that happens without loss or gain of heat) adjustment of temperature and humidity and for conversion of fire spread between horizontal and slope distances (Finney 2004).
2. ***Slope.*** Using Spatial Analyst tools, a slope grid file was generated from the elevation grid file. Slope measurements are represented in percent of inclination from horizontal. The slope input file is necessary for computing slope effects on fire spread and solar radiance (Finney 2004).
3. ***Aspect.*** Using Spatial Analyst tools, an aspect grid file was generated from the elevation grid. Aspect values are presented in azimuth degrees and are important in determining solar exposure.
4. ***Fuel Model.*** Vegetation coverage data in the form of a GIS shapefile were used in this analysis to create a fuel model file. Derived from Dudek's vegetation mapping data (Dudek 2011), the vegetation types were classified according to existing National Forest Fire Laboratory (NFFL) and BehavePlus fuel models, and the data file was converted to a grid file for inclusion in FlamMap modeling. Table 2 presents the vegetation and associated fuel type classifications for the Preserve.

5. ***Canopy Cover.*** Canopy cover is a required file for FlamMap operations. It is necessary for computing shading and wind reduction factors for all fuel models. Canopy cover is the horizontal percentage of the ground surface that is covered by tree crowns. Canopy cover is measured as the horizontal fraction of the ground that is covered directly overhead by tree canopy. Crown closure refers to the ecological condition of relative tree crown density. Stands can be said to be "closed" to recruitment of canopy trees but still only have 40% or 50% canopy cover (Finney 2004). Coverage units can be categories (0–4) or percentage values (0–100). Table 2 presents canopy cover assignments for each vegetation type/fuel model

Table 2
Fuel Models and Associated Canopy Cover Values

Vegetation Community/Land Cover	Fuel Model	Canopy Cover Value
Coast Live Oak Woodland	9	3
Diegan Coastal Sage Scrub	SCAL18	0
Disturbed Habitat	1	0
Eucalyptus Woodland	TU5	3
Non-native Grassland	1	0
Non-native Vegetation	GS2	0
Orchard	9	2
Southern Coast Live Oak Riparian Forest	8	3
Southern Mixed Chaparral	SH7	0
Southern Riparian Woodland	8	2
Southern Willow Scrub	8	2
Urban/Developed	98	0
Valley Needlegrass Grassland	1	0

Weather

In order to utilize weather and fuel moisture variables for the Preserve, data from the Ammo Dump Remote Automated Weather Station (RAWS) was analyzed. While data from the Sweetwater weather station was used to evaluate temperature and precipitation for the Preserve, utilization of RAWS data is necessary for fire behavior modeling as it includes data for fuel moisture conditions (unavailable from the Sweetwater weather station). As of the date of this report, no RAWS are located on the Preserve property. The Ammo Dump RAWS is located approximately 22 miles to the north-northwest of the Preserve and is located in a similar inland position as the Preserve. While the Valley Center RAWS is located closer to the Preserve, it is more than 10 miles further inland, and is placed at an elevation approximately 400 feet higher than the Preserve. The following summarizes the location and available data ranges for the Ammo Dump RAWS:

- Latitude: 33.381389
- Longitude: -117.285556
- Elevation: 1,068 feet
- Data years: 2001 to 2010.

Wind and weather data are a required component to fire behavior modeling efforts. The Ammo Dump RAWS data was processed with the FireFamily Plus v. 4.0.2 (FireFamily Plus 2007) software package to determine summer (50th percentile) and fall (97th percentile) weather conditions to be incorporated into the Initial Fuel Moisture file used as an input in FlamMap. Wind direction and wind speed values for the two FlamMap runs were manually entered during the data input phase. All other weather data were held constant for each of the FlamMap runs. Table 3 summarizes weather and fuel moisture data inputs used for both summer and fall weather conditions.

Table 3
FlamMap Weather Input Variables

Model Variable	50th Percentile Weather	97th Percentile Weather (w/ Max. Wind)
1 h fuel moisture	7%	2%
10 h fuel moisture	9%	3%
100 h fuel moisture	16%	8%
Live herbaceous moisture	60%	30%
Live woody moisture	90%	60%
20 ft wind speed (mph)	10 mph	50 mph (maximum observed Fall wind speed)
Wind direction	225 degrees	45 degrees
Slope steepness	Variable by location	Variable by location

mph = miles per hour

FlamMap Fuel Model Outputs

Two output grid files were generated for each of the two FlamMap runs, and include representations of flame length (feet) and fireline intensity (BTU/feet/second), as shown in Figures C-1 through C-4. The aforementioned fire behavior variables are an important component in understanding fire risk and fire agency response capabilities. Flame length, the length of the flame of a spreading surface fire within the flaming front, is measured from midway in the active flaming combustion zone to the average tip of the flames (Andrews, Bevins, and Seli 2004). It is a somewhat subjective and non-scientific measure of fire behavior, but is extremely important to fireline personnel in evaluating fireline intensity and is worth considering as an important fire variable (Rothermel 1991). 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 and is another important variable in initial attack and fire suppression efforts. The

information in Table 4 presents an interpretation of these fire behavior variables as related to fire suppression efforts.

Table 4
Fire Suppression Interpretation

Flame Length (feet)	Fireline Intensity (Btu/ft/s)	Interpretations
Under 4	Under 100	Fires can generally be attacked at the head or flanks by persons using hand tools. Hand line should hold the fire.
4 to 8	100 to 500	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	500 to 1000	Fires may present serious control problems—torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective.
Over 11	Over 1000	Crowning, spotting, and major fire runs are probable. Control efforts at head of fire are ineffective.

Source: BehavePlus 3.0.2 fire behavior modeling program (Andrews, Bevins, and Seli 2004)

The fire behavior analysis results for the Preserve vary depending on fuel type. As FlamMap utilizes site-specific digital terrain data (including slope, vegetation, aspect, and elevation data) slight variations in predicted flame length and fireline intensity values can be observed based on fluctuations of these attributes across the landscape. As presented, wildfire behavior in each of the fuel types varies depending on weather conditions. Given the climatic, vegetation, and topographic characteristics along with the fire history and fire behavior modeling results discussed in this VMP, the Preserve is determined to be vulnerable to wildfire starting in, burning onto, or spotting onto the site. Based on this information, adjacent residential development, and the fire history of the area, it is expected that wildfires will occur on the Preserve in the future.

Under extreme fall weather conditions (97th percentile fuel moistures and maximum recorded wind speeds of 50 miles per hour), fire can move rapidly through the site's fuels. Worst-case flame lengths were calculated at approximately 48 feet in chaparral vegetation types and approximately 41 feet in sage scrub vegetation on slopes exceeding 50% throughout the Preserve. Spread rates on site may exceed 8 miles per hour in dry flashy fuels (grasses and scrub) under extreme weather and slope conditions. Finally, under extreme weather and wind conditions, fireline intensity values may exceed 24,000 Btu/feet/second limiting the options for fire response personnel and emphasizing the importance of fuel modification and defensible space for adjacent residences.

It should be noted that the modeling results depict values based on inputs to the FlamMap system. Variations in weather or pockets of different fuel types are not accounted for in this

analysis. Additionally, the scale of analysis (3 square meters) limits fine-scale analysis and interpretation. 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 that could not be obtained for this analysis.

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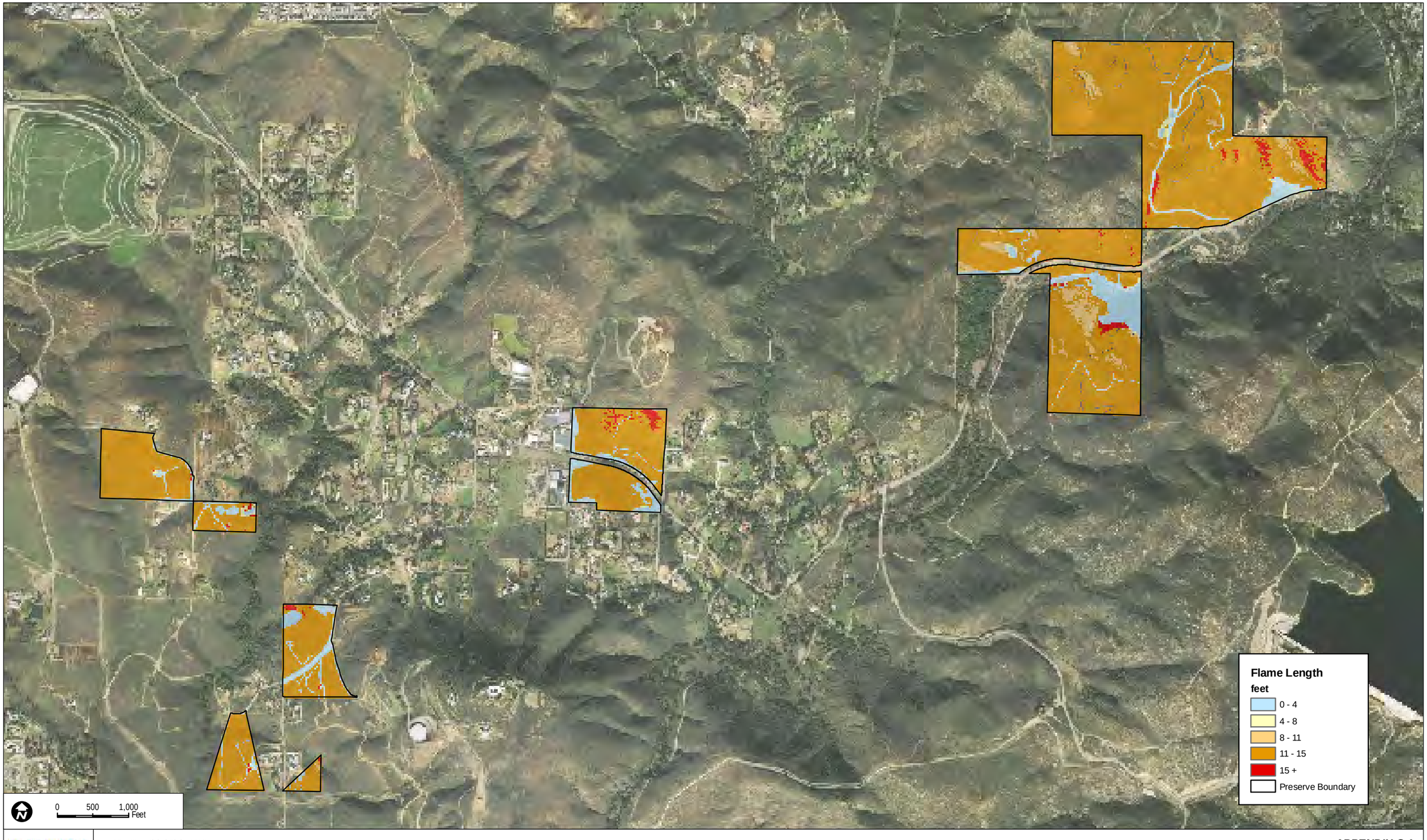

DUDEK

6680-2D

SOURCE: Digital Globe 2008

APPENDIX C-1

Flame Length, Summer Fire

Final Escondido Creek Preserve - Vegetation Management Plan

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SOURCE: Digital Globe 2008

APPENDIX C-2

Fireline Intensity, Summer Fire

Final Escondido Creek Preserve - Vegetation Management Plan

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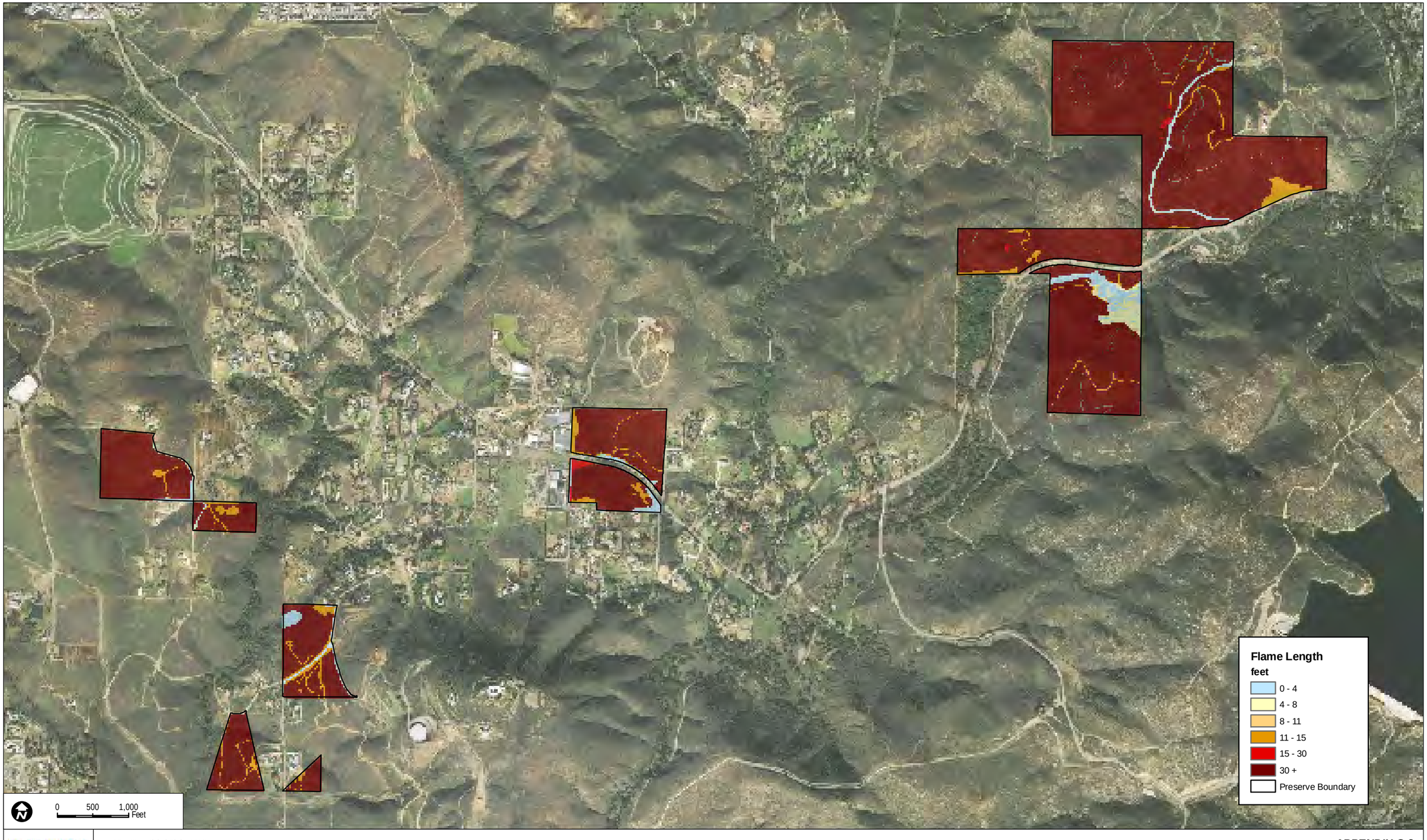

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SOURCE: Digital Globe 2008

APPENDIX C-3

Flame Length, Fall Fire

Final Escondido Creek Preserve - Vegetation Management Plan

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DUDEK

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SOURCE: Digital Globe 2008

APPENDIX C-4

Fireline Intensity, Fall Fire

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